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**The Secretary,  
Select Committee on Youth Suicides in the NT,  
BPO Box 3721,  
Darwin 0801, Northern Territory.**

**September 3, 2011.**

**Dear Secretary,**

I most strongly suggest that the **Select Committee on Youth Suicides in the NT** considers the Omega-3 oil deficiency observed in about 2,000 suicidees being studied by officers of the United States Department of Defence.

I attended a CSIRO conference in Sydney in December 2009 focused on the emerging benefits of Omega-3 oils. Attendees were mostly scientists or medicos. One of the key invited speakers was a medico Captain from the US Department of Defence, who had studied blood samples collected from 2,000 or so suicidees who had served in combat situations in recent times. He was asked to try to make sense of it all.

**He reported in Sydney that the only common factor he had been able to identify was a complete deficiency of Omega-3 oil in ALL blood samples.**

It was a most surprising revelation to the Australian scientists and medicos attending the December 2009 event – and to me. When I, as a food industry technical journalist, afterwards asked the US officer for an on-the-record comment, he politely refused, because, he said, he had yet to report the matter to his superiors. The December 2010 revelations to his scientific colleagues in Australia had been “confidential background”.

I have respected this confidence. But I believe I can again contact this US officer, and submit another report to the **Select Committee on Youth Suicides in the NT**.

I would also recommend that the Select Committee studies, if it can, Omega-3 oil content in blood samples from NT suicidees – and perhaps from suicidees in other Australian States and Territories. There was a feeling in Sydney in 2009 that Australian suicidee’s blood samples might also show a complete deficiency of Omega-3 oil – and show possible cause.

**If all suicidees are very deficient in Omega-3 oil intake it would clearly indicate an urgent direction for food industry and medical research.**

Omega-3 deficiency in humans can be easily corrected by eating foods containing this oil in its EPA and DHA forms in fish oil. The best natural food containing Omega-3 is two Queensland native fish – Silver Perch and Jade Perch (formerly named Barcoo grunter). But Australian Barramundi fish could also be a good source of Omega-3 oil **if grown in future in via sound aquaculture or aquaponics in the Northern Territory.**

The Sydney conference in 2010 appeared to agree upon a general human intake of Omega-3 of around 900 international units a day for healthy people to correct a global deficiency among about 70% of all people.

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In 2009 my heart specialist recommended that I take 3,000 international units a day of Omega 3 oil. I currently consume (via fish oil tablets) about 4,000 international units a day. It has greatly improved my mental health. This kind of medical advice, now advancing world-wide, has led fish oil sales to burgeon, because Omega-3 fish oil is currently the current major source. However, a predicted huge decline in wild-catch fish around the world will quickly lead to a lack of supply of Omega-3 oil from natural sources.

Another problem being encountered by the world's fish oil producers is that the top-end feeders in the fish food chain are also showing up more carcinogenic chemicals as oceans and seas become more polluted. This means that much more of the world's fish oil is selling at around \$85/kg instead of the "pharmaceutical-grade price" of around \$165/kg.

But the investment opportunity these two problems represent for aquaculture and aquaponics has not escaped a number of key investors in algae farming. Algae can be the basic producers of much-favoured EPA and DHA types of Omega-3 oil. The fish at the top end of either fresh or salt-water food chains have, until now, been the easiest providers of Omega-3 oil for human foods. Vegetable ALA Omega-3 oil is much less favoured.

Salt water algae farming for Omega-3 is occurring fairly widely around the world, including in Western Australia. It is generally undertaken on large areas using sea water. But it still suffers "pollution problems" in the oil and protein produced.

Fresh-water algae farming – for a pharmaceutical-grade Omega-3 oil and protein – should be started in Australia in 2012 by a company named **Qponics Limited**, of which I am a founding director (see news release attached, on the company's development project with the University of Queensland).

I contend that urban-based aquaculture and aquaponics in homes, restaurants or other food-service installations, can upgrade fish feeding via algae farming relatively easily, so that many people can well-correct the global deficiency of Omega-3 in human diets.

