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The Global Food Supply Challenge: Why Wood Could Hold the Key

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Challenges facing the feed supply-demand gap today have producers wondering where the next big breakthrough will come from. A growing global population—combined with factors such as changing socio-demographics — will place increased pressure on the world's resources to provide not only more but also different types of food. The increased demand for protein is particularly concerning, with animal-derived protein demand projected to double by 2050 to more than 465 million tons of meat and more than one billion tons of milk.[1]

The growth in animal protein demand amplifies sustainability and food security concerns as animal production systems intensify pressures on limited resources such as land and freshwater. In the face of rapid population growth and evolving sustainability requirements it will be difficult to increase production efficiently enough to meet these demands.

The strongest growth in animal proteins is expected in the consumption of farmed fish and poultry, with demand for fish on track to increase by more than 100 percent in 2050 from 2016.[2] The majority of fish supply will need to be met by aquaculture instead of wild catch, which cannot be increased above today's levels without depleting stocks.[3]

Fish protein currently contributes 17 percent of the global human population's intake of animal protein and, already today, aquaculture producers are experiencing protein sourcing challenges, with rapidly increasing production and greater need for high-quality protein sources.[4] As demand continues to expand, there are growing concerns about the availability of resources—including fish meal and fish oil — to safely and sustainably feed the world.

As we begin to approach the limits of conventional agricultural production systems, alternative proteins are gaining growing interest. According to Lux Research, alternative protein sources could expand to comprise up to a third of the market by 2054.[5] In this article, we will explore more about the advancement of alternative feed sources with a focus on single cell proteins (SCPs) derived from an unlikely source.

The Search for a Solution

In the search for new resources to help bridge the supply-demand gap, much of the focus has centered on a two-sided question. How to increase protein production while also addressing sustainability challenges? And how to produce more using less resources while reducing the environmental impact of production?

SCPs include microbes such as yeast, fungi, bacteria and microalgae, which can be produced via fermentation — thus requiring fewer resources in land, water and fertilizers than plant or animal sources. SCP biomass can serve as a sustainable source of animal feed and human food as it is comprised of protein and essential amino acids, along with micronutrients.

One SCP in particular, torula yeast, can also deliver additional benefits as a high-quality protein source. A nutritious alternative to conventional plant and animal protein sources (e.g., soymeal and fish meal), torula yeast offers a high-quality protein with an excellent amino acid profile, providing valuable

building blocks that improve nutrition and performance.[6]

Torula yeast also contains functional fibers, such as beta glucans and mannan-oligosaccharides, which are known to impact gut health as immunomodulators and pathogen binders, thereby assisting the animal's ability to fight disease. A particularly important quality for producers to consider in light of regulatory and consumer pressure to reduce antibiotic use.

Torula yeast is also devoid of the endogenous allergens that are found in milk, egg, wheat and soy products, making them an ideal protein source for susceptible populations, and, unlike other classes of SCPs, Torula yeast has regulatory approval for use in feed and food applications, a history of safe use and more consumer appeal than protein derived from insects or bacteria.

Wood to Food Technology

Producing a high-protein SCP product in commercially relevant volumes for animal feed through a process that is economical at commercial scale as well as sustainable and safe in terms of inputs and source material required, has limited the potential of SCP as a protein source. But a team of researchers at Arbiom are now looking in a place many have never even considered: wood. Wood is a renewable, readily available, natural and organic carbon source that has not historically been a part of the food supply chain, even though it contains sugars (C5 & C6 hydrolysates). Despite wood's promising attributes, bioconversion processing technology to extract its nutritional components has not been effective or efficient — until now. With technology being pioneered by Arbiom, wood has significant potential to help address global protein supply challenges in a way that is both sustainable and scalable.

Arbiom's scientists have developed bioprocessing technology to maximize the value of woody biomass by extracting its fermentable components and optimizing conditions for SCP production. The proprietary technology integrates wood pretreatment and processing with state-of-the-art fermentation of an enhanced strain of Torula yeast (*Candida utilis*), enabling production of a highly-digestible, high-protein ingredient from wood that can be produced in industrial-scale quantities.

Wood offers important advantages over the bioconversion of other feedstock material used to produce SCP, such as waste and wastewater, methane and glucose from food crops:

- Wood is sustainable, abundant and environmentally-friendly
- No irrigation or fertilizer required
- Traceability through strong industrial supply chains
- Advancements in global silviculture practices ensure forest health, productivity and biodiversity are maintained / enhanced
- Additive to food supply chain; does not compete with food crops
- Available year-round

For feed formulators, Arbiom's torula yeast protein product is differentiated from any other alternative protein available today as it is produced using wood hydrolysates as the substrate. Arbiom's torula yeast (brand name: SylPro®) is an ideal high-quality alternative to fish meal and soy protein concentrate, delivering a nutritional, economical, traceable and sustainable protein source for multiple species. Beyond aquaculture, other market segments face similar production challenges due to reduced use of growth promoting antibiotics, for example, and are exploring these types of alternatives to safely and sustainably rear young animals.

