

The Good Oil

MARCH 2020

Microencapsulated tuna oil achieves higher DHA absorption in toddlers



A new toddler study into the absorption of docosahexaenoic acid (DHA), which is important for the growth and functional development of infant brains, has shown that microencapsulated tuna oil was absorbed at a greater rate than unencapsulated high DHA fish oil.

To investigate the bioavailability of DHA in healthy toddlers, Clover Corporation's Research and Development team collaborated with the Universiti Putra Malaysia on a study comparing one-month supplementation with high DHA tuna oil versus two microencapsulated Omega-3 DHA formulations (dairy-based Driphorm® HiDHA® 50 and hypoallergenic Driphorm®HA HiDHA® 30).

"With leading international scientists confirming the importance of DHA in brain and visual acuity development during foetal and early postnatal life, a newly released directive under the European Commission stipulates DHA as a mandatory ingredient in infant formula," says Samaneh Ghasemi Fard, Nu-Mega's R&D Technologist and Research Liaison Officer, who coordinated this study.

DHA lower than recommended levels

"This poses challenges to manufacturers in preserving the stability and bioavailability of DHA at levels akin to human breast milk.

"The current median of estimated DHA intakes in toddlers in most countries is lower than recommended levels," Dr Ghasemi Fard says.

Sixty toddlers were randomly allocated to four groups:

1. Unfortified formula;

2. Unfortified formula plus high DHA tuna oil;

3. Fortified formula with dairy-based microencapsulated high DHA tuna oil powder;

4. Fortified formula with allergenic-free microencapsulated high DHA tuna oil powder.

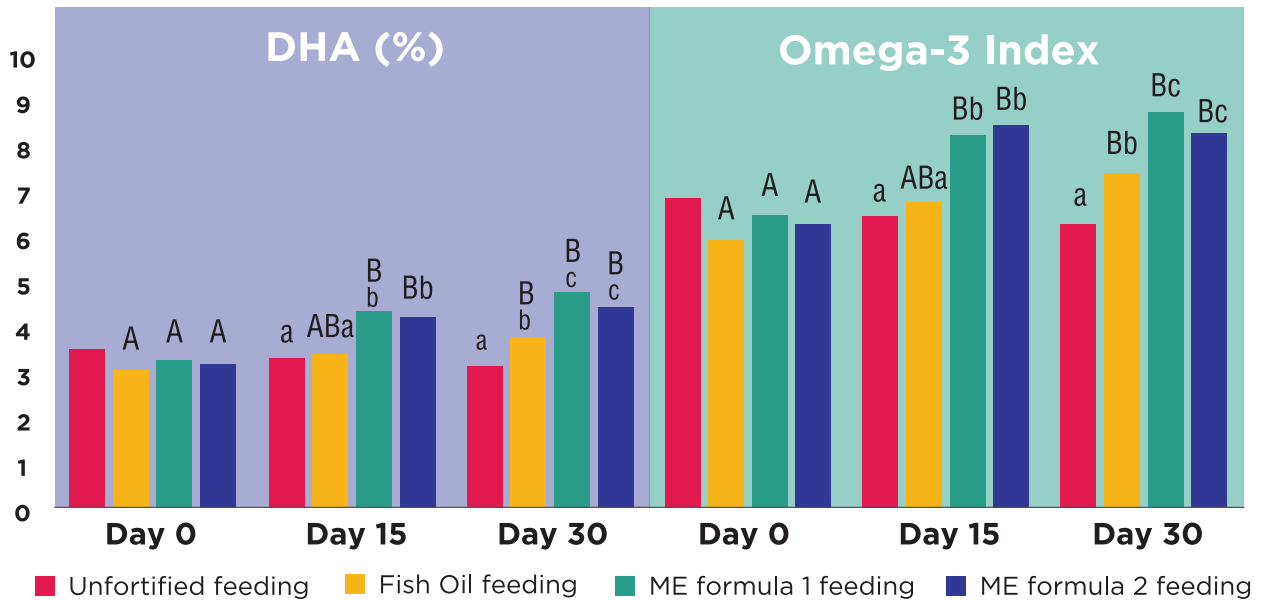
Bioavailability was assessed from both blood and faecal fatty acid levels. The results showed an enhanced bioavailability with significantly greater concentrations of blood DHA levels in the two formulas fortified with the microencapsulated HiDHA® tuna oil powders.