Can this also take place with Australian aboriginal populations in the NT? I think that sound education about simple aquaculture and simple aquaponics might well-answer this question.

**Can a possible better intake of Omega-3 oil mean fewer aboriginal suicides in the NT? I cannot answer that question. But is well worth posing and keenly studying, because the global evidence much-favours a higher intake of Omega-3 in human diets to avoid many mental problems – particularly from the US Department of Defence studies of blood samples of 2,000 suicides.**

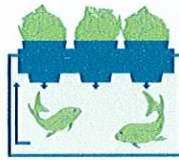
A number of my past reports are attached for your guidance. I will be happy to help with further evidence from the US Department of Defence if you wish that I try to obtain it.

Yours sincerely,

**Geoff Wilson,  
Director,  
Aquaponix Pty Ltd.,  
32 David Road,  
Holland Park 4121,  
Queensland.**

**Phones: 0412 622 779 or 07 3411 4524.  
Email: Wilson.geoff@optusnet.com.au**





**AQUAPONICS**  
Network Australia  
FOR HOBBYISTS AND EDUCATORS

## **Omega-3 fish oil will most help aquaponics**

**Aquaponics Journal, December 2009**

*By Geoff Wilson*

Omega-3 oils from fish and vegetables production via aquaponics are beginning to excite many scientists I meet.

They are well recognizing the world's food production problems now coming into clearer view as a result of the "peak oil" syndrome, the over-fishing of most of our seas, and the need to well consider more local food production using much-reduced supply lines and more local feed inputs.

Importantly, the focus of many scientists is identifying urban agriculture in its wider, total food production capability (which includes urban aquaculture and urban aquaponics).

Yet it is a world-wide phenomenon that seems to still be escaping the purview of most existing macro food producers. Perhaps they are thinking that ignoring the signposts is the less pleasant way of coping.

Whatever is the real problem, I find it heartening that the omega-3 oil story is emerging as a harbinger of better practice in aquaponics – where the important interaction of food fish and food plants makes the production of this healthy essential oil well integrated with common sense.

One of the scientists/educators I have much respect for in this is **Dr Mike Nichols**, a retired lecturer in hydroponics of Massey University, who is using his retirement to try to interest many fellow New Zealanders in setting up a New Zealand aquaponics group.

But Mike's transition from hydroponics expertise (a system that well uses artificial fertilizers and protected agriculture to good financial advantage), to less costly and more eco-friendly aquaponics, has been no less than enlightened discovery.

He wrote to me late last year about his recent study of the value of omega-3 oils from fish:

*" I have been giving a great deal of thought to aquaponics -- particularly with reference to the health giving properties of the correct source of Omega-3 -- the key fatty acid found in fish-- particularly oily fish. The difficulty is that the Omega-3 present in plant oils (eg hemsps seed, canola etc) is not quite the same as that found in the oily fish.*

*"That found in the oily fish is much more desirable, by a factor of at least five times.*

***"The Omega-3 found in oily fish is not, however, manufactured in the fish, but is derived directly from the plankton and phytoplankton that the fish consume (or from algae on land).***

*"Thus to have high levels of omega 3 on farmed fish it is necessary to feed the fish with fish meal (NOT land based plant derived foods) which means that with the current decimation of fish the oceans will run out inevitably there will be no more fish meal. Much of the health giving reasons for eating fish will then disappear.*

*"The answer must lie in developing sound methods of producing high omega 3 phytoplankton which can then be fed to fish. Perhaps one of the plant component of aquaponics might be to produce the phytoplankton to feed the fish, as the consumption of the correct Omega-3 appears to have such huge health advantages for humans".*

His final piece of interesting advice to me was: *"Have a look at [www.omega-3centre.com](http://www.omega-3centre.com)"*

What I found was that scientists are supporting a most interesting and enlightened action on Omega-3 education in Australia and New Zealand. The website is owned by The Omega-3 Centre (O3C), a not-for-profit health organisation promoting the benefits of long chain Omega-3 fatty acids. It was founded in 2006.

In its first two years the O3C says it has become a well-recognised and credible source of information on issues related to long chain Omega-3s.

