

AN APPROACH TOWARDS POTATO UTILIZATION
FOR THIRD WORLD COUNTRIES

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ABSTRACT

Almost all food systems and manufacturing processes of today cater exclusively for the middle high income consumers. Sophisticated processes and techniques exploit the consumer's requirements and can offer a wide choice of products to satisfy even the most demanding marketing criteria. In contrast, little or nothing by way of a parallel is directed towards the abundant low income consumers in third-world countries. This consumer type is financially unable to benefit from the wide array of food products available in the market and because of seasonality and high perishability nutritious fruit, vegetable and root crops are excluded from their diets during certain periods of the year. Attempts to apply existing food science and processing technologies for the benefit of such consumers has commonly been approached from either a technological or nutritional stand-point and have not met with much success. This paper explains a consumer-orientated approach to the development of potato based food products at the International Potato Center. It not only illustrates how conventional food industry approaches, using consumer information (food habits and taste preferences, food prices, costs and availability of raw materials, nutritional factors and processing technologies), are being used to develop potato based products acceptable to Peruvian consumers but also attempts to illustrate the relevance of the approach to root crop processing in third-world countries.

RESUME

Presque tous les systèmes alimentaires et procédés de fabrication actuels s'adressent exclusivement aux consommateurs ayant des revenus moyens ou élevés. Des procédés et techniques sophistiqués tirent parti des demandes du consommateur et peuvent offrir un large

choix de produits pour satisfaire les critères de demande commerciale même les plus exigeants.

Au contraire, peu ou rien ne s'adresse à la masse des consommateurs à faible revenu des pays du Tiers Monde. Ce type de consommateur est financièrement incapable de bénéficier du large éventail de produits alimentaires disponibles sur le marché. A cause de leur saisonnalité, de leur faible durée de conservation, des fruits, des légumes, des racines sont exclus de leur alimentation pendant certaines périodes de l'année. Des tentatives pour appliquer la science des aliments et les procédés technologiques actuels au bénéfice de tels consommateurs sont communément envisagées d'un point de vue soit technologique soit nutritionnel et n'ont pas eu beaucoup de succès.

Cette communication explique une approche orientée vers le consommateur pour le développement de produits alimentaires à base de pomme de terre au Centre International de la Pomme de terre (IPC). Elle montre non seulement comment les approches de l'industrie alimentaire conventionnelle utilisant l'information sur le consommateur (habitudes alimentaires, préférences gustatives, prix alimentaires, coûts et disponibilité des matières premières, facteurs nutritionnels, technologies de traitement) sont utilisées pour développer des produits à base de pomme de terre acceptables par les consommateurs péruviens mais aussi des tentatives pour illustrer la pertinence de cet approche pour le traitement des cultures de tubercule dans les pays du Tiers Monde.

INTRODUCTION

An increasing number of potato producing countries throughout the world are showing interest in processing. Frequently, in third-world countries, this interest is based on ill-conceived ideals of helping to smooth-out the gluts and deficiencies, and accompanying high price fluctuations, of prevailing supply patterns. Similarly, this interest is commonly manifested in desires to copy products and processes presently being used in industrialised nations. Such thinking, which fails to consider food processing as part of an overall food plan of the country or region concerned, rarely leads to the establishment of successful research and development projects and even less frequently to the establishment of new food products and industries.

However, in defense of this unfortunate but prevailing approach, it must be mentioned that : a) almost all food manufacturing processes of today cater exclusively for the middle/high income consumers, who constitute a minority of the population in many developing countries, and b) most of the training which has been provided in food processing has been based in the industrialised nations with focus on individual components e.g. nutrition, new products, processing or marketing of the food system with relatively little attention being placed on the underlying principles of these components and their application to an integration into a total food program.

