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TRAY PACKS FOR THERMALLY PROCESSED FOODS

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Today's life style brings new container shapes for thermally processed foods. The retortable tray container of half steam table size with top in dimensions of 29.8 x 23.8 cm.(11-3/4 x 9-3/8 inches) is a new rectangular shape that is gaining interest in both the military and industry for fast-food feeding systems. The familiar half-size steam table pan in Figure 1 is being developed into interesting hermetically sealed units that are attractive for thermally processed foods. Two bodies of a number of such containers currently being developed are shown here alongside the familiar stainless steel pan.

The name of the game in the Food Service business today is "convenience". Whether you are in the business of supplying a school lunch program, a hospital catering service, or one of the many restaurant chains, the one word that keeps popping up is "convenience". The retortable half-size steam table container is so attractive because its character spells convenience. It is a

C omplete package and serving system.
O ven ready.
N ew approach.
V ery light.
E asy to handle.
N o refrigeration.
I mproved quality.
E xpendable.
N ext generation.
C ommercially sterile.
E fficient shape.

We became interested in such containers a few years ago while reviewing a report by Lane and Widmer entitled "Sterilizable Semi-rigid Aluminum Food Containers." [1] The authors reported a Swiss group had developed a line of single serving units - containers of 10 to 300 ml. (1/3 to 10 fl. oz.) capacity. The units were formed containers with a perfectly smooth flange that could be heat sealed. It was this breakthrough in forming containers which led us to thinking a hermetically sealed half-size steam table container was feasible to fabricate and could contribute significantly to meeting our needs for a Food Service System for the Army. We, therefore, initiated a program to develop a family of containers for special purpose thermoprocessed foods that are compatible with food service systems. For those of you who have not been exposed to our recent efforts in this area, I would like to bring you up-to-date as to where we are, and what we are aiming for in the near future.

The Origin of Development: Looking back, we started our program by contacting several of the major material suppliers and container manufacturers for light-gauge multiserving units which could be thermally processed and could be fitted to steam table lines. We probed round as well as rectangular shaped containers. To us it was conceivable that a round container could be fitted to standard steam table openings with an adapter or template. We also investigated containers of various materials: aluminum, plastic, and tin plate.

Following up on our initial investigation, we began exploring with responsive sources the half-size steam table container. As a result, we tested a small number of sample containers for product and thermal process resistance. One of the promising containers was a two-piece unit with a drawn body and membrane cover. The body was made from 7-mil aluminum laminated with 1.5-mil polypropylene. The body was drawn to a container depth of 3.2 cm.(1-1/4 inches) by air-forming techniques. This container stood up well with corrosive foods such as beef with BBQ sauce and spaghetti and meat sauce. No signs of degradation or loss of adhesion of the interior coating was observed after thermal processing. For container evaluation purposes, the foods were thermoprocessed in water at 121.1°C. (250°F) for 60 minutes with 1.8 kg/cm^2 (25 psi) superimposed pressure.

In addition to the above tests, we conducted experiments to demonstrate the geometric advantage that the rectangular container had over a cylindrical can relative to heat penetration. We found that when filled with 1701 g. (60 ounces) of product these containers can be thermoprocessed in half the time required for 851 g. (30 ounces) of product in a conventional cylindrical can, namely the No. 2-1/2 can.

Our early work basically demonstrated that it is feasible to fabricate and thermally process tray-type containers of half steam table size using water processing techniques.

Significant Accomplishments

This past year, we have taken initial steps toward establishing the design parameters for such containers. We have been actively engaged with several companies interested in producing tray-type containers and related equipment for packaging food products, as well as packers who have a commercial interest in marketing items for the food service industry. Based on our needs, requirements, and cooperative efforts of industry:

1. We have obtained, tested, and evaluated a limited number of potentially suitable materials and sample containers from these sources for thermal processing;

2. We have built a heat sealing machine for half-size steam table trays; and

3. We have test packed several food products to obtain a preliminary consumer reaction and to appraise the containers for long-term storage.

Relative to the cooperative efforts of industry, we have been fortunate that serious interest has been shown by industry in our task. I point this out because the containers we have obtained are considerably more difficult to fabricate than say a flexible package. Unlike the flexible package, a formed tray container requires much more in the way of container manufacturing equipment, tooling, expertise, and funds to produce.

Several container modifications are shown in Figure 2 that were made on the air-formed container to date. The container in left foreground is upside down to show the contour of the bottom panel. It was one of the first designs of this container. It had no reinforcing impressions like the body on the right. We found that without reinforcement the bottom had loose metal and was easily dented. Reinforcing impressions added to the bottom and side walls improved the handling characteristics considerably.

