Nicholas Crookston

Dr. Bruce Welt

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Innovations in Materials for Microwaveable Soup Packaging

While soup sales in the United States expanded by nine percent from 2002-2007, most of the growth occurred in 2004. Packaging innovations in soups fueled this leap. Since then, soup sales have declined slightly in constant terms (Heller 1). These facts tell us that particularly in soups, innovations spur growth. In the present economy, innovation is a matter of success and perhaps even survival. The microwaveable soup sector has shown considerable technological progress in the past, and looks to do the same in years to come.

A microwaveable soup package must do a variety of things, such as withstand production and distribution, as well as be safe and convenient for microwave use. Withstanding production requires a robust package. In order to kill microorganisms in the container, soup manufacturers seal the filled container and heat it to temperatures up to 121°C, depending on the food's acid content. Then, the container is held at that temperature for up to an hour (sometimes at higher pressure than inside the container) and cooled. This process produces food that does not require refrigeration, though the shelf life of soup processed this way is still shorter in plastic containers than in metal cans (Rice 3-4). Afterward, the resulting package needs to survive the shocks and other problems associated with transport. Like the extremely high temperatures withstood in processing, the container must be able to bear the temperatures in the consumer's microwave. Lastly, it needs to do all of these things with a package that provides convenience to the user. Soup makers have accomplished these goals in different and innovative ways for many years.

Two types of microwaveable soup package currently dominate the market, the polypropylene cup used for ready to serve microwave versions of otherwise condensed soup types, and Campbell's high density polyethylene Soup at Hand container. These soup cups would not exist if not for a seemingly unrelated invention in the 1950s which led to the aforementioned plastic types (HDPE and PP) being developed. Initially, low-density polyethylene was the only viable ethylene polymer, but Germany's Karl Zeigler prepared HDPE by using a mixture of triethylaluminum and titanium tetrachloride at ambient temperature and low pressure. By using these catalysts Zeigler had made a polymer with molecules similar to LDPE, but the catalysts caused a much more linear structure in the plastic, as opposed to the disorderly branching present in LDPE. HDPE boasts oxygen and carbon dioxide transmission rates of about 25% of LDPE and has greater tensile strength. Its softening point of 135°C is sufficient to deal with the great heat present in soup manufacture. In 1955, Italian Giulio Natta used a catalyst similar to Ziegler's (the catalysts are now known as Ziegler-Natta catalysts) to orient propylene monomers as they added to the polymer chain. This gave a polymer of regular structure, now known as polypropylene (PP). Polypropylene has properties well suited for microwaveable soup applications: its softening point of 140-150°C also withstands soup manufacture and microwave ovens. Polypropylene guards against water vapor transmission well and is considered a medium gas barrier (Robertson 21-23). Both plastics are microwave transparent, meaning that microwaves will heat the food inside while only slightly heating the container (Robertson 279). While different types of containers characterized the first attempts at microwave soups, these two plastics reign in today's market.

The food industry began pursuing microwaveable packaging in the mid-1980s, when about half of US households had microwave ovens. Dial Corporation's Lunch Bucket brand made one of the first forays into microwaveable bowl packages with a seven-layer high-barrier plastic bowl topped by an aluminum lid and a vented plastic cap (Packaging Digest 2). While it won the 1987 DuPont Award for packaging, the bowl and the Lunch Bucket brand did not last. Campbell Soup released a microwave version of its Chunky line, but overpackaging and the resulting high price led to failure. General Mills released soups under the Impromptu brand, but these fizzled as well (Scheringer 1). In 1990, Campbell again tried a microwaveable package, but while it was not overpacked, it still failed (Koeppel 1). Early bowls often incorporated a three-layer polypropylene/ethylene vinyl alcohol/polypropylene arrangement so as to use the structural benefits of polypropylene as well as the barrier properties of ethylene vinyl alcohol (Rice 1). Such setbacks characterized the microwave foods sector in the 1990s, which did not live up to lofty forecasts (Robertson 284). Although early attempts at microwaveable soups did not succeed, fresh efforts would occur in the new millennium.

In the 1990s, the soup industry stagnated after the unsuccessful efforts toward microwaveable packaging. An industry analyst described the situation as "dismal" in 2000. Even within the troubled soup sector, Campbell had been steadily losing market share, dropping from 74% to 70% from 1996 to 2001 (Reyes 1). Clearly, the industry needed innovation, and the previously unsuccessful microwaveable sector would play a major role. Campbell responded to the changing market by rolling out Soup at Hand in 2003, a sippable line of soups in an HDPE cup. Consumers removed the polypropylene top, removed the pull-ring metal lid, and microwaved the container. The pull-ring metal lid provided a convenient way to open without a can opener, which would compromise the convenience of the package. The injection-molded polypropylene top’s sip opening provides ease of use and snaps tightly enough for on-the-go use. Campbell wraps the cup itself in a shrink label. The container gives the soup a one-year shelf life. While Soup at Hand did not succeed as the company had hoped initially, the packaging did not cause this; when Campbell redesigned the label to look like other company products, sales soared (Reyes 1). Even an innovative package like Soup at Hand must continually improve, and Campbell delivered in 2008. They now incorporate a Watson Standard Adhesives peelable foil seal instead of the pull ring metal type. This new seal peels more consistently than the previous aluminum lid and requires minimal packaging equipment changes (Butschli 1).

Around the time of its introduction, soups in microwaveable bowls joined Soup at Hand.

The microwaveable soup bowls in use today entered the market in the early 2000s and have been changing ever since. Different companies have their own variations in packaging. Campbell's ready-to-serve microwave soup bowl is a fifteen-ounce polypropylene type with a shrink label. It sports a metal pull-ring seal, which is removed prior to cooking.