In the industrialised nations, sophisticated processes and techniques are available to exploit the consumers requirements and can offer a wide choice of products to satisfy even the most demanding market criteria. Consumer analysis and market study is continuous by most food processing companies and there is a consistent effort to improve and streamline their product development programs. This is based on the understanding that all successful products go through four main phases in the market place : introduction, penetration, maturation, and decline. The duration of each phase depends on many factors but one thing is certain, all products have a beginning and an end.

In contrast, nothing by way of a parallel is directed towards the abundant low-income consumers in third-world countries. Typically, these consumer types are financially unable to benefit from the wide array of food products on the supermarket shelves. This linked with seasonality, perishability and accompanying high price fluctuations means that nutritious fruit, vegetables and root crops, like the potato, are excluded from their diets during certain periods of the year. The effect of seasonal production on continuity of supply and associated price fluctuations are greatest where, for any reason, only one crop is produced each year. This is the case in numerous tropical potato producing countries where, for example, potato production is limited to the cooler winter months. In such situations potatoes need to be stored for long periods, commonly in hot humid environments, if a constant supply of fresh potatoes is demanded by the consumers. Such storage frequently requires refrigeration which, if at all feasible, is expensive and results in a high cost product to the consumer. In such situations, the processing of potatoes into a more stable and acceptable food product could greatly assist in maintaining the required supply of this nutritious vegetable to low-income consumers.

However, most food manufacturers are not concerned with these low-income groups and so the available advanced technologies and research inputs remain largely for the benefit of the upper classes. Where attempts have been made to apply existing food science and processing technologies for the benefit of these consumers, these have largely been approached from either a nutritional or technological standpoint and have met with limited success. The food value of highly nutritious products remain unrealised unless they are organoleptically acceptable to and liked by target consumer groups.

Potato Processing at the International Potato Center (CIP)

The objective of the small potato processing project at CIP is to attempt to remedy some of the above mentioned deficiencies. The project aims, through illustrating how underlying industrial food processing principles can be applied to simple potato processing, to develop a relevant approach

for initiating food processing enterprises in developing countries. Simultaneously, the project aims to illustrate how consumer use of potatoes could be considered as having four basic phases : consumer study, product development, process development and transfer of technology.

The consumers

Any successful food processing project must be based on an identified consumer need or opportunity. This requires a knowledge and understanding of the target consumer group. This in turn requires an organised research input aimed at developing a product feasibility brief. Such a methodical approach should reduce risk and hopefully eliminates irrelevant data and allows a potential project to emerge. Due to shifting patterns in target consumer groups such studies must be a continuing process in any food processing project.

In Peru, which has an estimated population of 18 million, a continually growing and significant proportion of the population live in city slum settlements. Lima, the capital city, has close to 300 such settlements with a population in excess of 1.2 million. Other cities and towns have similar settlements.

The average income for a family living in such settlements has been calculated to be certainly no more than US \$ 130 per month. The present minimum wage is much lower than in dollar terms. In Peru, as a whole, an average family spends 60 per cent of their income on food, 24 per cent on clothing and medicine and the remainder on fuel, travel and electricity. Rice and potato account for one third of the money spent on food and approximately 30 kgs of each are consumed per family each month. As high rates of inflation continue to push food prices upward an ever increasing percentage of income is being spent on food, particularly in the lower income settlements.

The severe economic pressure under which these consumer types live force all family members to seek employment thus leaving little time for domestic work and food preparation. This, contrary to much common thinking, is creating a greater demand for convenience foods in the lower income groups than in upper income groups. Upper income groups commonly employ domestic help and so the time spent on food preparation is less critical to them. In spite of this, however, the small existing food processing sector caters primarily for these upper classes. For example, of the 250,000 ha of land dedicated to potato production in Peru, only 2 per cent of total production is processed. The conventional products, chips and French fries, are destined for the higher income groups.

In target areas information was collected on existing food habits as a means of helping to define market opportunities. It was found that, although along with rice, potatoes shares first place in consumer buying preference for agricultural produce, price fluctuations cause potatoes to become too expensive for many families within the low-income areas during certain periods of the year. A specific objective of the project thus became to find a way of utilizing the nutritional and organoleptically acceptable potato in processed foods that are within the economic constraints of low-income target consumers.

