

# Trends in Food Packaging for Foodservice

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(Received for publication November 23, 1977)

### ABSTRACT

Forces shaping the food package of the future include convenience, economy and energy conservation. Three new packages are particularly interesting, viz., retort pouch, hermetically-sealed trays and semi-rigid retortable trays. The retort pouch has been widely researched and is making inroads on the market. Applications should increase when materials used in the adhesive system are approved as meeting U.S. extractives standards. Foods can be thermally-processed and stored ambiently in shallow, hermetically-sealed trays. Processing is accomplished rapidly with improved quality and energy savings. Semi-rigid retortable containers range in size from single-serving to half-size steam-table trays.

Food packaging has changed markedly in recent years, and it appears that more dramatic changes will take place during the next decade. Although some of the factors which have influenced changes in military food packaging are peculiar to the military, the primary forces which have brought about changes are identical to those which influence the commercial market. Convenience, which reduces labor requirements both for the housewife and foodservice personnel in institutional feeding situations, has probably been the major driving force for packaging innovation during the last decade. In the immediate future, another factor, energy, may become the dominant force which stimulates packaging changes.

In this discussion, I will consider some areas of packaging that we are working on at the U.S. Army Natick Research and Development Command (NARADCOM). These are of particular interest for military feeding applications and may also find a place in the commercial sector.

### RETORT POUCH

The retort pouch is possibly one of the most thoroughly "researched" food packaging innovations ever conceived. From the military standpoint, the potential of the retort pouch as a replacement for the metal can for operational rations was recognized more

than fifteen years ago. Immediately recognizable advantages of the flexible pouch for operational rations include: lighter weight, easier to carry, reduced cube, and ease of disposal. Other, perhaps less obvious, advantages include the potential for a wider variety of products (meatballs, sausage links, cakes), improvements in quality of some items, reduced energy requirements for processing, and ease of opening without a can opener.

Figure 1 shows retort pouches of the type used throughout our development program at NARADCOM. The pouch is a 3-ply structure consisting of an inner layer of 0.003-inch thick polyolefin, a barrier ply of 0.00035-inch thick aluminum foil, and an outer ply of 0.0005-inch thick polyester. An outer carton or folder is considered necessary to provide additional protection against puncture, abrasion and excessive flexing during transportation and storage, especially for military applications, and probably will be used for early entries into the commercial marketplace.

To determine durability of retort pouches, we conducted a series of rough handling tests in which

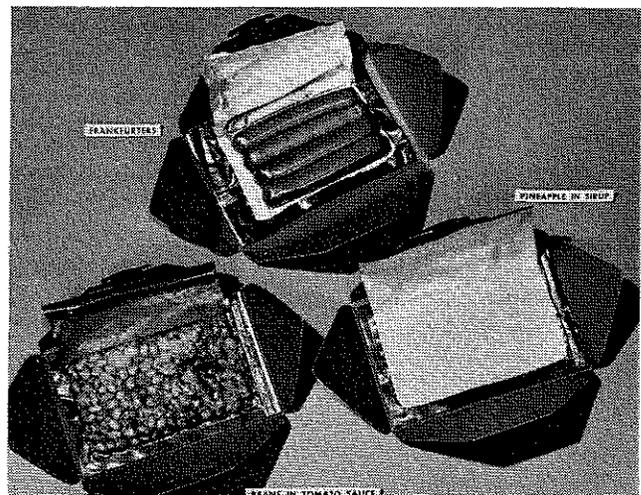


Figure 1. Retort pouches used by Natick Research and Development Command.

pouches and cans of comparable size were subjected to identical simulated handling (1). Our tests showed that the retort pouch is at least as durable as the time-proven metal can. Low-temperature (-20 F) as well as ambient condition tests showed no significant difference in performance between the two package types.

In addition to laboratory tests, field tests of experimental rations — using retort pouches for entrees, desserts, and some fruit items — were conducted to verify their durability under extreme conditions (5). Handling and transportation involved in moving the rations from an assembly contractor's plant in the mid-west to test sites in Georgia and Alaska, followed by transportation in military vehicles and in many instances several man-handlings, did not reveal any signs of lack of durability.