The average Omega-3 Index (EPA plus DHA percentage, relative to total fatty acids, in red blood cells) in Malaysian toddlers is 6.5%. After two weeks of supplementation during the study, toddlers receiving microencapsulated fish oil had an average Omega-3 Index of 8.8%. Those who did not receive microencapsulated fish oil had an Omega-3 Index of 6.8% at the end of the study. Omega-3 Index is an indicator of long-term bioavailability as well as a good indicator of the incorporation of fatty acids into tissues, Dr Ghasemi Fard says.

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DHA (%) and Omega-3 Index in toddlers fed different formulas at different time points



Values with lowercase different letters differ significantly for formulas.

Values with uppercase different letters differ significantly for time ($p < 0.05$). ME= microencapsulated.

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The study also assessed the effect of DHA supplementation on children's sleep and cry patterns, but found there were no significant effects. Some earlier studies have showed an association between sleep disorders and low DHA in children aged 7-9 years.

Improved absorption of tuna oil

"Microencapsulated high DHA fish oil provides an effective way of delivering DHA and EPA, as it enables the incorporation of fish oil into a wide range of food products without affecting palatability. It also extends the stability of the oil," Dr Ghasemi Fard says.

"The higher blood DHA level in the toddlers might be due to the improved digestion and absorption of tuna oil due to smaller oil droplet size, and to the effective protection of the oil encapsulate against negative conditions, such as pH or pro-oxidising substances in the gastrointestinal system of the toddlers."

The full research paper was accepted and published on 18th January 2020 by the Nutrients Journal with high Impact Factor of 4.171. It can be found at: <https://www.mdpi.com/2072-6643/12/1/248>





DHA levels in infant formula set to double in Europe and China

Average DHA levels in infant formula products in Europe will need to at least double to meet the minimum DHA level requirement under a new EU regulation, according to Nu-Mega Ingredients' estimates.

"We have undertaken a market assessment of the previous DHA fortification levels in Europe, and estimate that average DHA levels fall well short of the new EU Infant formula regulation (EU 2016/127) minimum fortification level that is to be enforced from February 2020," says Glenn Elliott, Nu-Mega's Research, Quality and Regulatory Manager.

Under this regulation, DHA becomes a mandatory ingredient at a minimum of 20mg/100kcal (and up to a maximum of 50mg/100 kcal) in 0-12 month infant formula products sold within the European Union.

China raises the bar on DHA levels

"The Chinese are also following the lead of the EU regarding raising the bar on minimum DHA fortification levels. In October 2018 the National Health Commission (NHC) in China released draft standards for infant formula where minimum DHA fortification levels of 15mg/100kcal (and up to a maximum of 40mg/100kcal) in 0-12 month infant formula products will be required if DHA is added to infant formula," Mr Elliott says.

"Again, based on Nu-Mega's market assessment of the DHA fortification levels within current infant formula products in China, we estimate that on average the DHA levels will need to be increased by 50% just to meet the minimum DHA level requirement under the forthcoming regulatory standards.

"These upcoming regulatory changes requiring an increase to the minimum DHA levels in infant formula presents a significant opportunity for Nu-Mega's HiDHA® Driphorm® micro-encapsulated infant grade powders."



Vegan and allergen-free high DHA powders the latest product launches from Nu-Mega Ingredients

Nu-Mega Ingredients continues to innovate in the high DHA encapsulated powder segment, with a new vegan product containing no dairy or animal derivatives to cater for the fast-growing vegan market. Nu-Mega have also launched a high fish DHA powder with no milk allergens.

"Both the true vegan product, Driphorm HA DHA-S 200, and the zero allergen product, Driphorm HA HiDHA 300, are three times more potent than other powders on the market," says Bassam Hallak, Nu-Mega's Global Business Manager.

"There is a lot of competition in this sector, but the potency of these powders makes them unique."