Although it is difficult to see in Figure 2, the cover and rim of the container have a full curl. This feature tucks away the sharp cut edge and provides added strength to the container. An additional formed cover with a 4. 8 mm. (3/16") recess was made as an alternate for the membrane cover. Slightly heavier gauge aluminum foil was used for the recessed cover which provided more rigidity and strength. The recess was most beneficial, however, in keeping the product from squeezing or creeping into the heat seal area and in reducing the amount of headspace in the container during closing.

Deeper drawn containers with straighter sidewalls and a relatively smooth flange were also made by mechanical forming. With side walls tapered 8^{o} from vertical and a vertical depth to flange of 5 cm.(2 inches), the capacity of the half-size steam table container was increased to approximately 115 fl. oz. and remained fully nestable. This now gives us a capacity range for such containers from 60 - 115 fl.oz. or in terms of servings, 7 - 14 servings.

A recently developed plastic material is worthy of mention here. It is a coextrusion of high density polyethylene-Saran-high density polyethylene. This multilayer plastic barrier material can be thermoformed into containers that will withstand thermal processing. At present, suitable applications for the material are being sought by the producing company. They have thermoformed a 454 g. (8 oz.) can (308. 5 dia. *) from this material with a top flange for double seaming. An easy opening aluminum lid is being used with this plastic can. We have also thermoformed sheet stock of this material into a tray and are investigating methods of lidding other than double seaming.

Figure 3 shows a sealing machine we had built under contract to our specifications for laboratory use. The machine is a prototype to establish an initial production capability for half-size steam table containers. It is an air and electrically operated machine that has adjustable and independent controls for temperature, dwell time, and pressure. It has an upper contoured heat sealing die shaped to fit the peripheral flange of the tray, and has a lower fixture with a cavity that will accommodate a tray varying in depth from 2. 5 to 7. 6 cm.(1 to 3 inches). The versatility and auxiliary parts we had included in this machine will allow us to develop and establish performance requirements for packaging in specifications.

Prior to our investing much more effort and funds in this task, we thought it prudent to obtain some basic data on acceptability and storage life of several food products thermally processed in an aluminum tray container. We, therefore, test packed in our laboratory three products. They were beef stew, macaroni and cheese, and sliced pork loin with gravy (Figure 4). As a group, they represent a wide range of products from the standpoints of preparation, filling, packaging and processing.

One of our objectives, as indicated, was to obtain a consumer reaction to several food products thermally processed and stored in an aluminum tray container. We wanted to find out first, how high a consumer panel would rate the food on the hedonic scale; and second, how the thermally processed product compares to a precooked frozen product packed as a test control. Before reviewing the results, however, it should be understood that there were at the very beginning preparation differences between a thermally processed and frozen product. In the former product, the major component was only partially cooked prior to sealing and thermoprocessing; whereas, in the latter product all the components were fully cooked in an open kettle or steamer. Table I gives the acceptability results of a 36 member consumer panel at periodic examinations over a 6 month storage period.

There were significant differences in acceptability found between the thermally processed products and frozen equivalents packed as controls. In general, the products were judged as follows:

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* Can maker's description.

1. Beef stew was better thermally processed than frozen.
2. Macaroni and Cheese was better frozen than thermally processed.
3. Sliced pork loin and gravy was acceptable either way - thermally processed or frozen.

In regard to the performance of the containers from the standpoint of product resistance, they appeared satisfactory for all three products. There were no visual signs of delamination or corrosion after 6 months of storage. To demonstrate that containers can be used for bakery items, fruitcake and poundcake were thermally processed in them. The batter was filled, developed and heat sterilized in the hermetically sealed containers (Figure 5).

A Bit of Insight: Our program for the immediate future calls for:

1. Continued effort to establish the design parameters and proceed to optimize selective containers.

2. Extensively test sizeable quantities of desirable containers and products for overall military use.

The latter includes testing for adequacy of each container relative to proposed standards for containers under development by the Consumer and Marketing Service, USDA, for products under their jurisdiction. The containers must prove themselves out in laboratory abuse tests such as drop, vibration, and shipping tests prior to military use tests (Service Tests) in the field. This is not a short-term project, as you must realize. To establish the adequacy of the container will take several years of concentrated effort.

