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THE ARMY'S PAST, PRESENT, AND FUTURE ROLE IN FOOD PROCESS DEVELOPMENT

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Background

Our current food processing industry can be traced back to a tasking by Napoleon that led his quartermaster to engage the services of the inventor Nicolas Appert to produce stable rations of food for his troops to carry into battle.

The canning industry that originated in 1809 has evolved for more than two centuries into a mature industry that still relies heavily on thermal processing to feed a growing population. The Army used thermal processing to develop the C Ration, which evolved into the Meal, Combat Individual that served U.S. troops from the end of World War II through the Vietnam era. These rations relied on cylindrical metal cans.

In the late 1970s, the Army replaced metal cans with the more flexible and versatile polymeric retort pouch for improved thermally processed products. This pouch was developed by the Natick Soldier Center in cooperation with industry and academia, and it is the central feature of the Meal, Ready-to-Eat (MRE). The 21st version of this ration to be procured in 2001 will have 24 different meals, each with a different entrée in a retort pouch.

Dehydration Process

To increase the mobility of individual soldiers, lightweight, calorically dense, or dehydrated rations are required. The freeze-dehydration process pioneered by the Natick Soldier Center produces high-quality meals with long shelf life. This process produced the Long-Range Patrol ration, which was first used during the Vietnam conflict. It is now used by industry for backpacker meals and survival rations, as well as for a variety of food ingredients.

Current processing efforts focus on cost-effective dehydration processes (such as osmotic dehydration) and the development of ready-to-eat, partially dehydrated intermediate moisture items.

Spinoffs

The military has continuously exploited a variety of mechanical, chemical, and electromagnetic energy sources and technologies for purposes of offense, defense, or communication. Numerous electromagnetic energy sources—initially developed for other purposes—can now be used for food and other materials processing. Currently, a considerable variety of thermal and nonthermal processes are being assessed to improve combat ration quality and variety. Thermal processes include high-temperature short-time processes such as ohmic, microwave, radio frequency, and induction heating.

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The Natick Soldier Center and its predecessor, the Quartermaster Food and Container Institute, pioneered early research on nonthermal processes. This research explored the food preservation potential of ionizing radiation (from both gamma and electron beam sources). The Natick program was transferred to the USDA in 1980; however, data from the Natick project have been important in getting approval of low-dose irradiation to improve the safety of fresh meat products and to extend the shelf life of fresh produce. Sterilized irradiated meat prepared for NASA under Natick Soldier Center guidance is currently used in the Space Shuttle Program.

Other Technologies

Other pacing technologies envisioned for 21st century combat rations are two nonthermal processes: pulsed electric field (PEF) and high-pressure (HP)

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preservation. PEF processing is applied to liquids or pumpable products using a flow-through treatment chamber. HP, also known as hyperbaric pressure preservation, can be applied to either liquid or solid foods in flexible containers. The food preservation technologies are being used to:

- Minimize processed-induced loss of color, flavor, texture, and nutrition;
- Retain the highest possible quality of food that is stored in stressful environments;
- Provide shelf-stable foods with fresh-food attributes;
- Optimize ration variety, acceptance, and consumption;
- Reduce the logistics burden and cost in comparison with conventionally processed foods; and
- Enhance the overall quality of life of the warrior.

Key Issues

Because nonthermal processing is relatively new compared to conventional processing, two key issues are particularly critical for PEF and HP technologies. The first is safety and process assurance, and the second is sensory quality and consumer acceptance during the intended shelf life of the item. For the military, the shelf life for these products must be at least 3 years at 80 degrees Fahrenheit and 6 months at 100 degrees Fahrenheit. Several products that were made shelf stable by nonthermal technologies were selected for microbiological and sensory assessment. These assessments were conducted on prototypes produced under contract from 1992-1995. The technologies, the contractors, and the prototype foods are as follows:

- Pulsed Electric Field: FoodCo (now PurePulse Technologies), San Diego, CA, produced spaghetti sauce with meat, banana yogurt drink, milk, and orange juice (refrigerated product).
- Hyperbaric Pressure Preservation: Oregon State University and the University of Delaware produced Spanish rice, spaghetti with meat sauce, fruit salad, and yogurt with peaches.

Assessment Results

After the products were shown to be microbiologically safe, sensory screenings were conducted comparing equivalent commercial and military products using standard descriptive and consumer acceptance methods. For example, batch-processed HP products from Oregon State University were spaghetti with meat sauce and Spanish rice packed in 8-ounce polymeric bowls with aluminum tear-off closures treated in-package at 75,000-pounds-per-square inch for 20 minutes. Assessment results for the appearance, flavor, and texture of the spaghetti and rice items met or exceeded benchmark products (both initially and after 1 year of storage at 80 degrees Fahrenheit).

A follow-on technology demonstration on HP processing was conducted under the leadership of Oregon State University. One objective of this demonstration was to optimize throughput and efficiency of a batch high-pressure processing system. Elmhurst Research Inc., which turned to cannon technology for inspiration for both a rapid-closing end cap and stress-resistant pressure vessels, developed a novel design for a batch processing system. This effort has become a true "guns-to-plowshares" event in that a prototype system is now under development that uses recycled 6-inch cannon tubes as pressure vessels.

Summary

As noted earlier, the military is a potential beneficiary of technological advances in food processing to support battlefield operations and peace-keeping missions. In addition to benefiting the Army, these technologies appear to have considerable potential for the food industry because of consumer demand for minimally processed foods with maximum nutrient retention; consumer demand for high quality, convenience, and safety; and international industry competition. For example, ohmic (thermal) products are now commercially available in Europe and Asia, while HP products are commercially available in Japan.

In fact, the DOD Combat Feeding Program serves as a catalyst for the food processing industry in leveraging resources for food processing research. In this regard, DOD has co-sponsored workshops to address the key technical barriers to commercialization of PEF and HP processing. These workshops have led to the formation of a new Division of Nonthermal Processing in the Institute of Food Technologists.

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