Growing international demand

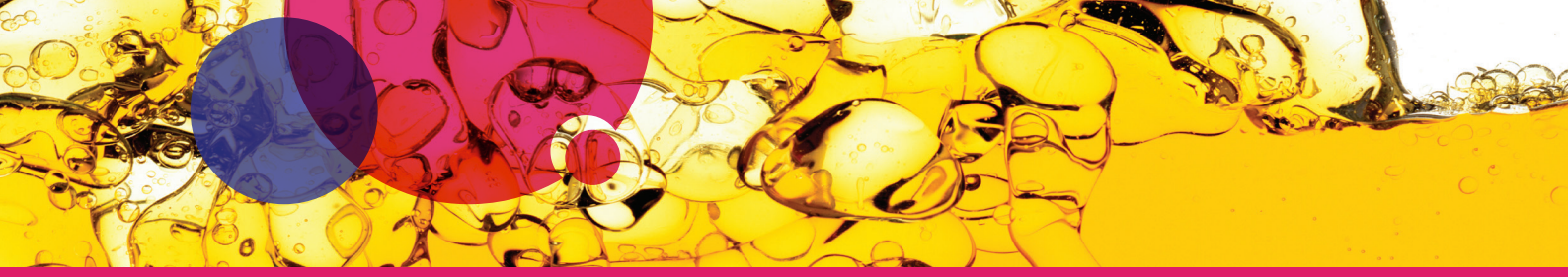
Both products can be used in bars, powders, gummies and pressed tablets.

The **new product developments** are in response to growing demand in the USA, Europe, Asia, Australia and New Zealand.

Nu-Mega's attendance in recent years at major trade shows, including Supply Side West and Vita Foods Europe, has given the company valuable insights into market trends, which have translated into new product developments.

These have included the earlier product launches of Driphorm® HiDHA® 360 (an ultra-high DHA powder), hypoallergenic DHA and ARA products, and a vegan DHA powder.

The company's client base in the USA and European markets has increased dramatically in the past few years, and the product range has more than tripled in the past three years. ■



Amongst the leading speakers at the 3rd AAOCS Infant Nutrition Workshop were (left to right) Dr Kirill Lagutin, Callaghan Innovation; Dr Anders Henriksson, DuPont products; Jan Carey, CEO of the Infant Nutrition Council, Dr Samaneh Ghasemi Fard, Nu-Mega R&D Technologist and Research Liaison Officer; Professor Peter Howe, The University of Newcastle; Dr Lourdes Urban-Alandete, Nu-Mega R&D Technologist; Associate Professor Michael Skilton, University of Sydney; Professor Andrew Sinclair, Monash University; Dr Flávia Fayet-Moore, CEO of Nutrition Research Australia; Professor Barbara Meyer, University of Wollongong; Professort Trevor Mori, the University of Western Australia.

Leading scientific speakers emphasise importance of nutrients including DHA during Infant Nutrition Workshop

The annual Australasian Section of the American Oil Chemists' Society (AAOCS) Infant Nutrition Workshop is one of the few meeting opportunities that focuses exclusively on lipid nutrition. It brings together key nutritionists, nutrition-related researchers and manufacturers for robust discussion and to examine possible collaborations.

The third annual workshop, held during the World Congress on Oils and Fats in Sydney last month, highlighted the most recent research in this field. Session topics covered both conventional and emerging topics, from prenatal nutrition to infancy and early life nutrition. The workshop culminated in a major discussion around guiding infant nutrition-related research in the future, infant formula structure based on human milk and regulations.

Professor Maria Makrides from the South Australian Health and Medical Research Institute (SAHMRI) presented data on Omega-3 fats in prenatal nutrition. She highlighted that women with singleton pregnancies and a low Omega-3 status (less than 4.1% of total fatty acids in whole blood) in early pregnancy are at higher risk of early preterm birth and most likely to benefit from Omega-3 supplementation to reduce this risk.

DHA an essential fatty acid

Infants have the greatest need for docosahexaenoic acid (DHA). Professor Andrew Sinclair from Monash University stated that dietary Omega-3 deficiency results in changes in learning, coping with stress, behavioral changes and responses in visual function. Also, DHA is an essential fatty acid for optimal neuronal function.

DHA is transferred to infants through the placenta, and later through breast milk. Therefore it is essential that mothers have sufficient DHA in their diets. For mothers who do not eat enough oily fish such as salmon, trout and tuna every day, high DHA fish oil supplements are necessary.

