Yeast a whimsical agent in the feed business Matilda Olstorpe

Yeasts are single-celled fungi that have been used for centuries for food or feed production. The usage of yeast most likely came before the development of written language as Egyptians were using yeast and the process of fermentation to produce alcoholic beverages and leaven bread over 5,000 years ago. In these processes, the yeast itself is not a primary product but rather a pawn in the production process. Yeasts may produce metabolites such as ketones, higher alcohols, organic acids, aldehydes and esters that alter the taste and structure of the product. In fermented animal feeds yeast is generally considered undesirable due to unwanted alcohol and carbon dioxide production in the feed. In addition, certain yeasts may confer off flavours and taints that reduce the feed palatability. However, yeasts can also inhibit mould growth, reduce the presence of *Enterobacteriaceae*, and increases the availability of phosphorus by degrading inositol hexaphosphate.

Yeast is an excellent source of protein, B vitamins, and minerals. Cultivated microbial biomass used as a protein product is referred to Single Cell Protein (SCP). The first purposeful SCP production originated in Germany during World War I, where *Saccharomyces cerevisiae* was grown on molasses for consumption. Later during World War II, *Cyberlindnera jadinii* was cultivated on different waste products from the paper industry and used as a protein source for both humans and animals. Microorganisms contain high levels of nucleic acid (NA) that may result in gout and kidney stone in humans if eaten in large quantities. In contrast, fish eat large quantities of microorganisms during a part of their life cycle and are thus adapted to metabolize high levels of NA. Currently, SCP is produced from many species of microorganisms, including algae, fungi and bacteria but is not utilized in any large degree due to political and economic issues.

The growing global human population and concomitant increase in the demand for animal protein in daily diets has raised new environmental and economic issues surrounding animal production. Moreover, from the background of hunger in some parts of the world ethical concerns if it is right to feed food grade agricultural products to animals obtain more consideration. This has lead to a resurgence of interest in using SCP as an alternative protein source, especially within aquaculture. Today, fish and soy meal are the dominant protein sources in commercial aqua-feeds. However, continued reliance on these protein sources is not sustainable since both fish and soy are also in demand for human consumption, and over-reliance on wild fish stocks will result in rapid decline in natural fish population without a sustainable management program.

Different yeast species have been evaluated for their growth capacity on various waste materials from industrial applications. The key to generating SCP for feed production is the optimal pairing of industrial residues to be used as substrate to the appropriate yeast species. The SCP production process must also be thoroughly optimised, as important parameters like protein content or proportion of unsaturated fatty acids can vary substantially depending on strain and cultivation conditions. For example, we have observed that protein content, an important parameter for feed quality, can decrease under certain conditions while the total biomass increased. In conclusion, animal production and especially aquaculture can be shifted from a competitor with human nutrition for food-grade resources to a net contributor of human food when the production basis can be changed towards utilization of residues with the help of microorganisms.