Product Development

If a potato based food is to have a long shelf life it must be processed. Of the conventional processes : freezing, canning and dehydration, the latter is the least expensive when one takes into account the overall costs and is the most relevant to the majority of developing countries. In most developing countries an extensive frozen marketing chain is not in place and the cost of canned produce places them financially out of reach to the majority of consumers.

If one produced a pure potato dried product, its cost based on the dry matter content of potatoes and not considering any processing costs must be approximately six times the cost of the fresh potatoes. Applying this to the cost of potatoes in Peru would make the price of dried potato too expensive compared with other dehydrated food product available in the market place. However, if one dilutes the potato with other lower cost national products such as cereals and legumes, it becomes theoretically possible to produce a product with a competitive price. Having been forced for economic reasons to consider the idea of potato extension or potato based food mixes, it becomes possible to consider enhancing the nutritional value of the potato by selecting other ingredients to strengthen the nutritional weaknesses of the potato.

Based on this, a number of dehydrated blends of predominantly cereals, legumes and potatoes were prepared in proportions which acknowledged the economic necessity for low prices foods. Based on flavour and cost some of the products were selected for consumer testing. One such mixture appears to have wide acceptance with Peruvian consumers. This mixture in its dried form contains 30 per cent potato with the balance composed of flours of rice, beans, oats, barley and maize, all of which are produced within Peru.

The approximate nutritional value of this mixed product, calculated from food data tables, is 10.6 per cent protein and 333 kcal of energy per 100 grams of product. The accuracy of this estimate has been confirmed through chemical analysis. Based on a method used by FAO/WHO, the calculated probable efficiency value of the products protein is 86 per cent as compared to 82 per cent, 70 per cent and 41 per cent

respectively for the proteins of potato, rice and beans alone. The dried product is reconstituted and prepared by the addition of approximately one litre of water to 80 grams of the mix and boiling for about 25 minutes. The cooked product, which has the consistency of a thick soup or porridge, has a neutral or bland taste which can be used as a base for breakfast, savory or dessert foods. For example, in some tests, consumers have added a little cocoa, sugar and cinnamon at the final stages of cooking and have made an appetizing breakfast food.

In initial consumer acceptability tests, more than one thousand individuals in two cities of Peru sampled the product. In these tests families were given half a kilogram of product for 'in-home' evaluation after a brief demonstration and tasting of the mixture. The results in all these tests were encouraging indicating a broad acceptance of the product. At this stage a product brief was developed. Confirmations of these initial consumer acceptability tests have been obtained from the continued daily use over an eighteen month period in a common kitchen providing lunch for approximately 100 children and in an extensive school feeding test involving six tons of product.

Process Development

The process used for producing the test mixtures was simple. Potatoes are cooked and mashed. Flours produced from the selected cereals and legumes are then mixed with the mashed wet potato. The mixing spreads the moisture content of the potato over the whole mix thereby facilitating easier drying. Drying has been accomplished by means of solar energy though, of course, artificial means can also be applied at a higher cost.

The sequence and process details may vary with different production scales, conditions and needs, and thus should not be regarded as fixed. In response to national interest in different levels of production, two demonstrative lines have been developed in the small experimental pilot plant at the CIP Huancayo research station. Huancayo, at an altitude of 3,200 m above sea level is situated in a major potato producing region in the central highlands of Peru and where the other mix ingredients are also readily available.

One line has the capability of producing 100 kg of dried product per week. One hundred kilograms of product would produce five thousand food portions of 20 grams of mix in 250 ml of water. This would be enough for a family of 6 to eat the product three times a day for nine months. This small line is aimed at the individual farm or urban family. For the farm family the advantages of simply converting a portion of the harvested potatoes into a processed product to give year-round food stability is being stressed. Also,

by processing the poorer quality tubers, storage and marketing of the fresh tubers could be improved.