For infants born from mothers with a low level of Omega-3 during pregnancy, DHA-enriched infant formula is suggested, Nu-Mega's Dr Ghasemi Fard said. However, based on the recent data published by Professor Makrides, supplementing women with a baseline Omega-3 status above 4.9% of total fatty acids in whole blood increased the early preterm birth.

Professor Barbara Meyer from the University of Wollongong talked about transport of DHA and arachidonic acid (AA) during pregnancy and postpartum. She stated that high-density lipoprotein (HDL) is the main lipoprotein that transports DHA and AA. Also, she observed that DHA is carried primarily in HDL, because HDL has important antioxidant properties that may protect DHA from oxidation in transit.



High EPA and DHA intake can reduce hypertension

Professor Michael Skilton from the University of Sydney said that early childhood nutrition can maximize cardiovascular health: a high intake of eicosapentaenoic acid (EPA) and DHA can decrease the prevalence of hypertension by 5%.

Professor Trevor Mori from the University of Western Australia also stated that both maternal and infancy studies highlighted the benefits of Omega-3 fatty acid supplementation on heart rate and insulin resistance in children between five and 12 years old.

Jan Carey, CEO of the Infant Nutrition Council, said they promote optimal infant nutrition by supporting the proper use of breast milk substitute and toddler milk drinks. She also stated that the fat component in infant formula, which can contain fish oil, is set by regulations for providing energy to an infant as well as supporting an infant's normal growth and development.

Challenges to manufacturers

Dr Lourdes Urban-Alandete from Nu-Mega Ingredients highlighted some challenges for industry to deliver high DHA-fortified food, beverages and supplements. These include: manufacturers formulating DHA dosage levels beyond the current source, targeting higher DHA dosages per serve and the impact of processing conditions on oxidative/sensory qualities. She stated that DHA has become a mandatory ingredient in infant formula, and DHA fortification levels in food and beverages have significantly increased. As a result, demand for this ingredient is increasing.

Dr Emmett Chua from Bunge Lodgers Croklaan and Dr Kirill Lagutin from Callaghan Innovation discussed structured lipid in infant nutrition, and how the lipid composition in infant formula needs to be similar to human milk (especially in triglyceride composition).

50% reduction in eczema

Dr Anders Henriksson from DuPont Nutrition and Biosciences discussed a unique range of oligosaccharides found in human milk. He explained that these oligosaccharides are highly bifidogenic and can promote a group of bifidobacterial that typically colonise infants. He also reported that consumption of Lactobacillus Rhamnosus during pregnancy and by babies after birth resulted in a reduction of about 50% of eczema prevalence.

Finally, Flavia Fayet-Moore, CEO of Nutrition Research Australia, discussed the importance of childcare and nurseries. Children in their initial 1000 days of life spend approximately five out of seven days in childcare, therefore

more than half of their daily food intake comes from these facilities. This can have a huge influence to their eating habits.

Key objectives need to be followed in these nurseries: fulfilling children's micronutrient needs and providing a variety of vegetables, food and textures for them. Modifying a child's diet by adding vegetables to every meal, increasing plant-based food and beverages, removing processed meats and adding whole grains as well as high fibre foods, can have long term positive effects on their diet. ■



Nu-Mega presented Student Awards at the 3rd AAOCS Infant Nutrition Workshop. Pictured (left to right) Dr Matt Miller, AAOCS President; recipients Julia Kuszewski, The University of Newcastle and Mitra Nosratpour, Monash University; Dr Samaneh Ghasemi Fard, Nu-Mega R&D Technologist and Research Liaison Officer.

The Nu-Mega Student Award Recipients

The Nu-Mega Student Awards assisted two local students attend the World Congress on Oils and Fats (WCOF) in Sydney last month. This award gave students the opportunity to present their research, meet leaders in the field, develop their skills and learn more about their field, Nu-Mega's Dr Samaneh Ghasemi Fard says.

The Nu-Mega Student Travel Award Recipients were Mitra Nosratpour from Monash University and Julia Kuszewski from University of Newcastle. They received their prizes of \$500 and a certificate at the WCOF in Sydney after they presented their works.

