Ultrapasteurized Liquid Whole Eggs Earn 1994 IFT Food Technology Industrial Achievement Award

North Carolina State University and Michael Foods share award for a significant advance in the application of food technology to food production

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☐ ULTRAPASTEURIZED LIQUID WHOLE EGG Products (UPLWE) have earned the Institute of Food Technologists' 1994 Food Technology Industrial Achievement Award for the Department of Food Science, North Carolina State University (NCSU) of Raleigh and Michael Foods, Inc of Minneapolis, Minn (Fig. 1).

The purpose of this award, consisting of a plaque to the organization, is to recognize and honor developers of an outstanding food process and/or product which represents a significant advance in the application of food technology to food production, and which has been successfully applied in actual commercial operation for at least six months, but not more than six years, prior to December 1 of the year in which the nomination is submitted. This year's award has been presented for the development of extended-shelf-life, ultrapasteurized liquid whole-egg products.

The egg industry produces millions of pounds of eggs and egg products each year. These products are valued for both their nutritional benefits and for their functional properties. In addition to retail sales, major consumers of eggs and egg products include both foodservice and food processing markets.

*Fig. 1—**1994 Industrial Achievement Award** is presented to (from left) Richard Olsen, Hershall Ball, Mohammad Hamid-Samimi, and Kenneth Swartzel during the IFT Annual Meeting and Food Expo, Atlanta, Ga., June 25, 1994*

For their respective markets both shell eggs and frozen pasteurized eggs have substantial limitations. For food processing applications, frozen pasteurized eggs require costly freezing, need to be thawed before use, have lowered functional quality, and may be inconvenient to portion. Foodservice operations using shell eggs need to be concerned with possible safety problems associated with *Salmonella* and *Listeria monocytogenes*. These operations must also dispose of discarded shells. The development of extended-shelf-life, ultrapasteurized liquid whole eggs has provided a boost to the egg industry by offering convenience, safety, and portion control. These features and acceptance of the product by fast-food firms and institutional users is causing a fundamental change in how eggs are marketed and used.

Initial Research

The ultrapasteurization and aseptic packaging of fluid eggs was initially researched and developed by NCSU food science professors Hershall Ball and Kenneth Swartzel and graduate student Mohammad Hamid-Samimi. This team of researchers saw an opportunity for applying basic food science and food engineering principles to develop a worthwhile process. One unique concept of the product is that it uses aseptic packaging with a non-sterile product.

Because essential information about how liquid whole egg products respond to heat treatments was missing, Hamid-Samimi focused his doctoral research on determining the flow properties of egg products at temperatures above 60°C at different shear rates and for varied exposure times (Swartzel et al., 1986; Hamid-Samimi, 1984). These studies were carried out on a benchtop heating unit with the objective being to determine flow properties of liquid whole egg at temperatures greater than 60°C and to establish processing limits based on degree of coagulation. These studies found that the highly

*Fig. 2—**Hershall Ball and Ken Swartzel** measure temperature of ultrapasteurized liquid whole egg product coming from an aseptic packaging machine*

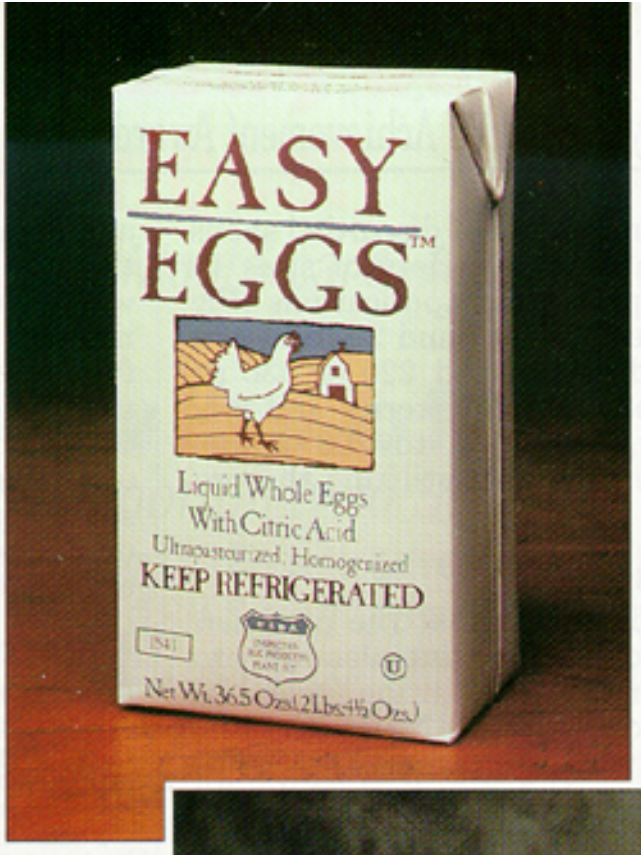

*Fig. 3—**Ultrapasteurized Liquid Whole Egg** products are available in a variety of packages from the 1 L bricks (left) for foodservice applications to 220 or 330 gal bag-in-box packages (below) for large-scale bakeries and food processing facilities*

