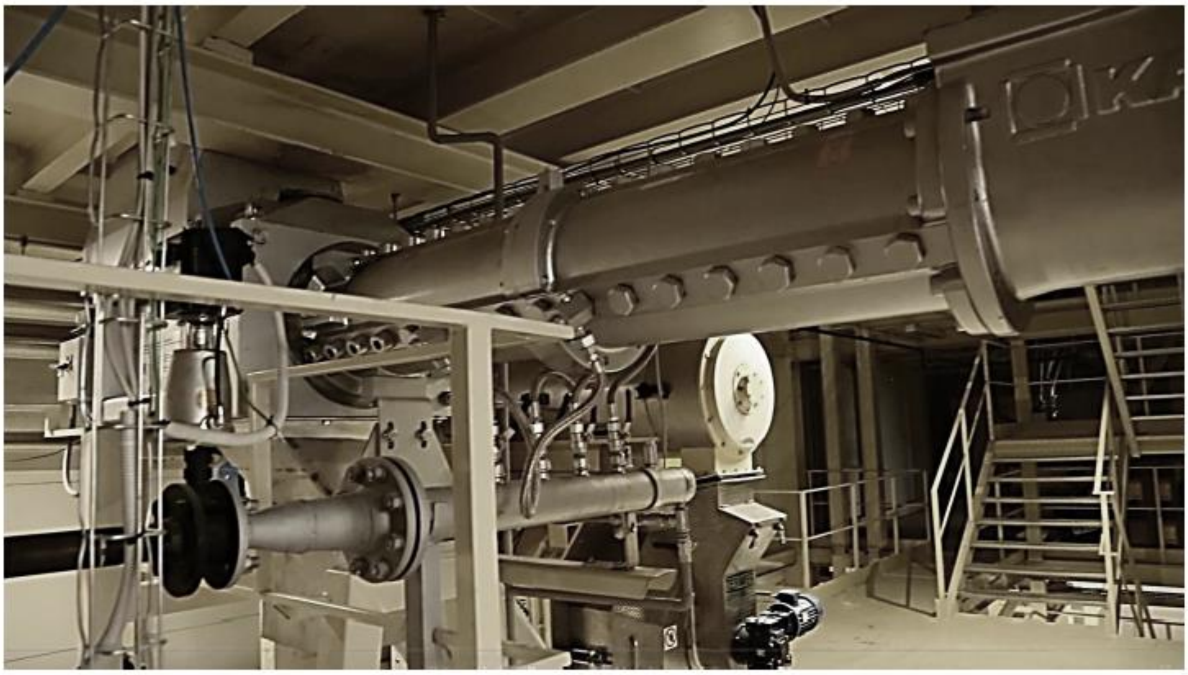
Extrusion as an effective method of upgrading feed components

The extrusion of plant-based raw materials is a hydro–baro–thermal process that induces physicochemical transformations. These changes result from the combined effects of water, steam, temperature, pressure, and mechanical stress applied to the feed material, and affect virtually all nutrients. The process alters the structure of proteins, fats, and starch, and modifies the fiber content of the extrudate. An equally important function of extrusion is the inactivation of anti-nutritional substances.



PHYSICOCHEMICAL CHANGES IN EXTRUDED PRODUCTS

Protein

The cooking process occurring in extruders increases protein digestibility by improving the availability of amino acids. Extrusion breaks double bonds (between amino acids) but cannot break the bonds within amino acid molecules, which results in the breakdown of the protein structure without damaging the amino acid molecules themselves. It also disrupts the bonds stabilizing the quaternary and tertiary protein structures. As a result, the protein becomes more susceptible to enzymatic hydrolysis.

Starch

Under high temperature and pressure, starch undergoes gelatinization and dextrinization – processes that enhance its digestibility. Extrusion disrupts the structural arrangement of starch, causing it to gelatinize and lose its crystalline nature. As a result, the regular granular form is irreversibly destroyed, rendering the starch water-soluble and more easily digestible.

Fats

During the extrusion process, fats are broken down into smaller particles, which enhances their utilization and reduces the risk of digestive disturbances. The oxidative stability of fats also improves, as enzymes responsible for rancidity – including lipase and lipoxygenase – undergo denaturation. Additionally, extrusion decreases the susceptibility of fats to ruminal degradation.

Fiber

The extrusion process causes significant changes in the content of individual dietary fiber fractions in extruded products compared with raw materials not subjected to this process. Abrasion, grinding, and shearing forces within the extruder crush and tear fibrous materials, resulting in structural modification of the fiber. In extruded components, a decrease in the insoluble fiber fraction has been observed, accompanied by an increase in the soluble fraction. As a result, the level of digestible fiber rises, improving the nutritional value of the extruded raw material and enhancing both protein digestibility and energy availability.

Anti-nutritional substances

As a result of high temperature and pressure, anti-nutritional compounds present in feed materials (such as urease, trypsin inhibitors, and amylases) are largely degraded or inactivated during extrusion. The enzyme urease, found in high concentrations in soybeans, loses its activity under the high temperatures generated during the extrusion process. A similar effect is observed with trypsin inhibitors. This contributes to improved nutrient digestibility and better protein utilization.

BENEFITS AND ADVANTAGES OF EXTRUSION

The qualitative transformations in extruded raw materials, as outlined above, markedly contribute to enhanced nutritional properties of the extrudates and influence the following aspects:

➢ **Digestibility**
The digestibility of key nutrients – including fiber, starch, protein, and fat – is significantly enhanced through extrusion. As a result, the incidence of digestive disorders, such as diarrhea, is reduced.

