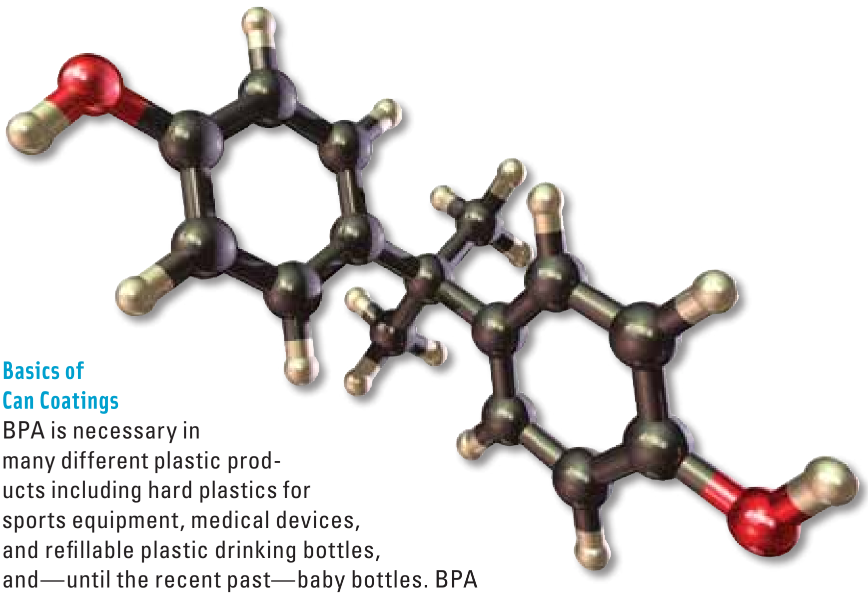
by Aaron L. Brody

Taking a Closer Look at **BPA and Its Alternatives**



A molecular model of Bisphenol A.

The chemical Bisphenol A (BPA), which is used in a wide variety of plastic packaging, has been the subject of an enormous amount of media attention and speculation based on its potential and highly debated harmful effects. Hardly a day passes that is not studded with trade and peer review publications questioning the safety or value of BPA—or questioning those who question.

Whether or not there are direct or indirect risks to humans from BPA, the publications and discussions are provocative, although they hardly prove any true correlation between BPA exposure and harm, even at the minute levels chemists are now capable of detecting or measuring. University of Georgia graduate student Marshall Howard, who is pursuing a master's degree in food technology, reviewed the BPA can lining issues, and this column draws some facts from his research and adds some thoughts, which might serve as precursors to more intense study and discussion.

The canning industry has challenged the movement against BPA. Websites such as www.bisphenol-a.org , www.factsaboutbpa.org, and www.plasticsinfo.org , which are supported by the chemical industry, dispute assertions about BPA that suggest potential risk from BPA exposure. Whether or not the dangers of BPA are real (and remember that it is the dose that proves the harm), the levels of BPA measured as being derived from food and its packaging are minute. Still, the issue is highly visible. Until we ever confirm or deny the reality of these assertions, alternatives to the use of BPA in can linings should be pursued; consumers perceive there is a potential hazard, and that is a significant issue.

Basics of Can Coatings

BPA is necessary in many different plastic products including hard plastics for sports equipment, medical devices, and refillable plastic drinking bottles, and—until the recent past—baby bottles. BPA is applied to harden polycarbonate plastics.

Because polycarbonate is so infrequently applied for food and beverage packaging, BPA comes into contact with the food supply mainly through its inclusion in internal can coatings. Beverage cans are predominantly made from aluminum (approximately 80% of all food and beverage cans). Food cans are made from tin or chrome-coated steel. Metal cans interact with their contained food substances and have detrimental effects on the quality. Plastic coatings retard interaction of the food with the metal as well as seal imperfections in the metal to reduce the risk of contaminants. Linings are an indispensable feature for canned foods vital to maintaining canning as a viable food preservation technology.

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Foods packaged in cans that do not contain an internal plastic coating are at risk from leaching metal from the can. Foods packaged in steel cans with tin coatings without internal plastic linings have been shown to contain a significant amount of tin. While there is a moderate risk of metal compounds in our food supply, it is well documented that metal cans might adversely affect the contained food product, and this can create perforations or cracks in the can. »»

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Table 1. Properties of Can Linings.