non-Newtonian properties of liquid whole egg at elevated temperatures do not permit the construction of a simple formula to predict its flow behavior in a pasteurization system. However, if very high shear rates could be used, higher temperatures and/or exposure times for pasteurization could be tolerated. The studies also found that the relationship for percent soluble protein loss as a function of time and temperature can be used as a limiting factor in processing.

Processing times and temperatures with an upper limit of a 5% soluble protein loss were suggested as a maximum for producing a functionally acceptable product (Swartzel et al., 1986). Time and temperature values of other investigators of pasteurized egg products were all under the 5% soluble protein limit.

The second significant feature of the research was the application of the equivalent-point method of thermal evaluation. The equivalent-point method for the thermal evaluation of continuous-flow systems defines the thermal treatment with one time and temperature, independent of activation energies (Swartzel, 1986). By utilizing the quantitative information from the equivalent-point method, the identification of the unique time/temperature processes required to achieve extended shelf-life products while preserving the functional properties of liquid whole egg were predicted.

With the results of the initial research in, the team then did some trial processing runs on continuous flow, high temperature, short-time pasteurization equipment at NCSU's Center for Aseptic Processing (Fig. 2). The aseptically packaged product was tested for pH, protein content, functional properties, taste, and stored for measuring shelf life. During shelf-life storage studies the team was surprised by the longevity of the product. They had predicted a shelf life of 6 to 7 weeks, instead acceptable product was lasting up to 6 or 7 months.

Commercialization

A key contributor to the industrial application of the extended shelf-life, ultra-pasteurized liquid whole egg technology has been Michael Foods, Inc., Minneapolis, Minn. And a major factor in this process was the efforts of Richard Olsen, the former chief executive officer of Michael Foods. Initial commercialization began in 1989 with a license to Morning Glory Egg Company of Richfield, N.C. Soon after, Morning Glory was purchased by Michael Foods, Inc. Through acquisition of Morning Glory, Michael Foods obtained the patent license and completed the commercialization of the technology invented by the researchers at North Carolina State University.

The commercial developers of the product had to optimize and establish limits for the full-scale process. They also had to work with the Food and Drug Administration and U.S. Dept. of Agriculture to define the product and confirm how it could be marketed and labeled. Since no standard of identity exists for the product, a temporary permit was issued in 1989 so it could be marketed and sold (FDA, 1989).

The commercial product, with a dated shelf life of 10 wks, offers several advantages over frozen eggs. The product is *Salmonella, Listeria,* and *E. coli* negative; may be easily poured from the container which allows for improved portion control; eliminates the need for thawing and rotating of frozen product from freezer to cooler; and avoids the loss of functional properties caused by freezing and thawing.

Although originally intended as a replacement for frozen liquid whole egg, the product has also gained acceptance as a replacement for fresh shell eggs. For foodservice applications the product not only offers portion control and is *Salmonella*-free, but also

eliminates the need for disposal of discarded shells. The product is available in a variety of sizes for foodservice and food processing applications (Fig. 3). These packages are 1 L brick and 20 lb bag-in-box packages for foodservice, and 220 or 330 gal bag-in-box units on pallets for bakeries and food processors. Currently, from 175 to 200 million lb/year of product are produced utilizing the process.

Future Prospects

The awardees demonstrated that the proficient application of food technology principles can produce significant advances. In addition, scientists from the Food Science Dept. at North Carolina State University along with counterparts at Michael Foods, Inc. demonstrated the unique ability to commercialize a basic research concept in a relatively short time.

All three original inventors, Ball, Samimi, and Swartzel, expressed their deep personal and professional satisfaction that has come from seeing a project evolve from basic research to what is now a 200 million lb/year industry. Swartzel remembers touring a huge plant built to process the product and turning to Samimi to ask him if he ever thought that the research done on a laboratory benchtop with a Brookfield viscometer would led to this. That research has created a product that is causing a fundamental change in how eggs are marketed and used in foodservice and food processing applications and may represent the forerunner of a variety of refrigerated foods for consumer use. Indeed, for some applications, the process may have improved on one of the oldest and best packages of all—the egg shell.

References

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