To determine whether retort pouches could be produced reliably under a production environment, NARADCOM sponsored a contract effort to define a system, engineer and construct a line, and produce 50,000 each of six diverse items (2). The results showed that, using basically standard equipment, in terms of process-related critical defects, retort pouches can be manufactured at a defect rate no higher than 0.1%, which is a figure frequently quoted for cans (4).

Products that have been successfully packaged in retort pouches in our development program include fruits, vegetables, stew-type items, frankfurters, beefsteak and a variety of cakes. In all, more than 22 diverse items have been produced and tested for quality and acceptability after various storage times. Acceptability in comparison to similar canned items is illustrated in Figure 2. In this test, soldiers were given free choice of the rations which contained foods in retort pouches or the conventional canned foods. The choice was clearly in favor of the retort pouch. Novelty of the package was ruled out as a significant contributing factor since all test subjects had previously eaten both ration types.

An obvious question at this point is: "What is the commercial potential of the retort pouch?" or "Why is it not available in the marketplace?". There has been, and continues to be, high interest in commercialization of the retort pouch in this country. The sole barrier to the initial introduction of retort pouches into the commercial U.S. market and to the initial procurement by the military is clearance of the pouch material by the Food and Drug Administration (7). FDA has ruled that the data are not adequate on the polyester and epoxy components of the adhesive system, used between the inner layer and the aluminum foil, to permit their use in the levels detected in food-simulating solvents. Basically, two approaches can be taken to obtain FDA approval: (a) conduct 90-day animal feeding studies using simulants for the extractives in question and, assuming favorable results, re-submit petitions to FDA, or (b) develop new material structures which result in extractives levels of virtually zero (less than 50 ppb has been suggested as the levels at which approval would be likely without feeding studies). New

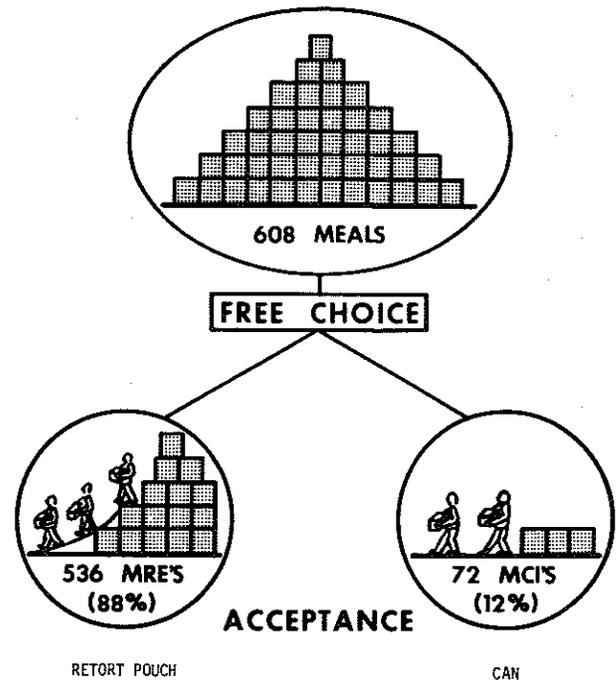


Figure 2. Acceptability of foods in retort pouches vs conventional cans.

materials are being developed which have extractives levels in the "floating zero" range. We have conducted preliminary tests on three such materials in our laboratories and are confident that, in the very near future, materials that satisfy both the physical and extractives requirements will be available.

Based to a large extent on our pioneering work, retort pouches have become a commercial reality in many countries. Figure 3 shows an Italian retort pouch made by Star of Milan, Italy. Reportedly the first producer to market this type of food package, Star has been marketing them in Europe since the mid-1960's. Retort pouches have also been produced for test or full-scale marketing in Scotland, Denmark, Germany, Canada, and Japan.

