FLEISCHWIRTSCHAFT international 4_2019

Nutrition in harmony

Sustainable and renewable food production is a fundamental human need

These days, the food and meat industry stands at an unhappy T-junction, because food and meat production is on the frontline of climate change. The industry is one of the largest contributors of human-induced greenhouse gas emissions causing global warming. The impact of global warming can be seen as a contradiction for the food industry: agriculture is vulnerable to the effects of climate change, while agriculture is simultaneously seen as a major contributor to greenhouse gas emissions.

By Henk Hoogenkamp

Extreme climatic events like excessive rain can play havoc on human food supply. *Photo: geralt / pixabay.com*

Changes in weather patterns, including extreme climatic events like prolonged drought and excessive rain can play havoc on agricultural crop yield and crop quality. It is common knowledge that farming is affected by unpredicted climate events such as – for example – high temperatures and low rainfall, putting pressure on agricultural production output and driving up food prices. There is no question that the collective food industry is highly vulnerable to the repercussions of climate change resulting in food insecurity and, subsequently, uncertainty in supply chains. Intensive animal farming is one of the main sources of human-induced greenhouse gas emissions accounting for some 15% of the total emitted in the atmosphere.

By altering the biophysical conditions of agricultural crop growing, long-term disruption of both the ecosystem and human health can be expected. Rising climate temperatures could potentially shift growing seasons. The extra carbon dioxide that is emitted into the atmosphere can change the chemical makeup of plants by diluting important macro- and micronutrients such as protein, vitamins and minerals. For many people living in affluent societies, a reduction in daily nutrients is not such a big deal. However, for the billions of people living in poor societies, a reduction of essential dietary intake can have severe long-term health consequences. For example, in countries like Indonesia and Bangladesh, rice accounts for 70% of the calories and the population has little choice to compensate by choosing other foods.

In a way, extra carbon dioxide that is emitted which makes crops like rice and wheat less nutritious sound counterintuitive because plants need carbon dioxide for photosynthesis and therefore beneficial to grow. However, it seems that plants have a certain optimum balance of carbon dioxide uptake from the air and the nutrition uptake from the soil.

Platform of change

Tackling climate change, including the taxation of agricultural greenhouse gas emission is a topic that is appearing on the horizon of debate. These rather revolutionary ideas are combined with moves to incentivize farmers to adopt regenerative practices to sequester carbon – putting back CO_2 into the soil.

So the question is not *if*, but *when* the food industry will collectively embrace regenerative agriculture by sensibly using systems – the electronic ledger methods that allows transactions to be verified autonomously – like smart technologies to improve efficiency where CO^2 (carbon) can be taken out of the atmosphere and returned to the soil, thus improving its "health" and productivity. As a bonus, the reliance on chemical fertilizers over time can be reduced. Examples of such are crop rotation, cover cropping, mixed farming and the use of cellular agriculture such as cultured milk protein and cultured meat, not to mention the advantages of hydroponic or aquaponic technology.

Urban farming is gaining momentum and – while still in its infancy – it is likely that crops will be grown in hydroponic vertical cultivation towers combined with state-of-the-art energy-efficient LED lighting. This new technology delivers high-quality nutritious and tasty vegetable and (some) fruits, cultivated using no pesticides, ultra-low water consumption and renewable energy. In addition, controlled environment agriculture allows crops to be locally grown, while long transport lines and emissions can be significantly reduced.

A fundamental rethink

The future of food requires a fundamental rethink of what people will eat. It may sound drastic, but it will be essential to eat more plant and less meat. If everyone on Earth ate a US-style diet, up to five times as much meat as in 2019 would be needed by 2050.

The human population could reach 10 bn. in 2050, and one of the biggest challenges would be nourishing without desecrating the planet. Creative solutions and unpalatable compromises will be needed to start another green revolution beyond today's use of mechanized farming, modern fertilizers, effective irrigation, and improved seeds to increase harvest yield output.

There is disconnection between how food is produced and how people think it is produced. The farming sector is largely industrialized and consumers somehow do not want to let go of their idyllic view of the farming countryside. The realities of farming are quite different, especially when it concerns intensive animal production.

Unsustainable going forward

The current agriculture model is unsustainable and modern food production methods will be needed to keep up with the world's rapidly growing population. As the population grows, so does the need for

ecological and nutritive sustainable foods with manageable environmental footprints. To summarize, animal proteins are packed with beneficial nutrients and vitamins, but very inefficient to produce. Plant proteins are environmentally sustainable but lack many essential amino acids that the human body requires.

