Minimum Packaging Technology for Processed Foods: Environmental Considerations

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Abstract

Modern food packaging technology brings traditional foods into a global arena which increasingly emphasizes their commercial and economic aspects. This means that food and packaging technologists become involved in the entire food supply system. This system ranges from the sea, village farm, plantation, to the markets and consumers in towns and cities, not only in their own country, but also in distant overseas markets. The surplus foods grown in the village have a need to be more carefully harvested, protected from spoilage and damage, packaged, and transported by various means to these markets. Unless the goods are sold with minimum spoilage and at their peak flavor, appearance, and nutritional value and presented in an attractive way, they may not be eaten at all. This is a worse situation than if the crop had never been grown and can represent serious loss and waste to a community. In addition, careful environmental considerations need to be given to minimum packaging forms to avoid pollution problems and ensure sustainability. Very little investment has been made so far in developing traditional technologies or in applying scientific knowledge in most of the developing countries; meanwhile the more expensive products of imported technologies have further slowed the development of indigenous technologies. It has been increasingly recognized that the time has come when these traditional technologies must be upgraded through scientific application of packaging principles and then integrated with other packaging functions such as marketing and advertisement.

Keywords: Food supply system, minimum packaging forms, minimum spoilage, shelf life, traditional foods packaging.

Introduction

Technologies are called traditional if, unaffected by modernization, they have been commonly applied over a long period of time. In general, traditional technologies tend to be cheap, easy to produce, apply, maintain, and repair. They are generally labor-intensive, which can be economically beneficial, but as far as food packaging technologies are concerned, the final products are often hygienically sub-standard and they usually have a short shelf-life.

Many traditional foods have nonetheless remained unchanged in process or package for centuries, due to the fact that they developed in a particular location and are deep rooted in the natural, cultural, religious, and socio-economic environment. Some have disappeared without a trace as a result of modern influences, while others have expanded on a global scale, becoming household products, e.g., soysauce, now a multimillion dollar industry. The reasons for this phenomenon need to be examined (Hicks 1983).

Traditional Food Packaging Technologies

Food Systems

Population drift from rural to urban areas has caused drastic changes in the food supply
network from farm to the consumer in many emerging nations. One traditional belief which can no longer be sustained is the old saying that, “There are always fish in the rivers and lagoons, and rice, taro, or sweet potato in the fields; therefore let there be no concern for the next meal”. It is more likely that the farmer has gone to the city or even overseas, and is earning a laborer’s wage to keep his family in food during the off-season. So food is now brought to the market by many and various means, and redistributed to these new consumers. There are new vistas for traditional food markets where the technologies are tested beyond their limits.

Given the circumstances in which many developing countries are today, the challenge for their traditional technologies is that often they do not contribute sufficiently to meeting socio-economic imperatives. This is true also of those food technologies where many of the processing methods have remained unchanged for centuries, and are becoming inadequate to cope with modern needs, because they are too labor-intensive and depend now too much on natural environmental conditions. It is now clear that there is a need to lessen the dependence on nature, reduce the drudgery, shorten the time of the work involved and upgrade the preparation, quality, packaging, presentation, and shelf-life of these traditional foods and their packaging.

Women and Food Processing

Women play a major role in most traditional food processing and packaging. They dry leaves, pulses, and cereals, make curds and cheese, smoke meat and fish, ferment, grate, dry sweet potato and carry out a wide range of food preservation and packaging processes. It is indispensable, therefore, that women view the proposed technology improvements as capable of reducing their labor, without diminishing their role and status, or, in the case of marketable products, their profit.

It should be borne in mind that the upgrading of traditional food and food packaging technologies is a sensitive area, for which reason the subject should be approached with caution and due regard paid to the social, economic and cultural factors involved, in addition to the gender issues.

Further sensitivity needs to be applied to the small business operation in the preparation and packaging of traditional foods. Programs for mass production of a particular food, many have dire consequences for the small business operator. In the consideration of the structural characteristics of traditional food industries, in particular the application of new food technologies and the use of labor saving continuous large-scale processing, the task needs to be approached thoughtfully.

Upgrading of Food Packaging

Upgrading of traditional food packaging technologies in many cases, introduces exogenous factors, i.e., the importation of technology from abroad. Whether or not adapted to local circumstances, the use of imported packaging technologies in many developing countries remains restricted to modern technologies; even when these are locally developed, they are more complex to use, repair, and maintain. They are also expensive and tend to rely on imported components and non-renewable sources of energy (Fellows et al. 1993)

Food Preservation Principles and Their Integration with Food Packaging

Food Unit Operations

Before food can be packaged, there are many unit operations involved after harvesting the raw materials, including cleaning, grading, disposal of unwanted material, then stabilization of the enzymatic, biochemical and microbial spoilage. If a study of the preservation and packaging of foods is undertaken, a key question is, “What factors cause spoilage and deterioration in foods”. The main factors are microorganisms (bacteria, yeast, and moulds), as well as enzymes, temperature, and biochemical changes in the foods. Food preservation techniques are designed to prevent these spoilage changes and
impart a keeping quality or shelf-life to the processed foods.