Several advantages of the retort pouch have been mentioned previously. The factors which I feel will have a significant influence on eventual commercialization of the retort pouch and on food packaging in general are availability and cost of energy. A retort pouch required only about half as much energy (Table 1) to fabricate as a conventional three-piece metal can and less than a glass jar or aluminum frozen food tray (3). When energy savings as a result of greatly reduced retorting times and reduced package weight throughout the transportation chain are considered, the economics of the pouch could be favorable.

Relatively slow production speeds (in comparison with cans) have been cited as a disadvantage of the pouch approach. Initially, production rates will be low, but at least one producer plans to test the pouch approach with gourmet-type items which can tolerate the higher cost associated with low-production speeds. Other firms are



Figure 3. Package and retort pouch produced in Italy.

TABLE 1. Energy required to produce four types of 8 oz food containers (Source: Reynolds Metals Co.).

Container	BTU/Container
Retort pouch	
Polyester, Aluminum foil, Adhesive, Polypropylene, Inks, Carton	1,934
Frozen food dish	
Aluminum container, coatings, Plug lid, carton	2,819
Glass jar	
Lid (Steel), Seal compound, Label, Glue	3,174
Can (211 x 300)	
Steel, Tin, Coatings, Label, Glue	3,560

already planning systems which are faster and less labor-intensive. Metal Box, Ltd., recently described a system which is capable of running 100 to 120 packages per minute, and equipment manufacturers feel that speeds of several hundred per minute can be attained with present technology.

### TRAY PACK

Another packaging concept which has created considerable interest both by the military and by the civilian sector is the use of a comparatively flat, hermetically-sealed tray for institutional feeding situations (8). Figure 4 shows three tray concepts that have been evaluated at NARADCOM for thermally-processed shelf-stable foods. Our initial work was done with shallow drawn aluminum trays, with a heat-sealed lid, shown in the lower right of Figure 4. Some feasibility work has been done with polymeric trays, and extensive studies are in progress with steel trays, filled and processed at NARADCOM, as well as with the commercial version, the KRAFT Pan.

Storage studies have shown that some food items thermally-processed in shallow trays of this type, after storage under ambient temperatures over a period of 26 months, compare favorably with frozen counterparts

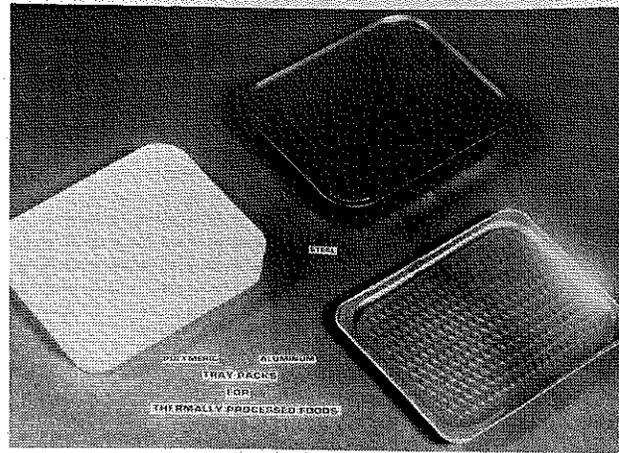


Figure 4. Three types of tray packs for thermally processed foods.

which were stored for the same period of time at 0 F (-17 C).

As with the retort pouch, the geometry of the tray permits processing to commercial sterility in considerably less time than a #10 can of nearly the same capacity. Mencacci (6) reported that by using agitation during retorting, processing times as low as 35 minutes are possible. The primary advantages of the reduced cooking time are improved quality and energy savings.

There are two variations of the steel tray-packs currently available:

(a) The unit produced by the Central States Can Company is made from tin-free steel and coated on the inside with a conventional can-coating enamel system. A flanged upper portion permits the pan to be placed into the well of a steam-table for reheating and serving.

(b) Kraft, Inc. is test marketing a similar unit. Although similar in outside appearance to the Central States unit, the Kraft tray is made from 25-lb. tin-plate (80-lb. base weight steel), has smooth walls, and the radii of the corners are somewhat sharper.

