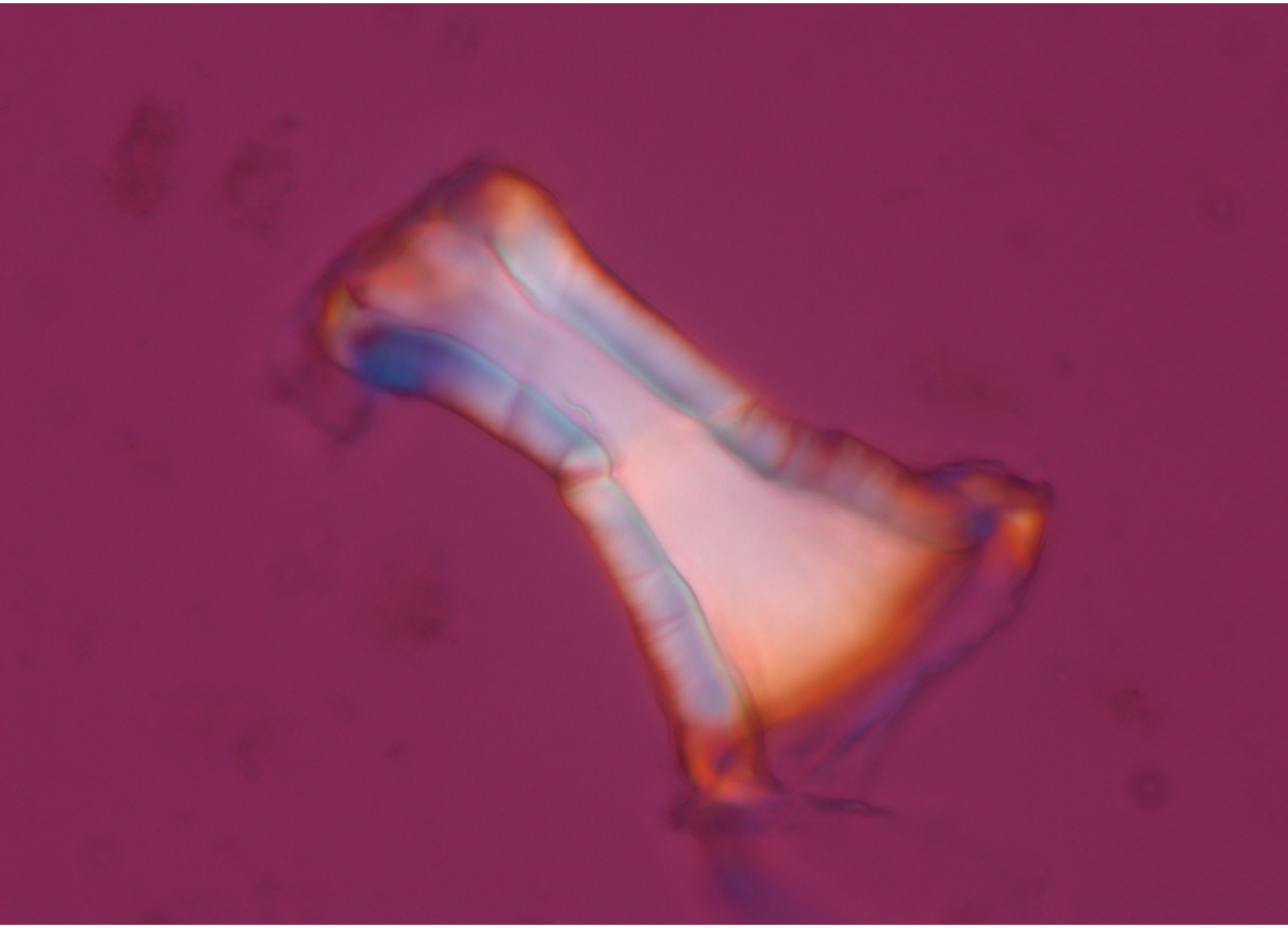
Application Note



Soy Products under a Microscope

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Plant-based foods are trendy. But health aspects are also behind the popularity of a meat-free diet. To manufacture foods with plant-based ingredients, high-quality raw ingredients are used that are primarily sourced from the surrounding region. When it comes to analyzing nutritional content, light microscopes play a crucial role in quality assurance.

Introduction

Food production in industrialized nations today is increasingly moving toward a completely plant-based system. Only a few years ago, plant-based alternatives could only be found in organic grocery stores and health food shops; today they line the shelves of every supermarket. In Germany, there are currently 7.8 million vegetarians and around one million vegans. And these numbers continue to increase. Alternative foods are trendy. In addition, a growing number of people are lactose or gluten intolerant, and they also often choose plant-based alternatives.

Modern food companies like Berief Food GmbH develop and produce excellent and innovate organic products from carefully selected plant-based ingredients. As a specialist for vegetarian nutrition, Berief Food GmbH places an emphasis on sustainability and the responsible and economical use of food and only uses high-quality raw ingredients to manufacture its products. The German company sources raw ingredients, such as soybeans, from the surrounding European region, and they can exhibit differences in their nutritional content. When it comes to analyzing nutritional content, light microscopes play a crucial role in quality assurance.

Figure 1 *Soybean plant*

Interesting Facts about Soybeans

Berief Food GmbH is a specialist in plant-based nutrition. The second-generation family business headquartered in the German town of Beckum develops and produces modern plant-based products.

Its main raw ingredient is the soybean (*Glycine max. (L.) mer.*), a legume that has its origins in China.