The approximate raw material requirements and prepared raw material inputs are shown in Table 1.

Table 1. Ingredient requirements to produce 100 kg of product

Raw Material	Potato	Rice	Broad beans	Oats	Barley	Maize	Salt
Requirements (kg)	170	17	21	21	23	12.5	4
Prepared Raw	Boiled Rice	Broad bean	Oats	Barley	Maize	Salt	
Materials (kg)	mashed potatoes	flour	flour	flour	flour	flour	
	120	16	16	16	16	12	4

The process steps used in the CIP line are illustrated in Figure 1. The processing implements used for this scale of operation are commonly available in most family kitchens or can readily be purchased locally.

The second line is directed to the community or small factory scale of operation and has the capacity of 1 to 2.5 tons per week. One ton of product will provide 50 thousand 20 gram/250 ml food portions, which would be sufficient for 396 families of six to eat the product three times a day for a week. The approximate ingredient requirements to produce one ton of product are ten times those illustrated in Table 1. All the small scale processing equipment used in this line (Figure 2) has been manufactured locally in Peru. Experience with this line has given a recovery rate of 54 per cent on the prepared raw materials, the wet mix having a moisture content of around 50 per cent and the final product 8 per cent to 10 per cent. The product is sun dried in a walk-in solar drying chamber. The central Andes region of Peru commonly has an eight month dry season and a four month rainy season. The potato harvest coincides with the beginning of the dry season during which period radiation levels are approximately 3000 kcal/m²/day. The drying chamber has a mean temperature of 21°C. This rises to 50° - 65°C on sunny

Figure 1

Flow diagram for 100 kg per week production line

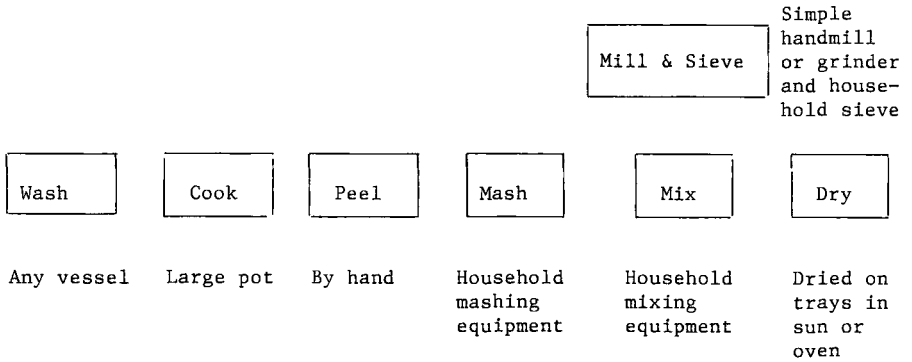
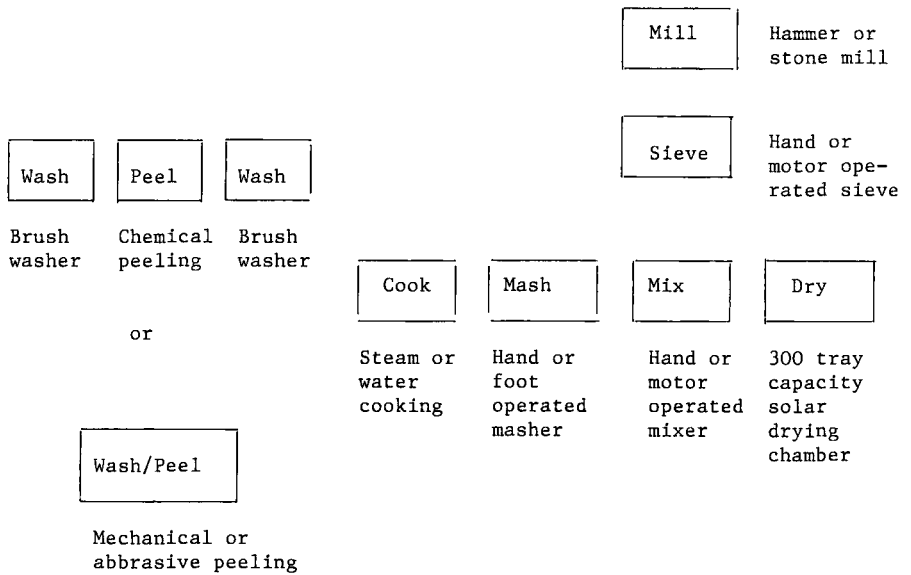