Hopefully, in the near future, commercial production capabilities will be available to procure and field test choice menu items. The need for these containers is growing. Recently, the Army built a modern feeding system in the Seattle, Washington area at Fort Lewis, and conducted a short-term experiment to increase customer satisfaction in dining and reduce operating costs. The Fort Lewis system was a departure from the old Army feeding method. It consisted of a centralized food preparation facility which prepared and delivered chilled and frozen foods to six dining facilities and operated a central dishwashing scullery. Test reports show that central food preparation has excellent possibilities for improving the Army feeding system, so much so, that a larger centralized food processing facility is currently being established at Fort Lee in Virginia.[2] It will be built to provide a training base for other centralized facilities.[3] Basically, however, these newer systems are chilled or frozen food systems which have a logistical weakness when consideration is given to large scale, world-wide use. This is where the shelf-stable heat-processed food will fit in. As the need for long-term shelf-life items becomes greater, we believe the retortable tray will find its niche.

Summary: Recent investigation of packaging designs has shown it is feasible to fabricate and thermally process tray-type containers of half steam table size, 60 to 115 fl. ounces. Initial work, stimulated by industry's new ability to form smooth, flat, heat sealable flanges on polymer-coated aluminum trays made this possible. When filled with 1701 g. (60 ounces) of product, these containers can be thermoprocessed in half the time required for 851 g. (30 ounces) of product in a conventional cylindrical can. Optimization of the half-size steam table container designs for military and industry food service systems is in process. The containers are multifunctional. They will keep prepared food in storage without refrigeration for long periods of time, and can act as the heating vessel and serving pan. These and other attributes of the containers make them very attractive for consideration in simplified food service systems. This is especially true where substantial savings in transportation, storage, and manpower requirements are principal needs. Current interest of container manufacturers and packers is strengthening. Tray packs for thermally processed foods are the container shapes of tomorrow.

Literature Cited -

1. Lane, J. H. and Widmer, K. Sterilizable Semi-Rigid Aluminum Food Containers. Star Aluminum Company Limited, Wolverhampton, UK. Paper presented at the Preservation and Packaging of Food Congress - Institute of Packaging at Harrogate, 25-26 June 1969.

2. Rowley, D. B., J. M. Tuomy, and D. E. Westcott. Fort Lewis Experiment Application of Food Technology and Engineering to Central Preparation, U. S. Army Natick Laboratories, Technical Report 72-46-FL, Feb 1972 (AD 739 499).

3. McLaughlin, J. D., Major General, USA. Improving Army Food Service, Army Logistician, May-June 1972.

TABLE I

Acceptability

Consumer Panel

Mean Hedonic Ratings

Product	Process	Storage		Examinations			
		°C.	(°F.)	Initial	1 Month	3 Months	6 Months
Beef Stew	Thermal	21.1	(70)	6.6 b	7.1	6.5	6.8 b
	Thermal	37.8	(100)a	6.7 b	6.7	6.3	5.9
	Frozen (Control)	-17.8	(0)	5.9	6.3	6.5	6.3
Macaroni and Cheese	Thermal	21.1	(70)	5.2	5.4	4.9	4.5
	Thermal	37.8	(100)a	4.9	4.8	4.5	4.3
	Frozen (Control)	-17.8	(0)	5.7	6.7 c	6.1 c	6.2 c
Sliced Pork Loin and Gravy	Thermal	21.7	(70)	6.3	6.8	6.0	6.1
	Thermal	37.8	(100)a	5.6	6.4	6.1	5.8
	Frozen (Control)	-17.8	(0)	6.6 d	6.8	6.5	6.9 c

a - Samples at initial examination were from 21.1°C. (70°F.) storage.

b - Significantly preferred to the frozen, control, at the 95% confidence level.

c - Significantly preferred to the thermal, 21.1°C. (70°F.) and 37.8°C. (100°F.), at the 95% confidence level.

d - Significantly preferred to the thermal, 37.8°C. (100°F.), at the 95% confidence level.

