From plant wastes to sustainable aquafeeds: the Novacq™ case history

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ABSTRACT: Every year 20–30 million metric tonnes of fish, one-third of the global fish catch, is used to produce aquafeeds. This practice is unsustainable and a critical threat to the viability of the global aquafeed industry. Efforts to find alternatives that totally match or improve the cost-effectiveness and nutritional performance of wild fish products, while reducing the burden on the natural environment, have failed, until recently. Now, an innovation using natural marine microbial processes has achieved this goal – a world-first success, improving the sustainability and cost-effectiveness of aquafeeds. The technology uses natural marine microbial processes to bio-convert plant wastes, such as bagasse or rice straw, into a bioactive product (Novacq™) that improves the growth and health of farmed prawns and eliminates the need for any wild harvest fishmeal in prawn feeds. The technology is patented and in full-scale commercial production by several licensees in a number of countries. The development of Novacq™ (an abbreviation of 'novel aquafeed' ingredient) is an example of why we need to rethink the way we produce aquafeeds. We need to continue to learn from nature how to produce sustainable aquafeeds and industrialise these processes in cost-effective ways.

Keywords: plant waste, prawn feed, Novacq™

NovacqTM is a feed ingredient for use in sustainable aquaculture of prawns, developed by CSIRO over the last 12 years. Fittingly, Nigel Preston called the present case study a 'case history' because of the time and effort from a dedicated group of scientists it took to come into being. Novacq™ is the solution to a very important underlying global issue that has hampered the development of truly sustainable prawn aquafeeds.

In 2014 we reached approximately 160 million tonnes global seafood production. We have now achieved the major milestone of aquaculturing more seafood than is wild caught. This growth of seafood production is a trend that is likely to continue, because of the growing global population as well as an increasing demand for good quality nutrients from seafood. However, it is important to note that a lot of aquaculture is reliant on fish meal, which is produced from one-third of the total fisheries. This means there is a real need to find alternative sources, other than fishmeal, so we can sustain aquaculture growth for the next generations. Currently the aquaculture sector uses 73% of all fishmeal and 71% of all fish oil produced. The leftover fish oil is principally used by the nutraceutical industry as fish oil pills.

This is an edited transcript of Dr Simon's presentation, with some of the slides shown. The paper was co-authored by Nigel Preston (Director General, WorldFish, Penang) and Andrew Chalmers (Business Development and Commercial, CSIRO Agriculture, Canberra).

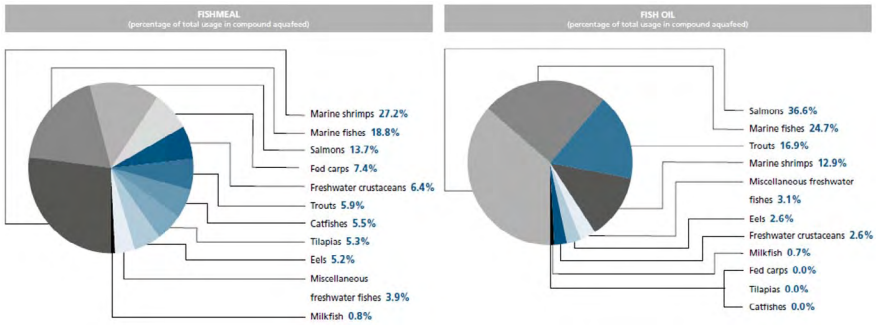

Figure 1. The use of wild harvest fishmeal and fish oil is most pronounced in higher value species such as salmon, other carnivorous marine fishes, and prawns. *Source*: FAO 2012.

As per Figure 1 (FAO 2012), aquaculturing marine shrimp uses almost 30% of the total fishmeal, and growing marine fish and salmon uses another 30% fishmeal. Salmonids use the bulk of the available fish oil however, with salmon and trout using more than 50% globally. Salmon, carnivorous marine fish and prawns are high-value species – and Australia produces all three.

Finding a substitute for wild fish products

There has been a lot of work aiming to replace the fishmeal in fish and prawn feeds, for example, using a range of alternatives mainly from terrestrial protein sources. Legumes and grains have been shown to be good substitutes for fishmeal, except that they lack some key micronutrients found in fishmeal. Furthermore, it can be argued that although using terrestrial crops to feed fish may be more sustainable than using fishmeal, it would be better to use crop by-products and the crop wastes instead, as these are a cheap and abundant source of carbon and do not use material that would otherwise be suitable for human consumption.

Prawns are one type of seafood that is disadvantaged by the lack of bioactive nutrients in plants used in aquafeed. Prawns in the oceans are a primary consumer of marine bacteria and plankton, which are dominant elements in the marine environment (Figure 2). The mass of bacteria and plankton in the oceans exceeds the total mass of all ocean-dwelling plants and animals – and marine bacterial processes are also dominant and vital parts of marine nutrient cycles.