Figure 2

Flow diagram for 1-2.5 tons per week production line



cloudless days, but remains below 35° C on rainy days. This means that even on the poorest drying days, from every 500 kg of wet mix placed in the chamber on 100 one meter square trays 270 kg of dried mix is produced every 48 hrs. The capacity of the line is largely determined by the size and efficiency of the drying facilities.

When producing and preparing foods for human consumption great care should always be exercised. During processing good manufacturing practices should be adhered to including personal hygiene, control of incoming ingredients, and quality control of process and finished product. It is always an advantage, from a microbiological point of view, to have a processed product which requires cooking prior to consumption, as is the case with the above described potato based food mix. Notwithstanding the safeness of this approach, it should always be the intention to produce the best and most hygienic product possible, consistent with the available resources. Although the CIP pilot lines are not operated commercially, product samples have been analysed in both the USA and Europe. In both cases all bacteriological counts were below the limits set for this product type in those countries. This simply serves to illustrate that products of acceptable bacteriological quality can be produced on simple lines relying on solar drying. Similarly, shelf life studies have illustrated that the product can be stored simply for periods of a least 12 months with no loss in consumer acceptability.

Transfer of Technology

As stated earlier, the overall objective and aim of this CIP potato processing project is to develop an approach to incorporate simple processing of local produce into stable foods, acceptable to low income consumers, within local food systems. Thus, although important primary attention in transfer efforts, outside of Peru, should not be placed on the specific product or production processes. Potato, or other commodity based dry food mixes can be modified according to consumer taste preferences, costs and availability of ingredients. Local crops with specifically desirable attributes can readily be incorporated into such processed foods. As already mentioned, the sequence and process details will vary according to many location specific factors.

In Peru itself, and with assistance from various national institutions, transfer efforts are being concentrated at three levels of operation. Commercial entrepreneurial interest is beginning to be shown in the product and small factory scale operations. The CIP pilot plant line has been demonstrated to interested parties. In both urban and rural communities that have been exposed to the product, interest is being expressed in the possibility of producing such a product within and for the community. Here again, emphasis must be placed on local availability and cost of ingredients, and

specific local crops to satisfy consumer preferences. In the central Andes region efforts have commenced on transferring this approach to potato utilization to individual families and one or two families in three selected areas have started to experiment with the product and process. All these efforts will be strengthened and continually evaluated in the coming months.

Outside of Peru, interest in this approach to potato utilization has already been shown by a number of countries including Bolivia, Colombia, Guatemala, Mexico, Bangladesh, Bhutan, Sri Lanka, Thailand and the Philippines. Food scientists from Guatemala and Bangladesh have received training at CIP and are being assisted in establishing similar projects in their own countries. Additional training will be given to scientists from Bolivia, Colombia and Bhutan in 1985. Also, and as a means of illustrating the flexibility of the approach examples of different potato and sweet potato based dried food mixes have been sent to interested scientists in several countries.

All these transfer efforts require additional strengthening through more training and back up visits and research. However, preliminary indications are that an industrialised approach can be applied to the development of simple processed potato products for low-income consumers in third-world countries provided that emphasis, from the beginning and throughout product and process development and transfer phases, is placed on the specific needs of the target consumer group.