Some of the changes need to be radical in terms of production and consumption. To meet the demand, this translates to 2% annual growth on average in agricultural output through 2050, which is highly unlikely under the current practices. To basically achieve the objectives to grow more food for the entire world – not only for the happy few – it makes sense to freeze the current agricultural footprint, improve land and water efficiencies, embrace modern cellular biotechnology, and shift diets (partly) from meat to plants. In addition, it is important to reduce the huge food waste in the various steps between harvest and point of consumption.

The plant protein movement is not "anti meat" or "anti dairy". Rather, it is about recalibrating supply chains and ultimately incorporates disruptive technologies, including cellular post-animal systems. The key factors are a transition to more sustainable protein production, while nurturing the welfare of animals, environment, ecology, and generating to a lower-carbon food platform.

It is expected that meat processors, including companies like Cargill and Tyson, tap into the alternative protein market, be that for meat-free products, cultured meat and possibly also insect protein. These emerging market drivers will continue its growth patterns and have the potential to capture a material share of traditional animal protein demand. Growth in alternative protein products can ultimately grow to one-third of total protein demand in 2025.

First and foremost

In the Greek language, "protein" means "first in life", which has never faded from people's minds throughout history. Protein has always been a component for well-being and survival.

Protein has the widest range of consumer acceptance, ranging from muscle building to weight loss. For most consumers, quality protein is equated with longevity, strength, endurance, as well as prolonged energy, including mental and cognitive alertness. The truth is that plant protein ingredients still have a long way to go when it comes to consumer appeal and perception. There is little doubt that dairy protein – especially whey protein – is seen as the gold standard to which every other protein comes second.

The plant protein ingredient manufacturers, specifically soy protein companies, need to learn to be more modest in their claim to fame. Soy proteins are indeed unique but, when it comes to nutrition, they often perform better nutritionally when blended with other sources of protein, especially whey protein, meat protein, and egg albumen.

Protein continues to go from strength to strength, even without specific accompanying health claims. Everyday food products like breakfast cereals, hybrid meats and plant-based meat products, and plant protein-enhanced dairy foods are ideal platforms to deliver these dietary protein solutions.

In a sense, protein is often seen as a "health halo effect" that goes beyond basic nutritive delivery. Food labels usually have a limited lifespan and only continue as long as the latest fad lasts. Protein might be an exception to this rule.

Plant protein-formulated food, including plant-formulated meat products, meets all modern nutritive and organoleptic requirements, and its "all-natural" status provides consumers with multiple positive health benefits. They are not only environment-friendly and ecologically sound, but also keen on addressing certain looming issues that are still under the radar: slow aging, healthy immune systems, strong energy levels, healthy skin, strong bones, alertness, a lower incidence of cancer, and a healthy heart.

Nutrient-dense vegetables, beans, fruits, and nuts – specifically walnuts and almonds – make up a significant part of a healthy diet, not only to keep the heart healthy but also to manage body weight and avoid long-term degenerative diseases. Diseases like prostate cancer, colorectal cancer, heart disease, and macular degeneration can be slowed down or prevented with a healthy and moderate diet. The medical and social costs associated with degenerative diseases will eventually rise to astronomical levels, and choices will have to be made as to which patients deserve to receive treatment as well as life extension.

Protein fractionation options

The two main functions of protein ingredients in formulated foods are nutritional value and functionality. The functional properties of protein ingredients can be inline-modified or manipulated to provide functions like dispersibility, solubility, gelation, emulsification, stabilization, and lightness.

The isolation or purification of protein ingredients from plant sources especially requires relatively high water usage and energy costs. It is a fact, however, that less purified forms of proteins can retain their functionality as compared to the premium isolated forms of proteins. This opens the door to innovative protein extraction technology like air-fractionation, while maintaining the techno-functional and organoleptic properties. Plant protein ingredients can be concentrated or isolated using wet extraction and dry extraction. The most common method is wet extraction, in which the legumes, cereals or seeds are fractioned through dispersion into the water to dissolve the protein and suspend the starch granules. Next is the separation of the slurry to separate the proteins from the starch granules. This separation is normally done using the centrifugal equipment.

Oil-rich legumes such as soy are usually subjected to solvent extraction using hexane to separate the oil, and the remainder is turned into soy flakes, which are further processed to obtain soy concentrate or soy isolate. Prior to the true isolation of the protein, both insoluble fibers and soluble fibers are separated by precipitating the proteins at their isoelectric point (pH 4.5-4.8) and are subsequently readjusted to a range of about pH 6.8-7.0.