The soybean is an annual plant that grows to a height of 80 to 100 centimeters. After being sown in the spring, the growing season lasts approximately 150 to 180 days, meaning it is ready for harvest in September/October. The plant only flowers for three or four days. The pods (Figure 2) grow to between three and six centimeters in size, and each contains two to four seeds. The beans in the pods begin to ripen when the soybean plant's leaves turn brown.

The United States, Brazil, Argentina, India, and China are the main countries that grow soybeans. The United States is the

Figure 2 *Soybean pod*

Figure 3 *Various soy-based products (image courtesy of Berief Food GmbH, Germany)*

leading grower and harvests up to 90.6 million tons annually. Each year, a total of 265 million tons of soybeans are harvested worldwide.

The soybean is a very nutritious plant. It has a high protein content (38%) and contains all eight essential amino acids (isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine), which the body requires for protein synthesis. In addition, soybeans consist of 15 % soluble carbohydrates (sucrose, stachyose, raffinose), 18 % oil, 14 % water and ash, and 15 % dietary fiber.

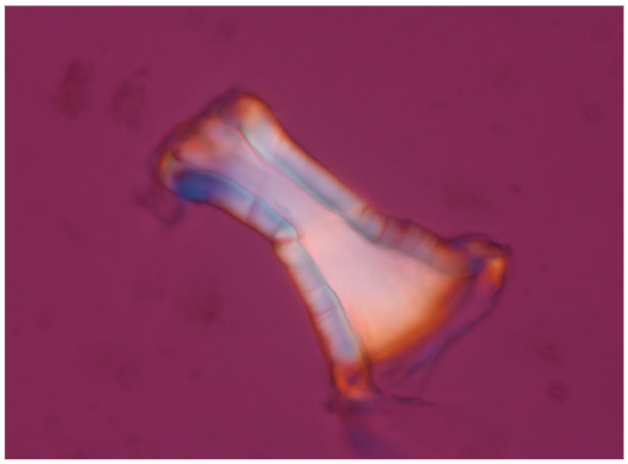
Figure 4 *Tofu is free of animal fats and contains high-quality plant-based proteins and polyunsaturated fatty acids (image courtesy of Berief Food GmbH, Germany)*

At Berief Food GmbH, soybeans are processed into a variety of different soy products, including drinks, soy yogurt, and tofu (Figure 3).

In this context, products are classified as made with either fermented or unfermented soy. Tofu, for example, is produced through extraction of the soybeans and subsequent protein precipitation. This results in a substance similar to ricotta cheese. Tofu (Figure 4) can exhibit different levels of water content and textures, with the differences occurring as a result of varying water-to-soybean ratios, the type and concentration of the precipitating agent, and the amount of curd removed. Tofu is generally used by vegans and vegetarians as a substitute for meat and cheese.

Using a Microscope for Quality Control

A fixed part of the general quality assurance process, here we are outlining the procedure based on the example of the “slurry” (ground soybeans in water). This serves as a preliminary product used in the manufacture of soy drinks. The size and shape of the carrier and palisade cells (Figure 5, 6) from the soybean seed coat reveal information about the degree to which the soybeans are ground when viewed under a microscope. The carrier and palisade cells give the soybean its light- or dark-brown color. The degree of grinding plays



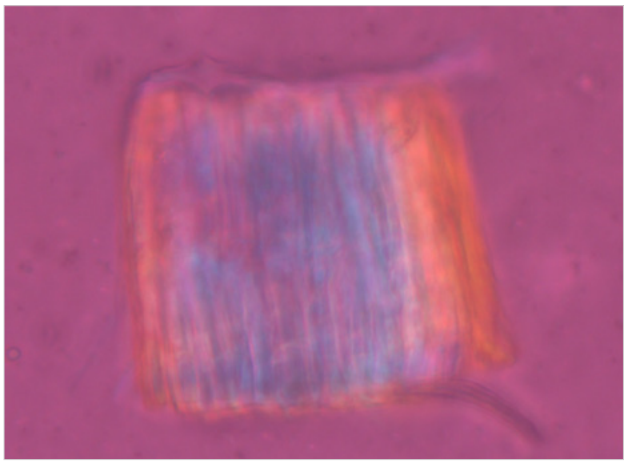


Figure 5 and 6 *Carrier and palisade cells from a soybean seed coat*

an important role in soy drink production. The more finely ground the components of the soybean, the more nutrients make it into the soy drink – and can therefore be absorbed by the body.

Figure 7 *ZEISS Axio Lab.A1*

In order to visually detect the sometimes minimal variations between the beans, an upright, transmitted light microscope of suitable quality is recommended, such as ZEISS Axio Lab.A1 (Figure 7).

Due to the wide variety of different topics that could interest a food company, a microscope that offers various contrasting methods, such as bright field, dark field, and phase contrast, is recommended. The objective lenses should be versatile and provide high-quality overview images (ZEISS N-Achroplan 5×/0.15), make it possible to produce well-balanced phase contrast images (ZEISS N-Achroplan 40×/0.65 Ph2), and also allow the operator to conduct bacterial examinations (ZEISS N-Achroplan 100×/1.25 Oil). Soybeans exhibit anisotropic properties. As a result, polarization contrast with a polarizer and analyzer can offer additional, informative findings. If there is a desire to document the findings in microscopic images, a camera should be selected that has an excellent dynamic range and the right resolution to also effectively capture polarization contrast images.

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