Mitra's work on "Characterization of thermal and structural behaviour of high DHA fish oil with milkfat in spray chilling conditions" was an insightful area of research on the effectiveness and use of spray chilling with different oils and fats.

Julia's work with high DHA fish oil supplementation can offer a potential approach to counteract cognitive decline by improving circulatory function in overweight/obese older adults.



Pictured above: Professor Peter Howe

Leading Australian scientist reviews - 30 years of DHA health developments

Professor Peter Howe is Emeritus Professor in the School of Biomedical Sciences and Pharmacy and Convenor of the Clinical Nutrition Research Centre, based at the University of Newcastle, NSW. He also holds honorary/adjunct professorial appointments at the University of Southern Queensland, the University of South Australia and the University of Adelaide.

He chairs the Therapeutic Goods Administration's Advisory Committee for Complementary Medicines and was a member of the ERA Medical and Health Sciences Research Evaluation Committee in 2015 and 2018. He is a registered nutritionist and a Fellow of the Nutrition Society of Australia and was founding Editor-in-Chief of the open access journal Nutrients. For this article he spoke with Dr Samaneh Fard, Clover Corp's R&D Technologist and Research Liaison Officer.

Ongoing research into the health benefits of high DHA in babies, children and adults has resulted in many new product developments internationally and in new regulations in Europe and China covering DHA in infant formula.

Recent publications including review paper by Fard et al (2018) showed important physiological functions of DHA, which differ to those of EPA, in the heart and cardiovascular system, the brain, visual function, inflammation and immune function.

However, research into the benefits of DHA-rich fish oil goes back at least 30 years, when Professor Peter Howe was working in the CSIRO Division of Human Nutrition in the mid-1980s.

"There was growing interest in fish oil from the heart health perspective. I was doing research on nutritional influences in pathogenesis of hypertension in an experimental model, the spontaneously hypertensive rat, and was keen to look at the impact of fish oil supplementation," Professor Howe says.

"At that stage, there was even a question mark as to whether the effects of fish oil were directly attributable

to Omega-3 fatty acids (n-3 FAs) or whether some physicochemical property of the oil might account for thinning of blood or other influences on the circulation."

Professor Howe's colleague Professor Peter McLennan, then a post-doctoral scientist, was doing independent studies at CSIRO with Professor John Charnock on the effect of dietary oils, including fish oil, on cardiac function, especially regulation of cardiac rhythm.

Fish oil lowered blood pressure

"My focus was on blood pressure regulation and the role of sympathetic nerves and vasoconstriction in the development of hypertension. It became apparent to me that fish oil was not only having antithrombotic (blood-thinning) and antiarrhythmic effects, but it was able to lower blood pressure in animal models by relaxing blood vessels."

Some of Professor Howe's earliest published work in the spontaneously hypertensive rat model indicated that the blood pressure lowering effect of fish oil was most prominent when sodium intake was restricted.

He subsequently confirmed this in a double-blind,



randomised, placebo-controlled clinical trial which evaluated the antihypertensive effects of fish oil supplementation, with and without concomitant restriction of sodium intake.

This unique study not only confirmed the antihypertensive benefits of fish oil but also revealed a synergistic influence of sodium restriction on the reduction of diastolic blood pressure.

He only regrets that this promising approach to the prevention of hypertension has not been pursued in subsequent clinical trials and that salt intake is not even considered as a confounder in major trials designed to evaluate cardiovascular benefits of fish oil supplementation.

Cardiovascular protective benefits of DHA

Professor Howe then went on to do further research in animal models, feeding synthetic diets enriched in purified EPA or DHA, which showed that, quite independent of any blood pressure reduction, the n-3 FAs (particularly DHA) protected against target organ damage in spontaneously hypertensive and stroke-prone rats.

They were living longer, there was no evidence of stroke and their heart and kidney function appeared to be improved. Professors Howe and McLennan then collaborated to fully characterise the protective benefits of a DHA-rich diet on the heart.

“At the same time, I was conducting human trials and I got some support from Clover Corp to do a trial with their



DHA-rich tuna oil which confirmed the benefits of n-3 FA on lipids in terms of TAG lowering. We also looked at the production of thromboxane and TNF-a, which showed a significant improvement.

