Background Report

We need a protein revolution

Meat substitutes made of peas, pasta containing Chlorella protein, black soldier fly meal as sustainable feed for aquacultures: In order to supply a growing global population with high-grade protein, new and innovative approaches are required today. By the year 2050, humanity will need 265 million tonnes of additional proteins a year. Alternative protein supplies such as pulses, algae, or insects will soon play a key role in nourishing humans and animals alike. Buhler is developing the industrial-scale solutions required to process them.

Proteins are elementary constituents needed for the growth and renewal of human and animal cells. They are continuously being formed inside the body and broken down again. In order to maintain this cycle, about 15 percent of daily energy intake should be in the form of proteins. To nourish the world’s population, agriculture produces 525 million tonnes of vegetable primary proteins every year, which are for example contained in corn (maize), rice, wheat, or soybeans. In 2050, however, almost 10 billion people will be living on our planet. By then, we will need an additional 265 million tonnes of protein annually if the trend toward ever-higher meat and fish consumption continues. Global production must therefore increase by 50 percent over today’s level.

Protein supplies are no longer sustainable even today
The growing protein gap poses an enormous challenge for humanity. Even today, our protein system is not sustainable. People in the industrialized countries cover as much as 70 percent of their protein requirement from animal sources, with vegetable proteins accounting for only about 30 percent. Two thirds of all vegetable proteins are processed into animal feed. The land, water, and energy resources required to feed and rear livestock such as cattle, pigs, poultry, or fish are immense. And animal protein production is not particularly efficient, either: Cattle need nine kilograms of feed to build one kilogram of body weight. The yield of edible meat is even lower.

Today’s vegetable proteins would suffice for 18 billion people
Up to 50 percent of the extra protein needed by 2050 could be obtained by eliminating waste. Today, some 30 percent of raw materials are lost, either because foods spoil due to improper storage in the processing chain between field and supermarket or because consumers throw them away. The shortfall could also be reduced by a stronger focus on a vegetable-based diet. If we were all to become vegans, we could provide food for 18 billion people with the protein volume produced today. However, this is unlikely to happen: As the emerging countries become more prosperous, meat consumption is set to rise by as much as 44 percent by the year 2050.

Pulses are experiencing a revival in the industrialized countries
Even if we continue to consume meat, there is no way around the increased use of vegetable proteins if we are to feed mankind in the future. High hopes are pinned, among other things, on pulses. Lentils, beans and chickpeas have long been prominent staples in India, Africa, and South America, while being largely ignored in Europe and North America. In the past few years, however, they have enjoyed something of a revival. Health-conscious consumers appreciate pulses for their high protein and fiber content.
Worldwide production today is just 77 million tonnes. This is 15 times less than corn (maize) and 10 times less than rice and wheat, despite the fact that the cultivation of pulses in itself is beneficial: They fix nitrogen taken from the air, require less fertilizer as a result, and contribute to maintaining soil fertility. In order to enhance awareness of this gluten-free protein source, the United Nations has declared 2016 as the International Year of Pulses.

The processing technology is available today
The potential of pulses is still far from exhausted. Bühler offers solutions for processing them into top-quality products on an industrial scale, including all the important steps such as cleaning, hulling, splitting, and sorting. A criticism often leveled against pulses in the western hemisphere is that they require a lot of time to prepare and can be hard to digest for people not used to them. The crucial point therefore is downstream processing: The challenge for manufacturers is to develop products with a high level of acceptance. Lentils and peas, for instance, could be transformed into high-protein flours for use as additives in bakery products or pasta. It is even possible to produce pasta with an attractive flavor and texture using only pulses. Another option is the production of snack foods or instant hummus. Last but not least, pulse flour can also be used for the production of meat substitutes – so-called texturates – whose texture closely resembles that of the muscle meat of animals. Such novel products could make pulses more attractive for larger consumer groups.

Today’s animal feeds are expensive and not sustainable
The research community and industry are also giving more attention to exploiting the potential of new raw materials such as algae or insects for producing protein. They could, for example, be used as sustainable alternatives to feeds based on, say, soybeans and fishmeal. Today, almost 80 percent of the global soybean harvest is processed into animal feeds. Rain forests are often cut down – in Brazil, for example – to make way for the cultivation of soy. Fishmeal is largely made from wild fish, exacerbating the problem of overfishing. In addition to sustainability aspects, economic reasons speak a clear language as well: The prices for soybeans and fishmeal have tripled between 1994 and 2014.

Algae are rapidly growing protein supplies
A possible alternative might be industrial-scale cultivation and processing of microalgae such as Chlorella or Spirulina (Arthrospira). Their production does not compete with existing farming areas and is highly efficient. They also take up very little surface area: 1 kilogram of algae protein can be produced within an area of only 1.6 square meters, compared with the roughly 50 square meters required by pigs for the same output. Algae are cultivated in open basins, in pipes or pouches, as well as in enclosed tanks. Their production is particularly sustainable in integrated biorefineries, where the algae can also be used to process waste at the same time. However, industrial-size plants for cultivating and processing them on a large scale still remain to be developed.
Bühler technology allows gentle rupturing
One critical processing step is the rupturing of the algae walls because of their toughness. In a research project, Bühler has demonstrated that agitator bead mills are the most cost-efficient mechanical method for this purpose today. This wet grinding technology, which is also used for the dispersion of printing inks or paints, ensures gentle rupturing of the cells. The proteins contained in algae cells are especially promising for supplying proteins for human and animal consumption. In addition to animal feeds, they allow the production of additives for bakery products, pasta, or snack foods as well as meat substitutes. But beside their different proteins, algae also contain high-grade polyunsaturated fatty acids or color pigments, which can also be profitably utilized.

Insects can be fed with waste
Insects, too, offer much potential. Mealworms or fly larvae are easy to breed and can in some cases even be fed with agricultural or food waste. They are also remarkably efficient, being capable of transforming a mere two kilograms of feed into one kilogram of insect mass. Another benefit is their low space requirement: One kilogram of insect protein can be produced on a single square meter. What's more, larvae excrement can be used as fertilizer in farming.

Insect meal might replace fishmeal
Whereas insects are consumed also by humans in certain regions of the world such as Asia, it is as yet uncertain as to whether western consumers would accept insect-based food products. The primary focus for the time being, therefore, is on processing them into feeds. Because insect meal is similar to fishmeal as a source of protein, it could be applied in aquaculture and help relieve the pressure on natural fish populations. However, one unresolved issue is the legal situation: In some countries, animal proteins have been banned from use in livestock feeds since the BSE crisis. Also the large-scale breeding and processing of insects is still uncharted territory. The output of existing processing systems is still relatively low. Bühler is currently setting up a pilot facility with a partner in China for processing fly larvae and mealworms on an industrial scale. The aim is to produce insect meal as a replacement of fishmeal plus a high-grade fat with properties similar to those of palm kernel oil.

Bühler is prepared to take up the protein challenge
One thing is certain: The protein market will become perceptibly diversified over the next few years. Today's market for high-protein vegetable food ingredients is still dominated by soy proteins and gluten. But soon alternative sources of protein such as pulses, algae and insects will be playing a significant role. As the market and technology leader in the field of cleaning, drying, sorting, grinding, and extrusion processes, Bühler is excellently positioned to support the switch to the new proteins. Industrial-scale processing solutions based on tried-and-tested process technologies ensure that the protein requirement of a growing global population will be covered also in the future, both efficiently and sustainably.