*"Our activities include an annual scientific symposium, consensus workshops for members and consumer and healthcare practitioner media campaigns. These have helped to enhance the understanding of the role that long chain Omega-3s have on optimum health maintenance and disease prevention.*

A management committee of noted scientists determines the priorities and direction of the O3C, which is co-ordinated by the centre's Executive Director.

What has this to do with aquaponics ?

My answer to this question is:

**Potentially the Omega-3 Centre is a vital means of showing how the science and technology of food production focused on food value (in a number of contexts) can be expected to greatly shape what foods we will produce in future, for better health and for lower costs.**

Aquaponics is the food production technology with the most to gain from this important new way of judging the true value of what we eat.

Shamefully, at present the Omega-3 Centre in Australia has little or nothing much to do with aquaponics. Yet the centre's stated vision clearly supports the fish and vegetable combination that we understand aquaponics to be. The Centre says:

*"Our vision is to be recognised as the leading Australian and New Zealand authority on long-chain Omega-3s and their benefits for nutritional health by the media, health professionals, government, educators, seafood, food and complementary medicines organisations and ultimately the consuming public.*

*"The Omega-3 Centre is dedicated to improving the health status of Australians and New Zealanders by:*

- *Promoting optimal consumption of long chain Omega-3s;*
- *Championing a clear message differentiating shorter chain Omega-3s and long chain Omega-3s;*
- *Co-ordinating authoritative evidence-based advice to regulatory and health authorities;*

- *Supporting the development of the market for fish and seafood, healthy foods and dietary supplements containing long chain Omega-3s; and*
- *Facilitating and promoting research and development in this area*

The Omega-3 Centre says on its website:

"It is imperative that sound science underpins all communications from the Omega-3 Centre. To help keep the centre abreast with new research and regulations regarding long chain Omega-3s we have appointed five scientific advisers.

These are:

- **Prof Andy Sinclair**, Deakin University – Scientific Adviser, Research
- **Dr Laurence Eyres**, Auckland University – Scientific Adviser, Lipid Chemistry
- **Dr David Roberts**, formerly Australian Food & Grocery Council – Scientific Adviser, Policy & Regulatory Affairs
- **Dr Peter Nichols**, CSIRO – Scientific Adviser, Seafood
- **Ms Wendy Morgan** – Scientific Adviser, Nutrition

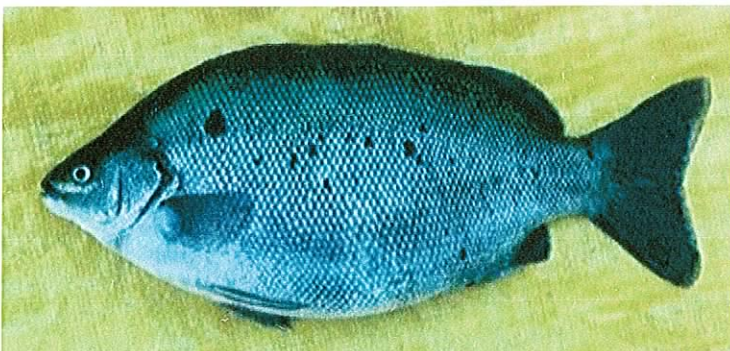
Australia's Omega-3 Centre is thus a major, unintended supporter for aquaponics producers to promote their specialized food-production technology because there are very close parallels in the aims of the noted food scientists and what aquaponics producers are trying to do.

Future aquaponics production around the world will be influenced by the Omega-3 story that is now very strongly being put by food science professionals, especially those trying to make better sense of food production in a world facing climate change problems and the tragedy of developed-country obesity epidemics.

Australia's strong scientific approach to promoting the Omega-3 story can be expected to trigger considerable me-too approaches around the world. Please write to "Aquaponics Journal" if you see in your country what Mike Nichols has observed in Australia and New Zealand.