“Until that time, most fish oil used in clinical trials was being sourced from North Atlantic fish which are rich in EPA so, not surprisingly, the benefits of fish oil supplementation were being attributed to EPA. Indeed William (Bill) Harris published a paper in 1996 declaring that EPA was primarily responsible for the TAG-lowering effect of fish oil.”

Professor Howe presented his study results at the 3rd ISSFAL (International Society for the Study of Fatty Acids and Lipids) meeting in France in 1998. “In our study, we did a direct comparison of Clover Corp’s high-DHA tuna oil with an EPA-rich fish oil and we showed for the first time that the equivalent dosage of n-3 FA from Clover Corp’s DHA-rich oil was equally, if not more effective, than EPA-rich fish oil in terms of its ability to lower plasma lipids and thromboxane.

DHA delivers anti-inflammatory benefits

“Of course people had assumed that EPA would be beneficial because it is a precursor of 3 and 5 series of eicosanoids. It therefore can competitively inhibit the production of inflammatory eicosanoids from arachidonic acid, including leukotriene B4, so EPA would be the main mediator of anti-inflammatory effects.

“I think that was a sound mechanistic argument at the time, but we now realise there are other ways in which DHA can

“At low dietary intakes, DHA but not EPA inhibited ischaemia-induced cardiac arrhythmias. At intakes of 3.9–10.0%en, DHA was more effective than EPA at retarding hypertension development in spontaneously hypertensive rats,” Professor Howe says.





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deliver anti-inflammatory benefits.

“From a cardiovascular point of view, the indication was clear: DHA is at least as beneficial if not more so than EPA in providing protection against hypertensive target organ damage, particularly the kidneys, in animal models and in reducing cardiovascular risk factors in humans. I only wish I could validate in human trials some of the studies we did looking at renal protective effects of DHA in the rat model of hypertension.

“Fortunately, cardiovascular disease is much better managed now. However, fish oil, particularly tuna oil, has a unique protective role in the circulation and its preventive potential should be fully exploited. I’ve been consuming high DHA fish oil for 30 years and I am still doing OK,” Professor Howe says.

“I subsequently became interested in the mental health aspects of fish oil and some of the pioneering research by

**“Omega-3s in fish oil can help to control blood pressure, and there is increasing evidence they also can improve mental performance in older adults,”
Professor Howe says.**



Dr Andrew Stoll of Harvard Medical School indicating that you needed 10 g or more of EPA-rich fish oil to improve depression.

“People were thinking in terms of n-3 FA influencing neurotransmitter function, recognising the importance of Omega-3, particularly DHA, in early infant brain development. So it seemed logical that effects of n-3 FA on brain function, mood and cognition would somehow be mediated by direct effects on CNS neurotransmission.”

It took much longer to recognise the microcirculation in the brain as a potential target for the beneficial effects of n-3 FA, despite the critical dependence of brain function on adequate cerebral perfusion. This is a target that can be modified in the short term by dietary interventions including n-3 FAs. Indeed, many bioactive polyphenols may also be influencing brain function indirectly via improving the delivery blood to brain regions on demand.

“Our current research addresses this hypothesis: vasoactive nutrients such as DHA are able to enhance mood and cognitive performance in adults by improving cerebrovascular function. We are conducting clinical trials to evaluate such benefits with promising outcomes.”

Nu-Mega Ingredients

Nu-Mega™ Ingredients is a wholly owned subsidiary of publicly-listed Australian company, Clover Corporation. It specialises in the manufacture and supply of Omega-3 DHA and Omega-6 ARA powders, the nutritional ingredients which are added to infant formulas, general foods and pharmaceuticals.

Clover Corp has a tuna oil refinery in Melbourne, where it takes crude tuna oil from various supply sources and converts it into a food and infant grade quality tuna oil.

Nu-Mega’s spray dried microencapsulated powders use a CSIRO patented technology to stabilise the sensitive Omega-3 and Omega-6 oils which can then be dry blended into a variety of foods, beverages, infant formulas and pharmaceutical products. The oils can be heated with no impact on product smell or taste, and have a shelf life of two years.

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