Combining these ingredients, our CSIRO team has devised a way of using natural microbial processes to convert the waste carbon from crops into a novel bioactive aquafeed ingredient, which we have called Novacq™. The CSIRO process uses commonly used equipment and facilities (Figure 3). We take waste carbon from a source of solid or liquid waste, and add some specific micronutrients along with a source of nitrogen which can come from fertiliser. Converting these ingredients requires low-cost systems that are adaptable all around the world where prawn farming occurs. The CSIRO team started with small-scale tanks and moved into larger-scale ponds to produce greater quantities of Novacq™.

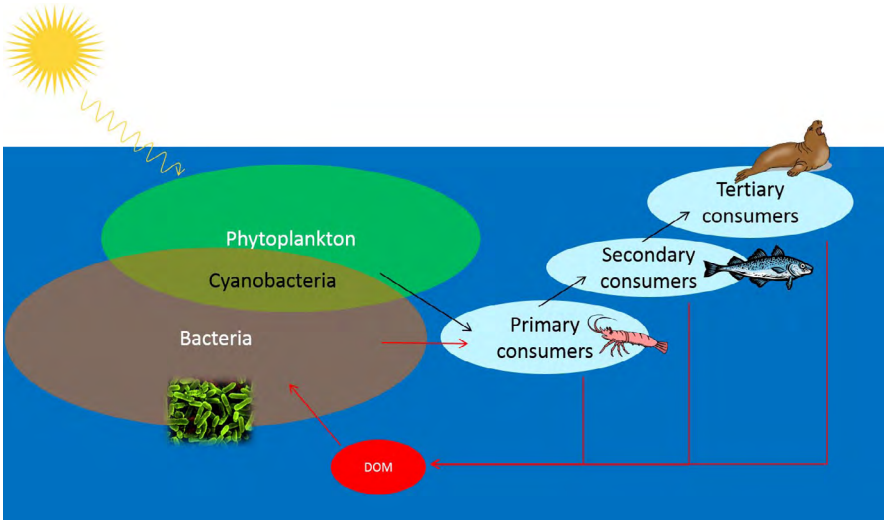

Figure 2. Marine microbial processes have a critical and dominant role in marine nutrient cycles.

We find Novacq™ has outstanding effects on the culture performance of prawns. With Novacq™ we have been able to improve prawn growth and health – and even to grow prawns without any fishmeal in their diet (Glencross *et al.* 2014).

The CSIRO team has also demonstrated that the growth benefits of Novacq™ remain in selectively bred prawns (Glencross *et al*. 2013). There have been several other experiments by CSIRO and more recently by Ridley Corporation, our Australian Novacq™ licensee that is actively involved in R&D, confirming outstanding improvements in growth rates in the order of 20–50% depending on the particular Novacq™ batch and feed formulation used.

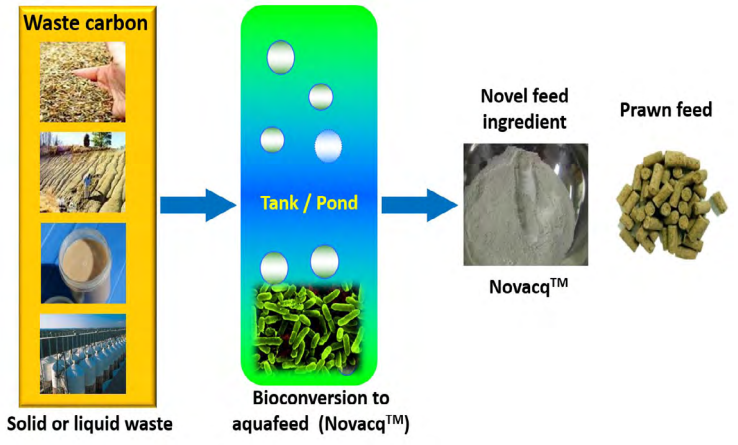

Figure 3. Novacq™ is a natural bioactive that improves the growth and health of farmed prawns and eliminates the need for any wild harvest fishmeal in prawn feeds.

The Novacq™ technology is adaptable everywhere prawn farming occurs, including in developing countries. CSIRO's aim is to facilitate the distribution of Novacq™ throughout the world, via our current licensing partners: one in each of Australia, China and Vietnam which can produce and sell Novacq™ exclusively in their respective territories. Ridley has multiple production and distribution territories including Australia, Thailand, Indonesia, Malaysia and the Philippines.

The global adoption of Novacq™ has the capacity to revolutionise feeds for cultured prawns, and potentially other commercially relevant crustaceans, while reducing the pressure on wild fish stocks.

Reference

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Cedric Simon is the Aquaculture Nutrition Leader for the Integrated Sustainable Aquaculture Production team, part of the CSIRO Agriculture and Food Business Unit. As a Senior Research Scientist, his role is to initiate, lead and contribute to a wide range of research projects which assess, review and analyse impacts of dietary changes on aquatic animal production. This is done within national and international settings and is integrated with complementary work in genetics, reproduction biology, aquatic animal health, environmental management and socio-economics. Cedric has broad research interests, including the digestive physiology and nutritional requirements of crustaceans, fish and molluscs, the non-invasive assessment of nutritional condition, feed additives, and sustainable aquafeed ingredients and formulation. He holds a PhD in Marine Science from the University of Auckland and a BSc in Aquaculture from James Cook University.

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