*STORY ENDS*

*Geoff Wilson is a journalist and communicator in aquaponics, green roofs and walls and in urban agriculture. He contributes regularly to "Aquaponics Journal", but most of his current work is focused on green roofs, especially those moving towards aquaponics. He is a member of the Aquaculture Association of Queensland, and a former member of its management committee – representing aquaponics growers. See [www.ginalife.com](http://www.ginalife.com)*



*CAPTION: Jade perch, pictured above, is an Australian native fish species that has been developed as an important new aquaculture opportunity. Its next advance is most likely to be in aquaponics. The fish has the highest natural levels of Omega-3 oil in its flesh and carries stomach sacs of Omega-3 oil. Although a little too fatty for most non-Asian tastes Jade perch has found ready markets. It has also found acceptance in a number of other countries, especially throughout Asia. Its extraordinarily high omega-3 levels - 2,000 or more milligrams*

*per 100 grams of body weight - has made it a popular table fish in these countries. Most human-food fish with Omega-3 oil content has between 50 to 150 milligrams per 100 grams.*



# MEDIA RELEASE

Monday, June 6, 2011.

## NEW PARTNERSHIP PLANS TO SHAKE UP OMEGA-3 INDUSTRY

Brisbane-based Qponics Limited (ASSOB:QPO) today announced its partnership with UniQuest, the main research commercialisation arm of The University of Queensland, to launch into the high-growth, billion-dollar, global omega-3 oils market.

### **Qponics is developing a unique production system for quality organic DHA<sup>1</sup> and EPA<sup>2</sup> omega-3 oils.**

Responding to the market's 14 percent annual growth rate, the company plans to construct its first operational plant in the Camden area 60km south west of Sydney. This will integrate the cultivation of algae into a sustainable aquaculture-horticulture process.

With omega-3-incorporated products emerging as strong players in the functional foods sector, the \$US1.3 billion market for marine and algal oil ingredients has grown significantly to meet global consumption - which exceeds 70,000 tonnes per year.

There is rapidly increasing demand globally for DHA/EPA omega-3 oils. Deep-sea fish are presently the most common source but their numbers are in global decline, and most vegetarians around the world do not consume fish or fish oil. These factors signaled a major market opportunity for omega-3 oils produced from algae.

Qponics' CEO, Dr Graeme Barnett, says the research contract with The University of Queensland will provide a significant boost to the company's market entry.

"Because we will continuously farm the oil-producing algae, which are single-celled photosynthetic plants, there are no issues about sustainability and our omega-3 oil will be vegetarian-friendly," said Dr Barnett.

"Our aim is to sell ethically produced DHA/EPA omega-3 oils to a wider segment of the global market, which will present a more viable option both to companies that use omega-3 in their products and to end-consumers of products who are looking for quality, healthy alternatives to fish-based products."

DHA and EPA Omega-3 oils are essential in healthy brain development; however, studies in Western countries indicate most adults and over 70% of children may be deficient in these oils.

"The University of Queensland is one of Australia's most prestigious universities and is recognised around the world for its high-quality research," Dr Barnett says.

"Utilising the excellent resources available at the University has been a strategic decision by Qponics to accelerate the development of our DHA/EPA omega-3 oil products."

Associate Professor Peer Schenk from UQ's School of Agriculture and Food Science says the joint research will help provide a product with major health benefits.

"Consumer demand is increasing for omega-3 oils rich in DHA and EPA as a nutritional supplement to prevent various neurological, cardiovascular and degenerative diseases," says Associate Professor Schenk.

"My team is working with Qponics to develop a renewable source of organic omega-3 fatty acids, particularly for vegetarians, infants and pregnant women, as an alternative to traditional plant and fish-based sources, like flaxseed and Atlantic salmon.

"Our research involves collecting Australian algae strains from various freshwater environments and examining conditions for growth optimisation with a selection of potentially high quality oils.

"It's an excellent opportunity for the University to work with emerging industries on developing a quality product that aims to make a positive difference to the health of consumers."