FIGURE 1

FIGURE 2

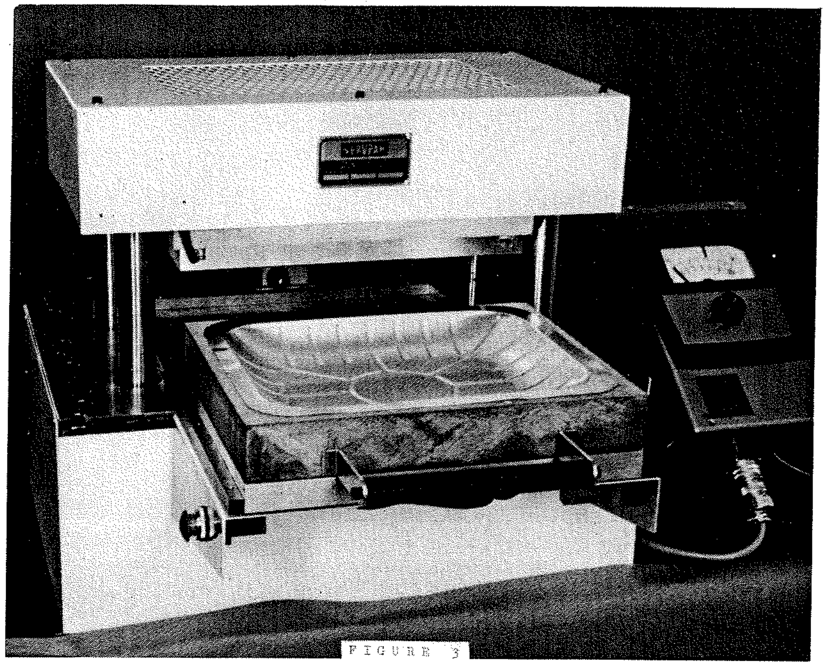

FIGURE 3

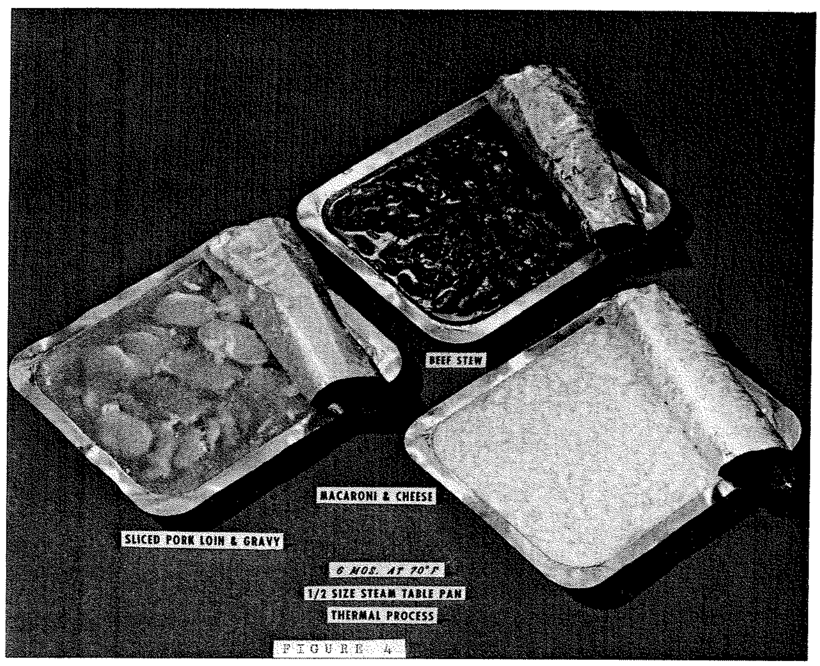

FIGURE 4

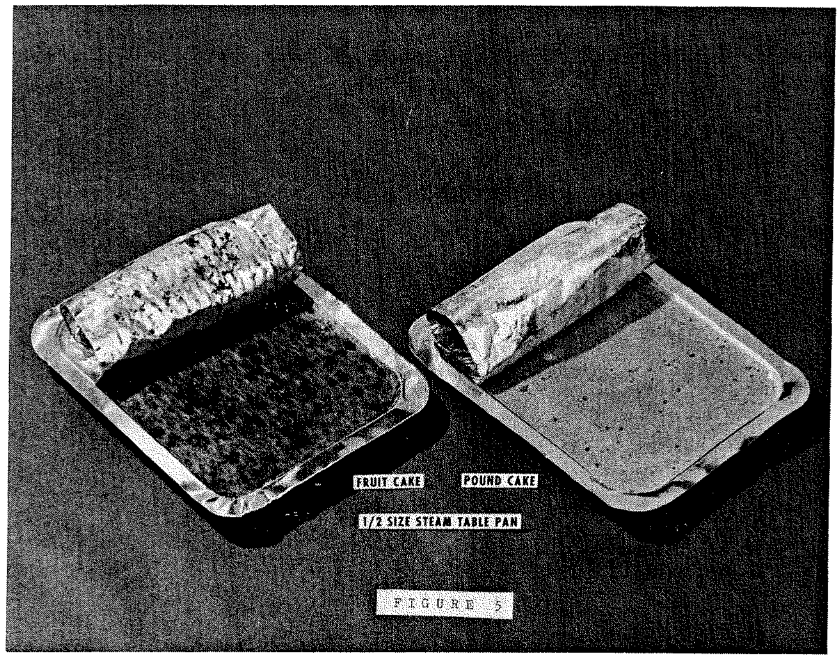

FIGURE 5