A polymeric tray, as shown in Fig. 4, has been used for preliminary tests at NARADCOM. These trays were thermoformed from coextruded polypropylene/PVDC/polypropylene and were closed with heat-sealed lids made of a foil laminate. Acceptability of beef stew was tested after 1-year storage in polymeric trays with and without a laminated overwrap. The data from these preliminary studies indicate that for some food items adequate oxygen and water vapor transmission barriers may be provided by polymeric trays.

Based on encouraging results from our preliminary tests and potential advantages envisioned, we are planning further tests with polymeric half-size steam-table trays. Primary among the potential advantages of polymeric material over metal is the potential for using microwave ovens for reheating, resulting in savings of both energy and time. Heat-sealing the lid to the container body also offers the possibility of increased production speed over double-seaming, as is used for the steel containers.

### SEMI-RIGID RETORTABLE CONTAINERS

Semi-rigid, polymer-coated, drawn-aluminum containers for thermally-sterilized foods have been developed in Europe and appear to be finding markets in various parts of the world. To my knowledge, this type of container is not in use in this country; however, at least one version of the semi-rigid tray has been approved chemically by FDA.

An array of sizes, ranging from single-serving to half-size steam-table trays, is available. Shown in Figure 5 is a typical single-serving size semi-rigid container purchased at a market in France.

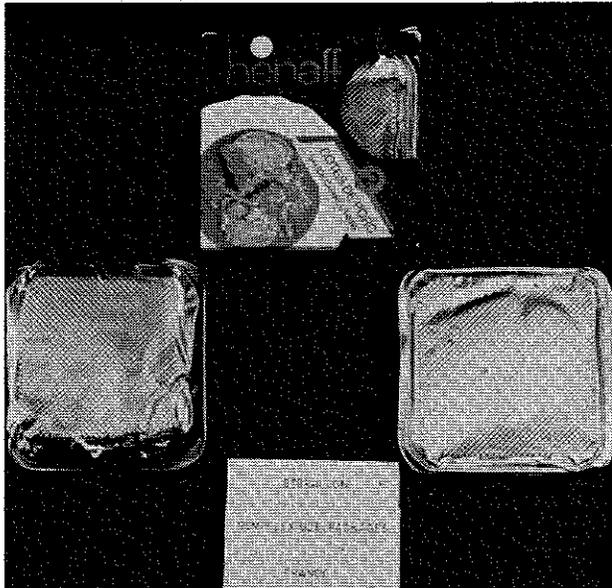


Figure 5. *Semi-rigid single-serving retort package.*

The limited testing of single-serving size semi-rigid retort packages that we have conducted has shown that, despite severe denting, the incidence of package failure is surprisingly low. From the commercial standpoint, there is a possibility that denting may be interpreted as package failure, as is frequently the case with metal cans. Heavier gauge aluminum, presumably to overcome the denting problem, is being explored.

A recently completed series of rough-handling tests on half-size steam-table units made from the semi-rigid material (5-1/2 mil aluminum foil 1.2 mil Nylon) showed a very high failure rate. Additional strength, both to

reduce failures and to improve handling characteristics, would probably be required for this type of container to withstand military handling and transportation.

### CONCLUSIONS

During this discussion, I have considered several approaches to packaging which differ somewhat from those most familiar to the housewife, the soldier, and the foodservice worker. None of the approaches is so superior that it will have smooth sailing or achieve instant success, nor are conventional cans or frozen, boil-in-bag items about to be instantly replaced by a revolutionary packaging method. Each new packaging system will have to establish its own place in the market. Rather than viewing new packaging systems as replacements for existing systems, it would be better to view them as additional options available to the food packer.

### ACKNOWLEDGMENTS

This paper reports research undertaken at the U.S. Army Natick Research and Development Command and has been assigned No. TP-1915 in the series of papers approved for publication. The findings in this report are not to be construed as an official Department of the Army position. Presented at the 25th Annual Food Technology Conference, University of Missouri, Columbia, March 4, 1977.

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