## **ENDS**

1. DHA = Docosahexaenoic acid; 2. EPA = Eicosapentaenoic acid

**About UniQuest:** Established by The University of Queensland in 1984, UniQuest is widely recognised as one of Australia's largest and most successful university commercialisation groups. With more than 80 staff and group revenues exceeding \$320 million in the past five years, the company is also benchmarked in the top tier of technology transfer worldwide. From an intellectual property portfolio of 1,500+ patents it has created over 60 companies, and since 2000 UniQuest and its start-ups have raised more than \$400 million to take university technologies to market. Annual sales of products using UQ technology and licensed by UniQuest have passed \$5.2 billion. UniQuest now commercialises innovations developed at The University of Queensland and its commercialisation partner institutions: the University of Wollongong, University of Technology Sydney, James Cook University, University of Tasmania, Mater Medical Research Institute, and Queensland Health. UniQuest also provides access to an expansive and exclusive network of independent academics to tailor a consulting or project R&D solution to meet the diverse needs of industry and government, facilitating some 500 consulting, expert opinion, testing, and contract research services each year. UniQuest is also a leading Australasian provider of international development assistance recognised for excellence in technical leadership, management and research. Working with agencies such as AusAID, NZAID, the Asian Development Bank and the World Bank, UniQuest has developed and implemented more than 400 projects in 46 countries throughout the Pacific, South-East Asia, the Indian sub-continent and Africa. For more information about UniQuest, please visit [www.uniquest.com.au](http://www.uniquest.com.au).

**About Qponics (ASSOB:QPO):** Qponics Limited was founded as a private company in 2009 and presently operates out of the Start Innovation Centre, at the Brisbane Technology Park, Brisbane, Australia. In January 2011, Qponics became a public unlisted Australian company incorporated in Queensland, as the Company prepared to gain admission onto the Australian Small Scale Offerings Board (ASSOB). The Company's business philosophy is centred on the concept of ethical, organic and sustainable production from algae of high quality omega-3 oils in urban and semi-rural settings to ensure proximity to markets and distribution channels. Its aim is to operate algal photo-bioreactors integrated into an ecologically balanced aquaculture-horticulture system for the production of omega-3 oils to ensure that operations eliminate environmental pollution and minimise carbon emissions and water consumption. The use of the term "organic" as a descriptive for Qponics' algae oil products and algae oil production processes are subject to the Company, at a future time, applying for and being successful in gaining organic certification for its products and processes. For more information about Qponics, please visit [www.qponics.com](http://www.qponics.com) and [www.assob.com.au/QPO](http://www.assob.com.au/QPO).

**Qponics Limited, ABN 84 149 001 678**

**30b McKechnie Drive, Brisbane Technology Park, Eight Mile Plains,  
Brisbane, QLD 4113, Australia.**

## **Media enquiries:**

**Qponics:** James Blaxland on +61 (0)439 860 521 or [james@zakazukha.com](mailto:james@zakazukha.com)

**UniQuest:** Leanne Wyvill on +61 (0)7 3365 4037, +61 (0)409 767 199 or [l.wyvill@uniquest.com.au](mailto:l.wyvill@uniquest.com.au)

SPECIAL EDITION: OMEGA-3

## All-conquering omega-3 market set for further growth

By Stephen Daniells, 18-Aug-2011

Related topics: Nutritional lipids and oils, Bone & joint health, Cardiovascular health, Cognitive and mental function, Consumer Trends, Omega-3

**The market for omega-3 food, beverage and supplements in the US is over \$5 billion with saturation point nowhere in sight, but how does the market break down, what are the up-and-coming sources, and where will we go in future?**

In the first part of our special series on omega-3, NutraIngredients looks at the state of the omega-3 market, recently valued at almost \$8 billion (€5.57 billion) by Packaged Facts.

According to the new report, the market grew 17% from 2009 and such growth is predicted to continue, said the market researcher.

The US dominates with sales of \$4bn (€2.78bn) in foods and drinks compared to \$1.3bn (€900m) for dietary supplements, with much of the food and beverage figure accounted for by omega-3 fortified infant foods and formulas.

The US food and beverage sector is expected to grow 14.4% annually between 2006 and 2014, compared to 18% growth in the US supplements sector.

### Saturation a long way off

Impressive growth is predicted to continue, said Packaged Facts. This was supported by Adam Ismail, executive director of the Global Organization for EPA and DHA Omega-3s (GOED).