➢ **Bioavailability**
Improved digestibility of the feed also enhances its bioavailability. As a result, the availability and absorption of nutrients are increased. Nutrients are more efficiently absorbed and utilized by animals, rather than being excreted and lost.

➢ **Palatability**
Extrusion significantly enhances the palatability and aroma of feed, leading to increased voluntary intake by animals. During the gelatinization process, starch is broken down into simpler, sweeter compounds, contributing to improved taste and feed acceptance.

➢ **Stability**
High stability of extruded products is also worth noting. This enhanced stability results from the partial binding of fats within the processed matrix, which increases their resistance to oxidative degradation. Additionally, the near-complete inactivation of lipase and lipoxygenase (enzymes responsible for lipid hydrolysis and rancidity) further extends shelf life and improves fat stability.

➢ **Product hygienization**
Extrusion also contributes to the hygienization of the resulting products. Strictly controlled processing parameters reduce the presence of pathogenic microorganisms, making the products exceptionally safe for use. Hygienic quality is markedly improved, yielding products with a high microbiological standard.

EXTRUSION AT LIRA COMPANY

Wytwórnia Pasz LIRA (LIRA Feed Manufacturing Plant) was one of the first feed companies in Poland to implement industrial-scale extrusion of plant-based raw materials. The first extrusion line, provided by the well-known American company InstaPro, began operating in 2004. Initially, the equipment was used only to manufacture extrudates for piglet feed.

It quickly became apparent, however, that extruded raw materials were also highly effective in feeding other categories of pigs, as well as cattle, horses, and companion animals. The growing demand for extrudates led to further investments. Currently, LIRA operates four extrusion lines.

In modern extruders, the most important process parameters – such as temperature and pressure, as well as the amounts of steam and water – are controlled and regulated automatically. The high level of precision in process control and regulation ensures smooth management and reliable supervision of this advanced technological system. However, even the most advanced automation systems require the insight and experience of trained professionals to unlock their full potential. A correct extrusion process, and the proper quality of the resulting extrudate, are ensured by strict adherence to the technological regime.

After all, the difference between a good and a poor extrudate can be like the difference between a chair and... an electric chair!

BRIEF PRESENTATION OF LIRA PRODUCTS CONTAINING EXTRUDATES:

Porcus®
pasze dla prosiąt

This is an exclusive line of feeds designed for piglets from the first days of life until they reach approx. 30 kg of body weight. The product range is distinguished by excellent digestibility, palatability, and exceptionally high nutrient absorption. The PORCUS product line is a precisely formulated feed, designed to meet the needs of piglets across different technological groups and developed through LIRA's extensive experience in collaboration with its most trusted clients.

O-MEGA L
innowacyjne rozwiązanie

This innovative formula combines flaxseed, dried fruit, corn, and milk thistle endosperm. It is primarily applied in the nutrition of core herds across all animal species. PORCUS products are rich in energy, protein, and fiber – but most notably, they deliver essential omega-3 unsaturated fatty acids, which can enhance reproductive performance by up to 30%. Among the many advantages of this product, the most notable are a shortened labor duration, relief from constipation, and the birth of larger, more uniform, and healthier litters. o-MEGA L is a formulation that genuinely supports both labor and reproductive health!

This next-generation product is manufactured from rapeseed meal, processed under strictly defined and reproducible extrusion parameters. In ruminant nutrition, it is used as a source of valuable and currently the most cost-effective bypass protein, with a UDP index exceeding 60%. Its high content of sulfur-containing amino acids, particularly protected methionine, makes Golden Protein the optimal protein component in modern feed rations for high-performance animals. The high digestibility of protein, and fiber in particular, also makes this product an excellent component in the nutrition of monogastric animals such as pigs and poultry.

This innovative product, rich in easily digestible and soluble fiber, is formulated from fibrous plant-based raw materials. Carefully selected fiber fractions (cellulose, hemicellulose, and lignin) support optimal digestive tract function by improving the passage of feed content, thereby helping to prevent constipation. Its high water-holding capacity enhances the feeling of satiety and effectively satisfies the animals' physical hunger. Thanks to its high water absorption capacity, this product also contributes to drier bedding. Through extrusion, the fiber undergoes structural transformation and functions as an excellent prebiotic, supporting the overall health of animals.

This latest line of premium muesli-type feed mixes has been developed for the most demanding animals. Through the integration of cutting-edge technologies – extrusion and micronization – we have developed products that significantly boost growth rates while enhancing animal strength and overall health. The use of top-quality raw materials, combined with advanced production technology, has resulted in a unique line of highly palatable and easily digestible products. The first product from the CHRUPKA line was introduced for calf nutrition. However, it quickly became evident that these feeds – highly palatable, easily digestible, nutritionally rich, and uniquely structured – were eagerly consumed by other animals, including horses, alpacas, dogs, rabbits, and rodents. CHRUPKA even proves effective as fish bait.

Today, LIRA is a leader in the Polish market in the field of extrusion. Nearly 20 years of experience, together with state-of-the-art extrusion lines, guarantee the high quality of our products. Yet the company does not rest on its laurels. It continues to invest in the future – in growth and innovation… always maintaining the highest quality of its products and services, because "quality is remembered long after the price is forgotten."