Lining Type	Advantages	Disadvantages
Oleoresin	Good flexibility Relatively inexpensive	Porous Stains from sulfur exposure
Phenolic	Moderate flexibility Very resistant to sulfur staining Functional at wide pH ranges	Limited flexibility High heat treatment required for application
Epoxy-Phenolic	Good flexibility Very versatile	Contain BPA
Vinyl	High flexibility	Heat sensitive during retort process Mostly used in beverage cans
Acrylic	Clean appearance Sulfur stain resistant	Flexibility can be limited at low pH ranges
Polybutadiene	Sulfur stain resistant if treated with zinc oxide	Low flexibility

Can coatings must perform well in many different ways including resisting retort temperatures, providing an inert barrier, preventing contact of the food product with the container material, as well as not imparting or removing flavors. Coatings must be flexible because the metal undergoes heating that may cause the can to expand and contract, and so the coating must be able to stretch without damaging its adhesion to the can. Can coatings must also be able to be spread evenly and to completely cover the inner surface of the container so that no part of the can is exposed to the food product. Early can coatings were made of oleoresins, which are natural oils and resins from plant-based materials. Oleoresins must be baked onto the surface of the can to ensure adherence and total coverage.

In an effort to get to a more functional coating, other options were developed in the 1950s; these include phenolic, epoxy, vinyl, acrylic, and polybutadiene-based coatings. General purpose linings are based on epoxy phenolic resins, which contain minute quantities of their chemical building block, BPA.

Can coatings must be applied directly to the tin or aluminum surface that will become the interior of the can. The main application methods are roller coating for flat sheets prior to the forming of the can and spraying for two-piece cans.

Can coatings are a ubiquitous and necessary technology that cannot be abandoned due to their function in the food industry. Food cans provide a necessary function that allows us to have a safe, desirable, and stable food supply. Without can linings, we would not be able to safely contain foods and beverages in reliable and shelf-stable packaging without the risk of off flavors and metal exposure.

BPA and Human Exposure

BPA is a chemical produced at very high volumes and is allegedly present in measureable levels in the bodies of 90% of Americans. Human exposure to BPA does not just come from canned foods, but they are the main source.

BPA has been shown to have a similar structure to the human hormone estrogen, which has been associated with female characteristics as well as increased rates of heart disease, diabetes, and some forms of cancer. Studies have shown that BPA and related chemicals can bind to estrogen receptors in the body. There is claimed to be a potential for this process to disrupt the normal hormonal activity. BPA has been shown to bind to hormone receptors and thus be absorbed as estrogen in the body.

Recent research has prompted the European Union (EU) to ban the use of BPA in polycarbonate baby bottles. Baby bottles were singled out because there is concern that infants are more susceptible to BPA exposure. The U.S. Dept. of Health and Human Services affirmed that it has concerns over the potential risk of BPA in humans, and the Environmental Protection Agency (EPA) calls BPA a chemical of concern based on preliminary data. While agencies in Canada and the United States have issued cause for concern with BPA, there has not been sufficient evidence to cause them to take further action to reduce consumers' exposure to BPA.

While there is a small trend for companies to stop using BPA in their can linings, most have not taken overt action, rather relying on can makers and their liner suppliers. This is due mainly to the lack of functional alternatives to BPA. Several chemical companies have begun developing BPA substitutes, and more research will be initiated to find better alternatives.

Can Lining Alternatives

BPA's functions are necessary to produce a can that is versatile and will remain shelf-stable for extended periods. BPA substitutes are hardly used because they are generally not as functional. In order to continue to remove BPA from the food supply, safe, functional, and affordable alternatives must be available. BPA-containing epoxy resins are by far the most functional options available. Currently, no single replacement can lining product provides the same function and product protection as BPA-containing linings.

Other less-functional alternatives to BPA-containing can linings are available and have had some success in the food industry. For example, more expensive polyester can coatings have been used in Japan since the 1990s.

Another option for linings of canned foods is oleoresin. Cans utilizing the oleoresin technology are more expensive than those using other technologies as the oleoresins are costly and the baking process is both labor- and energy-intensive.

Over the past two decades, there has been much debate over BPA and the potential adverse health effects that can occur through consumption even at very small levels. Well-respected research and media outlets have given extensive attention to the possible risks, which has caused several consumer and health advocacy groups to object to BPA in food containers. In order to get the food industry to embrace a BPA replacement, it is important to have a similarly functional material that can be versatile for many different canned food products.

While can linings are a necessary feature for metal cans, the availability of BPA replacements is lagging behind demand. New technologies are being developed, but it is not clear when these replacements will be available and how functional they will be. Another replacement option, which is employed in Asia, is the use of polyester coatings. These can be used as can coatings or as additional linings that cover the BPA-containing lining. In the U.S., oleoresins have gained some traction in can linings through their adoption by a few natural food companies in their low-acid canned foods but are limited by their cost and functionality.

It is important for governments not to overreact to the threat of BPA by limiting its use in cans. The canned food industry provides a valuable service to consumers in that it makes safe, nutritious, and shelf-stable food available year round. If governments start to regulate the use of BPA before viable alternatives are on the market, it would mean that these canned products would not be available to consumers. While it will take some time for the industry to develop and implement the replacements for BPA, the food industry is moving toward safer alternatives. **FT**

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