Speaking to NutraIngredients-USA, Ismail said: *"We do agree that we are only at the beginning of this market. There is still too much of the world's population with insufficient intakes, and too much supportive science to deny that they are necessary nutrients.*

*"Growth in developed countries has shown that EPA and DHA can be accessible to almost everyone, so there is no reason that we cannot get to the point where almost everyone in the world is getting sufficient intakes through their diet."*

Ismail noted that the fastest growing markets are to be found in Asia, and they are growing almost three times as fast as North American and Western European markets.

*"It is also the market where the most rapid functional food development is taking place...despite low per capita incomes,"* he added.

### The ingredients

The main omega-3 fatty acids present on the market consist of the marine sourced eicosapentaenoic acid (EPA, C20:5 n-3) and docosahexaenoic acid (DHA, C22:6 n-3) and alpha-linolenic acid (ALA, C18:3 n-3) from plants like flax.

The supply of EPA and DHA is dominated by the fish oil players. According to GOED, the market is led by companies such as Nissui, Pronova, Ocean Nutrition Canada, Epax, Denomega, Croda, Cognis (BASF), and Omega Protein.

Fish oil represented about 80% of the 2010 global market of omega-3 for human consumption, said Packaged Facts, with 75% of this used in dietary supplements.

Alternate sources are making inroads into the market, however, with krill oil increasingly grabbing headlines. The main krill oil suppliers include Neptune Technologies and Bioresources, Aker BioMarine, and Enzymotec.

Packaged Facts is predicting that krill *"will be an important player in coming years within the supplements segment as more scientific studies support the health boosting properties of krill"*.

This is not to say that krill is limited to supplements, with both Aker and Neptune offering ingredients with GRAS (generally recognized as safe) status for use in food and beverages.

Algae-sourced omega-3s are also blooming, with the market having seen a number of new entrants in recent months. Previously dominated by Martek (now DSM Nutritional), suppliers now offering algae-derived omega-3s include Aurora Algae (EPA only), Avesthagen (DHA only), and Algae Biosciences Corp. (EPA and DHA).

GOED's Adam Ismail said that growth of these new sources is actually on top of fish oil sales still.

*"However, aside from krill oils, not many of them have made it to market yet,"* said Ismail.

*"It remains to be seen what will happen when they do get launched, but I suspect they will continue to be on top of fish oil sales instead of cannibalizing them because there are enough new consumers coming into the omega-3 market worldwide that all sources are needed to supply the demand."*

Another marine source of the ingredient is the New Zealand green lipped muscle, ranked among the top 'eco-friendly seafoods' according to the US environmental agency Blue Ocean Institute's list. The most well-known of these is Lyprinol marketed by Pharmalink.

## **Plants**

Think plant sourced omega-3 and the thought is ALA. Much attention has been paid to the conversion of ALA to the longer chain EPA, with many stating that this conversion is very small. Indeed, between 8 and 20 per cent of ALA is reportedly converted to EPA in humans, and between 0.5 and 9 per cent of ALA is converted to DHA.

In addition, the gender plays an important role with women of reproductive age reportedly converting ALA to EPA at a 2.5-fold greater rate than healthy men.

According to Packaged Facts: *"The rapid growth in ALA products speaks to consumer receptivity to non-marine sourced omega-3s that can be easily incorporated into their daily meal and snack times."*

*"For the foreseeable future, nonetheless, DHA/EPA introductions should continue to outnumber ALA introductions, due to the far more extensive documentation of benefits of potential benefits of DHA omega-3s in relation to health concerns."*

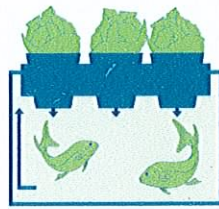
In recent years the race has been on find a way to source EPA and DHA directly from plants for human use. Solae and Monsanto teamed up in 2007 to commercialise the latter's soybean variety developed specially to be rich in SDA. The rate of conversion of SDA to EPA is understood to be comparatively efficient - between 5.5:1 and 6:1.

Genetic engineering of plants is also being pursued by DuPont and BASF.