Atop the seal lies an injection-molded polypropylene lid, which the consumer snaps back onto the bowl prior to cooking. The lid has holes that allow venting during cooking. This snap on friction-fit lid had the problem of popping off during cooking, so Stull Technologies devised a locking mechanism on the lid in 2005. In order to remove the lid, the consumer pushes two tabs and lifts the lid off. When placed back on, the lock makes a snap that lets the consumer know it is fastened (Stull 1).

Like Soup at Hand, the microwave bowls have one-year shelf life. Other soup makers use differing approaches.

General Mills' Progresso line of microwaveable soups displays packaging similar to Campbell's first-generation microwave soup bowl. They too use a fifteen-ounce polypropylene bowl, though slightly differently shaped from its Campbell's counterpart. Rexam manufactures the bowl. This bowl line also uses metal pull-ring seals and a polypropylene top, which is placed back on top of the container after the seal is removed. The bowl uses a friction-fit top, which pops back onto the container but does not offer the same degree of protection from popping off that the Stull lid used by Campbell's does.

While Progresso's bowls have a one-year shelf life, other bowls manufactured by Rexam can have up to eighteen months shelf life due to incorporating high barrier materials (Rexam 1). While plastic bowls share many characteristics, a great deal of innovation has occurred with seals on those bowls.

While Campbell's and Progresso use the tried and true metal pull-ring aluminum top on their bowls, Hormel has done differently. In the early 2000s, Hormel gradually switched over its Kids Kitchen production facilities to produce microwave bowls topped with all-plastic lids. It incorporated a novel application of spin welding, whereby machines rotate the lid at high speed and force it onto the bowl. The bowl and lid weld together due to pressure and friction providing the heat needed for fusing. Unlike metal, the plastic lid has no sharp edges that may cut children, which is particularly important for that product line (Higgins 1-2). While plastic bowls dominate the market, other types of bowls can be used.

Ball Corporation aims to provide an alternative to plastic bowls with its new Fusion-Tek microwaveable can. While regular cans cannot be microwaved, Ball gets around this by using a removable top and plastic bottom with foam-coated steel sides. This allows microwaves to penetrate the top and bottom of the can. The container uses the ubiquitous metal seal, which is removed prior to cooking. It also uses a plastic top that is placed back onto the bowl before cooking. Ball uses a Stull locking cap for Fusion-Tek, much like Campbell's plastic soup bowls. The Fusion-Tek can offers benefits it plastic brethren cannot match, such as shelf life and manufacturing efficiency. Shelf life for Fusion-Tek cans is 18-24 months, trumping the one-year shelf life of plastic bowls (Reynolds 1). Ball accomplishes this via the high barrier characteristics of metal, as well as the high-barrier PP/EVOH/PP bottom (Ellis 1). Since consumers often leave soups in the cupboard for weeks, this can be useful (Heller 1). The can's tall, thin shape allows it to run on existing can lines, minimizing equipment costs (Reynolds 1).

Fusion-Tek is not the only microwaveable steel can, however.

Arcelor's Creasteel cans are also microwaveable, but they offer the ability to be shaped in many different ways. Arcelor says Creasteel offers a minimum of manufacturing steps for highly unusual shapes and consequently, more money saved on equipment. Creasteel works with a variety of closures, including heat-seal foils, easy open ends, or seamed rings (Food Production Daily 1). Arcelor believes their container to be superior to Fusion-Tek since the tall, narrow Fusion-Tek can caused uneven heating. Both cans will likely enjoy use, however, since Arcelor mainly operates in Europe and Ball in the United States (Ellis 1).

Another player in the microwaveable can field is Crown Food Europe. They too have released a plastic covered metal bowl. Theirs also incorporates an easily opened peelable lid, which is convenient for elderly people and children. This container won a DuPont Diamond award in 2005. Crown's container boasts a shelf life of three years, far exceeding that of Ball's Fusion-Tek and plastic containers (DuPont 1). Ideas like these mean an interesting future for soups and food in general.

What does the future hold for microwaveable soup packaging? While it is impossible to know for sure, convenience, safety, taste and product variety will likely play a role. While products such as Soup at Hand and microwave bowls have made soup considerably more convenient, there remains room for improvement. Microwave soup bowls can try more peelable closures, like the new Soup at Hand lid, as well as other things in the drive for convenience. Microwaveable soups have enjoyed a good safety record, but a recent *Milwaukee Journal Sentinel* article claims that microwave containers, including those from Campbell's, released toxic doses of bisphenol A into the food they held. Campbell's disputes the findings, but such concerns need to be monitored by astute firms (UPI 1). Taste, as always, will remain a concern for food companies. Manufacturers use extremely high heat to sterilize soups in the container, but this heat also mars the flavor of the dish. Companies such as Andersen's, popular in California, use aseptic methods to avoid this. Aseptic sterilizes the product and container separately and combines them in a sterile environment (Turcsic 2-3). Aseptic packaging, however, cannot be microwaved due to its foil layer (Ashman 3). Finding a way to manufacture an aseptic microwaveable container could allow innovative soup companies to enhance taste for existing soups as well as releasing new types of soup with more delicate flavors. In addition to building brand value, packaging improvements in the future can help cut costs.

With the economy slowing and waste concerns rising, companies will try more than ever to reduce material volume and costs. Lightweighting will continue to be popular, and new materials to lessen costs will be welcomed especially.

As always, competition in food will be fierce. Innovative packaging materials can give firms the edge needed to triumph over competitors and bring more value to customers. Microwaveable soup offers convenience and low cost to consumers, and is ideally positioned for the hurried lives of modern people. Recent history shows that innovation in soup packaging creates growth, but companies that stagnate risk losing market share and profits.

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