In addition to the benefits that wood-based SCP offers the agricultural industry, recent developments in bioconversion technology bring potential new opportunities to wood processing companies. Mills,

for example, typically experience 30-34 percent mass losses on site in the form of slabs, edgings, sawdust, fines and bark.[7] By aligning themselves with a partner in bioconversion technology development, these companies may be able to find a more profitable use for their current wood wastes and/or new market segments to explore.

The Road Ahead

Technology is poised to play an increasingly important role in meeting protein supply-demand needs as market requirements continue to evolve and expand. New SCP-based protein solutions offer promising ingredients for feed formulators, farmers and, ultimately, end consumers, bridging the gap between agronomy and industry and opening up the door to a new era of renewable resources that can be utilized to meet market demands head-on.

Innovators across the food supply chain recognize that to meet society's growing nutritional needs, we must produce food that is more ecologically sustainable and biologically healthy. Arbiom's bioconversion technology is a strong example of how innovation can help address global food supply needs by identifying ways historically non-food material, such as wood, can expand global food production potential in a more resource-efficient process to produce protein. It's a win-win for the industry and a milestone for helping drive healthier, more sustainable solutions to meet global nutritional demands.

To learn more, visit www.arbiom.com.

References:

1. Factors Influencing a Sustainable Equilibrium. Foods. 2017;6(7):53. doi:10.3390/foods6070053.
2. "Global Animal Protein Outlook 2018," Rabobank Research, Food & Agribusiness, November 2017. https://www.demolenaar.nl/wp-content/uploads/2017/11/hier.pdf
3. Ritala A, Häkkinen ST, Toivari M, Wiebe MG. Single Cell Protein—State-of-the-Art, Industrial Landscape and Patents 2001–2016. Frontiers in Microbiology. 2017;8:2009. doi:10.3389/fmicb.2017.02009.
4. The State of World Fisheries and Aquaculture 2016 (SOFIA) (FAO, 2016).
5. Lux Research (2014). WhooPea: Plant Sources Are Changing the Protein Landscape. State of the Market Report.
6. United Nations Food and Agriculture Organization (FAO) (2014). Economic Analysis of Supply and Demand for Food up to 2030 – Special Focus on Fish and Fishery Products, FAO Fisheries and Aquaculture, 1089, p. 22.
7. VTT Technical Research Centre of Finland Ltd. (2017). Single Cell Protein, State of the Art, Industrial Landscape and Patents 2001–2016. Frontiers in Microbiology, 6, p.1.
8. Ramage et al. The wood from the trees: The use of timber in construction, Renewable and Sustainable Energy Reviews, Volume 68, Part 1, 2017.

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Ricardo Ekmay, PhD, Arbiom's Animal Nutrition Director, has expertise in animal nutrition and new product development. Prior to his time at Arbiom, Ricardo spent several years with Dow AgroSciences, garnering experience in product development, regulatory affairs, and science policy advocacy with the commercialization of ProPound® canola and Enlist® soy/corn/cotton among others. Ricardo received his BS in Animal Science from Cornell University, and his MS and PhD in Poultry Science from the University of Arkansas. Ricardo returned to Cornell for completion of his post-doctoral studies. Ricardo has broad expertise in all facets of animal nutrition including both monogastric and ruminant animals, and has a strong passion for feed ingredient development and food systems. He is a member of the Poultry Science Association, American Society of Animal Science, and American Society for Nutrition where he serves as the industry representative to the Animal Nutrition Research Interest Group. His expertise has been sought after for task forces and working groups within Crop Life International and the International Life Science Institute. He also devotes his time to community outreach and the promotion of Science, Technology, Engineering and Mathematics (STEM) education, especially in the Hispanic-Latin community.

About Arbiom:

Arbiom is committed to meeting the sharp increase in global food and resource requirements with technology that transforms the most sustainable and readily available carbon source in the world – wood – into intermediate materials for a range of applications in the feed, food, and chemicals industries. Arbiom's technology platform integrates the company's proprietary enzyme technologies and biomass processing expertise to convert wood into food. Arbiom is partnering with biomass stakeholders and leading firms in aquaculture, biotechnology and bio-based industries to continue developing and scaling up its technology. Headquartered in Durham, North Carolina, Arbiom has offices in Paris, France, and Norton, Virginia, where it operates a pilot plant.

For more information, visit www.arbiom.com