Packaging is an integral part of the processing and preservation of foods and can influence many of these factors. It can influence physical and chemical changes, including migration of chemicals into foods. The flavor, color, texture as well as moisture and oxygen transfer is influenced by packaging. The effects of temperature changes and light can be modified by packaging materials. Let us consider the more important methods of preservation of foods used by food industries today and how they integrate with the food packaging used in their processing.

- **Cold preservation:** Used to slow down or inhibit chemical and biological processes in bacteria and spoilage agents in the foods.

- **Fermentation preservation:** Used to slow down spoilage factors through the production of alcohol or acids which assist in preservation. This technique is often combined with pasteurization.

- **Reduction of available water:** Many spoilage factors require the presence of moisture in order to operate. When this available water is removed or reduced then better preservation can be achieved.

- **Pickling or curing preservation:** These methods can be used together with smoking and with refrigeration as a combined form of preservation.

- **Chemical preservation:** Used to inhibit the spoilage factors and to complement other food preservation techniques.

- **Gas environment control:** Used to inhibit post-harvest deterioration, often used together with refrigeration.

- **Combination and assorted methods:** Several food preservation techniques may be effectively combined to reduce spoilage factors to acceptable levels. These include combinations of those listed, together with the following techniques.

### The Influence of Packaging on the Environment

Packaging in the modern world has a considerable impact on the environment. Food packaging makes up two fifths of the household waste (Senaner *et al.* 1991).

Packaging also accounts for an increasing share of the costs of the food processing industry, rising from about 4% in 1947 to 10% in 1987, and continuing to rise. Despite new materials which have reduced packaging weight, the total and relative costs of food and beverage packaging are increasing (Connor and Schiek 1997).

On average, the cost of packaging materials represents about one-fifth of material costs, however, in 10 out of 40 food industry sectors, packaging costs exceed the costs of the edible food stuff ingredients (Connor and Schiek 1997).

In most countries packaging continues to be driven by consumer demand, with regulatory bodies playing a limited role. In Europe, however, legislation and taxes on packaging have been established to encourage reduced packaging waste and more sustainable packaging practices.

### Case Studies of Some Traditional Foods and Their Packaging

China is one example of an ancient civilization in which the different national minority groups have developed their specific food cultures. These traditional foods are a valuable cultural heritage to the Chinese people.

There are examples of foods which have been introduced by culture transfer and become traditional in time. The processing of rice, wheat, soybean, and sesame was introduced to Japan from ancient China, translated first to the centers of power and religion, later to the regions. Hence, such technology transfer is not a new phenomenon.

There is a vast difference, however, between the early, more leisurely adoption of
transferred food cultures and the explosion of new technology at present threatening to overwhelm traditional food processing and packaging techniques and to suppress the original characteristics of the traditional products. The attraction of traditional foods is related to their wide variety and diversity. For example, in Japan there are approximately 500 varieties of ‘Tsukemono’, a fermented pickle. This attraction may be lost when new technology is applied without careful thought.

Another aspect of traditional foods is the way many of them have simply disappeared without trace, whilst others have expanded on a global scale and have become household products in most countries. One such example is soysauce. Its wide acceptance and commercial expansion may be the result of a wider influence, with regard to meat-like flavors in diets where meat is absent, either by choice or through circumstance. It is found, packaged in a multiplicity of forms, in almost every country.

The question is posed whether there are other traditional foods, which by careful upgrading and packaging can follow the example of soysauce in becoming widely accepted. Also that these foods can begin to generate higher incomes for small business operators.

Some examples of traditional foods with potential for expansion are from the following countries:

**Indonesia**

**Tempeh:** This is a vital source of protein in Indonesia, serving as a meat substitute. It is a product of a solid substrate fermentation, using the mould, *Rhizopus oligosporus*, as the active organism (Steinkraus 1981).

The soybeans are soaked, dehulled, partly cooked, and inoculated, then incubated for 1-2 days. This enables the mould to form fibrous mycelia which knit the soybeans together in a compact cake which can be sliced and cooked.

The traditional form of packaging for tempeh has been banana leaves as a wrapping material. Now a number of tempeh cottage industries are using the tray or the plastic bag technique. The tray of inoculated beans is covered with banana leaves and wax paper, then incubated. The final product is sliced and wrapped in banana leaf, or plastic (polyethylene) bags.

A more recent technique is to incubate the tempeh directly in perforated plastic bags or tubes with perforations at 0.25 to 1.3 cm intervals to allow a controlled access of oxygen. The tempeh can be sold directly in this packaging.