The wet fractioning allows definitive fine-tuning of the protein properties, including modification of solubility with the aid of added enzymes that can create adjustments of specific organoleptic flavor, color and odor, as well as improve emulsification, foaming, whipping and gelation. The disadvantage of wet fractionation is the use of a high amount of water and chemicals – such as hexane, hydrochloric acid and sodium hydroxide of the protein base – for acidification and neutralization.

Dry fractionating of protein is emerging as a more sustainable alternative, which requires significantly less energy and water. Moreover, the absence of drying as well as the exposure to harsh chemicals, allow the protein to retain its native functionality. The latter could also be a requirement to obtain organic or natural protein accreditation. The main disadvantage of dry fractionation is the lower level of protein extraction, thus, a lower protein concentration.

The principle of dry fractionation is that milling can mechanically separate protein and other components like starch and fibers. This initial process is followed by rotor air classifiers separating the smaller protein-rich components from the larger starch granules and fiber dispersed in a stream of air.

These newer fractioning methods may also consist of a dry separation step followed by an aqueous fractioning step. In the dry separation step, the grains or pulses like pea, soy flakes, quinoa and hemp are ground and a lighter high-protein fraction is separated by using air. The downside of this method is the generation of a protein fraction that is less pure than the traditional chemically extracted, but it is more natural due to the mild processing. These semi-dry fractioned proteins are healthier and considered as a more appealing choice for consumers who seek out natural or organic food options.

Enzyme miracles

In simple terms, enzymes are proteins that occur naturally in the cells of plants, animals and microorganisms and are essential to the metabolism of many biochemical processes, including digestion. Enzymes help in proper breakdown of food and better absorption of nutrients within the body. In other words, enzymes assist in digesting the protein for better assimilation.

Nearly all commercially-made foods contain at least one – and often more – manmade enzymes like lipases, amylases, and proteases, which mainly act as catalysts to trigger predetermined fermentation functions. Enzymes like amylase used in food and beverage processing are deacti-

vated and, therefore, not present in the final product. As such, enzymes are considered processing aids that do not require labeling on the finished product. An increasing number of commercial enzymes are made by genetic modification or modulation.

Calculating protein quality

The plant protein industry was surprised by the new methods of measuring protein quality by the Food and Agriculture Organization of the United Nations (FAO/2013), which recommends using the Digestible Indispensible Amino Acid Score (DIAAS) as opposed to the Protein Digestibility Corrected Amino Acid Score (PDCAAS), which favored plant protein and soy protein.

The new DIAAS method clearly demonstrates the superiority of dairy protein over plant protein. Rice protein may be the exception because of its high levels of arginine and leucine – the highest levels in all cereals and grains. This feature will make rice protein ideally suitable not only as a stand-alone protein for hypoallergenic food but also as a partner for dairy protein relevant to nutrition in general and special food segments like clinical nutrition, sports performance, weight management, and sarcopenia.

Protein and, to a lesser extent, fiber are parts of a larger trend of consumer concerns about the benefits of foods. This trend can be clearly seen on labels where protein is increasingly given a more prominent position. Protein enrichment is the new buzz in affluent societies. Protein and fiber enjoy a very positive consumer perception and increased awareness, although these ingredients mean different things to different people.

Protein sourcing

The collective term “vegetable protein” was coined (1992) by the soy industry to diffuse negative consumer bias against the word “soy”. “Vegetable protein” is somewhat misleading, thus, a more accurate catchall name is “plant protein”. Sustainable and renewable food production is a fundamental human need. There are two options to feed the world: to get more food from the land currently farmed, or increase the acreage to farm on. Nevertheless, sustainability will depend on whether farming can successfully continue to produce food over time with little or no damage to the Environment through deforestation, depletion of groundwater, and inefficient use of nitrogen and phosphorous fertilizers. Note that phosphorous fertilizer is a finite resource. Also, global warming and carbon dioxide emissions could ultimately be the deathblow to sustainability.

Whichever choice is made, it will need to be coupled with concerted efforts to grow fewer crops for animal feed raising meat animals, as well as to significantly reduce food waste. If the global population does not curb its appetite for meat, the answer might well be that megafarms are the most appropriate way to move forward and to accept large-scale meat, farmed fish, and dairy production.

Henk Hoogenkamp
is a protein application specialist, board member, venturist and author.

Author’s address: Hoogenkamp1@gmail.com