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**AQUAPONICS**  
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## **Aquaponics definition:**

### **From Wikipedia, the free encyclopedia**

***Aquaponics is the symbiotic cultivation of plants and aquatic animals in a recirculating environment.*** Aquatic animal\_effluent (for example fish waste) accumulates in water as a by-product of keeping them in a closed system or tank (for example a recirculating aquaculture system). The effluent-rich water becomes high in plant nutrients but this is correspondingly toxic to the aquatic animal. Plants are grown in a way (for example a hydroponic system) that enables them to utilize the nutrient-rich water. The plants take up the nutrients, reducing or eliminating the water's toxicity for the aquatic animal. The water, now clean, is returned to the aquatic animal environment and the cycle continues. Aquaponic systems do not discharge or exchange water. The systems rely on the natural relationship between the aquatic animals and the plants to maintain the environment. Water is only added to replace water loss from absorption by the plants or evaporation into the air. Aquaponic systems vary in size from small indoor units to large commercial units. They can use fresh or salt water depending on the type of aquatic animal and vegetation.

### **Addition by Geoff Wilson, Director, Aquaponics Network Australia:**

**Integrated Urban Aquaponics** is an advanced form of fresh food production expected to expand rapidly in Queensland now that LED-lit aquaponics is being developed (using **L**ight **E**mitting **D**iodes that provide low cost energy from solar power collectors). The major input is natural fish feed. Plants feed off the fish wastes – which are converted by microbes into plant food. Refreshed water goes back to the fish tank. This means that “organic” human foods can be produced in water-based systems rather than just soil-based systems – greatly reducing the use of water.

Future LED-lit aquaponics systems in Brisbane will be “protected cropping” next to home kitchens or restaurants. They are expected to have little more water use than that contained in the fresh fish, fresh vegetables and fresh fruit. This is because of adoption into the aquaponics technology of a new Australian innovation – solar-powered air moisture harvesting. This condenses external or internal air moisture at a lower cost than supply of municipal water. Solar power supply will be provided for water pumping, lighting and water heating. Fish feeds will be provided from recycling of clean, urban organic matter – so such wastes do not go to municipal waste dumps to create methane gas production. Methane is a “greenhouse” gas 21 times worse than carbon dioxide in global warming effects.

**Future integrated urban aquaponics will closely mimic Mother Nature”** - to reduce water use, to minimise energy use, to effectively use solar energy for low-cost food production based on air moisture, and to recycle clean urban organic matter for very effective provision of organic food – and to reduce the overall carbon footprint in homes and commercial buildings.

## History:

Aquaponics began at least several thousand years ago in Asia when fish and other aquatic animals were grown in conjunction with rice.

The ancient Aztecs had a "chinampa" system that merged fish culture with plant culture on floating islands and fish culture in the water. It is still observable in Mexico City. The early Egyptians were also reported to have simple aquaponic systems based on Nile waters.

But in the 1980s a dozen or more universities and non-profit organisations in North America upgraded Chinese and Aztec ideas for home-based food production that would help combat food supply problems of atomic warfare – where "protected cropping" using fish and plants would be named aquaponics - combining **aqua**culture and hydro**ponics** technologies.

Aquaponics was judged to be the best "backyard" food production system that provided reasonable security from atomic wastes in air and water. "Protected cropping" in buildings were the major advance.

North America now has about 1,000 high schools successfully using simple aquaponics to better teach science, maths and other subjects. Students learn to grow healthy fresh food at home in small spaces – and can use vermiculture, algae-culture and insect culture to produce high-protein fish feeds of various kinds from clean organic wastes.

The technology is now being adapted at Whites Hill State College in Brisbane, Queensland, Australia, for its lower-cost approach to securing on-site, healthy, fresh, organic food production in cities.



### **Home-based aquaponics**

**These two pictures show the well-adapted home aquaponics of a Western Australian executive who loves the production of healthy, fresh organic food (fish, vegetables, fruits and herbs) based on modern aquaculture and horticulture.**

**Food plants are grown in waist-high containers using heat-fired clay particles as substrate.**

**Fish are grown underground to keep water at reasonable temperature, and to protect children from accidents.**