**Source:** F.G. Winarno, Director, Food Technology Development Center, Bogor Agricultural University, Indonesia

**Thailand**

In Thailand, fermentation is a favorite means of food processing and over 44 commercial, traditional fermented foods have been identified. These foods are highly acceptable country-wide and are essential components of diets. They are used as condiments and supply specific flavors as well as being sources of protein, calories, and vitamins.

The level of traditional fermented technology of the small and medium food manufacturers are generally at the household or slightly larger (backyard) level. The problems faced are maintenance of quality standards, efficient fermentation on an industrial scale and new product and package development.

**Phak Sian Dong:** It is a Thai native fermented vegetable (*Gynandropsis pentaphylla*) (Sundhagul 1975). It is pickled in a liquor which is prepared with coconut juice and salt added, or rice water and salt. The ‘Phak Sian’ is wilted in the sun to lower moisture. The fermentation takes only 36-48 hrs. and the shelf-life is only 2-3 days if no further processing is applied. If the process and the packaging were upgraded, this product could give a longer shelf-life.

**Source:** Naradom Boon-Long, Department of Food Science and Technology, Kasetsart University, Thailand.

**Pakistan**
**Roti:** An operation for the production of semi-leavened bread was set up as the 'Roti' Corporation of Pakistan. The Corporation was charged with producing good quality, semi-leavened bread under hygienic conditions, modern packaging, and distribution. Sixteen plants were set up with a capacity of 35,000 'Rotis' per shift, a total of nearly two million 'Rotis' per day.

The project had difficulties because:

a. The taste and texture were different from traditional ‘Roti’.

b. The Roti crumbled on rolling.

c. People wanted fresh ‘Roti’ bread.

d. Women were dislodged from their work at home.

e. The overheads and packaging made ‘Roti’ more expensive than home made ones.

Diversification was the only solution to the economic recovery of the plants.

**Yoghurt or ‘Dari’:** A most common dairy product in Pakistan consumed widely in the hot months of the year. Traditionally ‘Dari’ has been prepared by unqualified milk retailers in broad earthenware dishes (‘Konondas’). The milk is boiled and cooled to around 38°C then cultured with yoghurt from the previous batch. After 6-8 hrs. it sets, then it is cut and sold fresh. The quality is never uniform.

The product and the process have been upgraded since, with upgrading of the quality control and the packaging. Now the milk is correctly processed, analyzed, standardized, pasteurized, inoculated, incubated, and packaged in sanitary polystyrene containers, then refrigerated.

The retail cost is relatively higher, but kept minimal by recycling the containers which are washed, sanitized, and reused.

**Source:** Dr. F.H. Shah, Food Technology and Fermentation Division, PCSIR Laboratories, Lahore, Pakistan.

The importance of food packaging in the FAO programs is evidenced by the number of projects undertaken so far. Food packaging is seen as a vital link in the overall chain of food production, processing, marketing, and distribution. In fruit and vegetable processing, technical projects cover the entire food chain from the harvesting of horticultural produce through storage, processing, packaging, and marketing. Roots and tubers projects range from storage, post-harvest loss reduction, through flour production and bakery products development. In vegetable oils, assistance has been provided by FAO in the processing of oilseeds, palm and olive oil extraction, small-scale processing and refining of edible oils.

Other food processing activities range from advisory work on agro-industrial development, coffee processing, coconut processing, cocoa and chocolate projects, soybean and cashew nut processing.

Other examples include:

- Development of handling and packaging systems for soft fruits in an Asian country.
- Upgrading of dates processing and packaging in the Near East Region.
- Introduction of modern packaging methods for highland vegetables and fruits in an Asian country.
- A coordinated program of food packaging activities for the Asia and Pacific region covering commodities, packaging materials, equipment, and quality aspects of packaging.
- Projects on the processing and packaging of cereals, including rice, wheat, sorghum, millet, maize, and quinoa have been implemented, and there has been technical backstopping by FAO in many countries for these staple foods.
- Feasibility studies are taken to the pilot processing industry stage. Related technical research, training, and extension programs have been supported in a dozen countries.

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consumption. In the Asia and Pacific Region, FAO has been involved in over 40 projects which involve the upgrading of traditional food technologies.

Food packaging is an integral part of the processing and preservation of these staple foods and can also minimize many of the potential spoilage changes, imparting improved keeping quality, and increased shelf-life to the processed and packaged food.

These and other activities and ideas are being proposed in recognition of the importance of food packaging in the containment, transportation, distribution, marketing, and consumption of high quality traditional foods. The mandate of FAO for the improvement of food processing and packaging has placed considerable emphasis on the upgrading of traditional food technologies, particularly for staple foods.

References


