

IMAGE: NATURE'S CROPS



A step forward in plant-based fish oil

Fish oil contains the highest amount of long-chain omega-3 fatty acids, but is unsustainable and unsuitable for vegetarians. Rose Hales looks at whether Ahiflower oil, which has been selectively bred to contain high levels of the omega-3 fatty-acid SDA, might be a viable alternative

A new source of long-chain omega-3 fatty acid has been found, which is plant based, non-GM and is ready for large-scale production. The plant is known by many names including *Lithospermum arvense*, *Buglossoides arvensis*, corn gromwell, bastard alkanet and Ahiflower – it

is set to transform the industry for long-chain omega-3 oil, which is currently dominated by fish oil due to a lack of comparable alternatives, until now.

Ahiflower is the name given to the plant by Nature's Crops International (NCI), a Canadian company that worked with agricultural researchers at Scotland's Rural College (SRUC) to field-trial and breed the best performing varieties for commercial sale. Ahiflower received its name from the Hawaiian word for tuna – ahi – as an acknowledgement of the plant's relationship to traditional omega-3 sources.

It is part of the boraginaceae family and has been thought of previously as an invasive weed. "As a plant, *Buglossoides arvensis* is pretty much endemic in the whole of the Northern Hemisphere. It has traditionally been seen as a weed species associated with the cultivation of wheat", Greg Cumberland, general manager of the Ahiflower Division of TCI (Technology Crops International – part of NCI) told *NutraIngredients* in March 2015.

In its natural state, the plant contains around

14% stearidonic acid (SDA – a precursor of long chain omega-3 fatty acid), however "TCI procured naturally-occurring germ plasm from all over the world and selectively bred it over a period of years" to produce a high-yield crop containing 18-20% SDA. NCI describes Ahiflower oil as "the richest effective combined omega-3+6 fatty acid source from a single non-GM plant".

A dose of approximately 2.3-3g/day of Ahiflower oil provides the recommended EPA minimum daily equivalent of 200-250mg, TCI says.

In addition, according to operations and agronomy manager of NCI, Simon Meakin, it would take more than 20 tonnes of fish to produce the same amount of oil that can be produced in 1ha of corn gromwell.

Decoding the acronyms

Omega-3 fatty acids are not just one type, but several, and understanding the differences is necessary in order to fully comprehend how a new oil such as Ahiflower fits within the current market.

Omega-3 fatty acids are split into long-chain and short-chain, although some short-chain have longer chains than others. Conversion between one and another is also possible in some circumstances. The two main types of omega-3 fatty acids that are linked with infant development, cognitive and eye function are called docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). These are long chain fatty acids. A shorter chain fatty acid is alpha-linolenic acid (ALA) – ALA is not linked to the same health benefits and cannot be converted by the human body to DHA, but can be converted to EPA, although only in very small amounts. A fourth, and less well-known type of omega-3 fatty acid is SDA, this is the type present in Ahiflower oil.

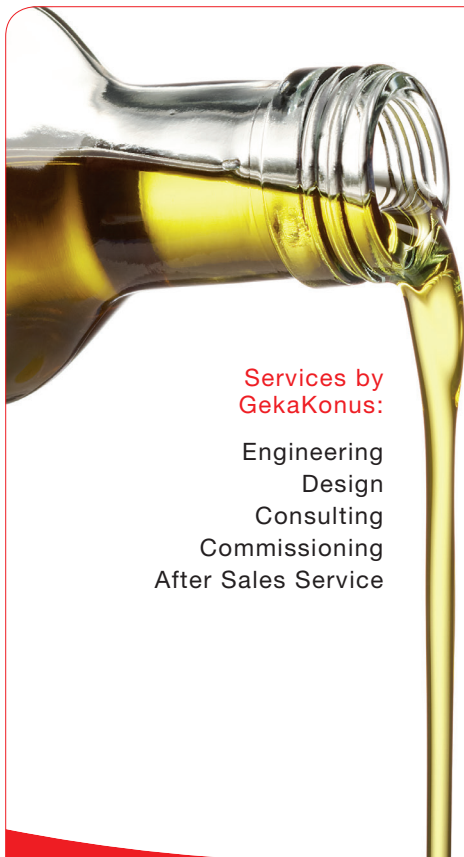
SDA is a shorter chain omega-3 like ALA, although it does differ from ALA for reasons that some claim make it superior. According to *Today's Dietitian's* 'Spotlight on Stearidonic Acid', foods supplemented with SDA "were found to raise EPA concentrations in the red blood cell membranes with approximately 17% to 41% of the efficiency of EPA on a gram-for-gram basis, a conversion efficiency three to five times higher than that of ALA". The results were found in studies of SDA, which were largely funded by Monsanto, which has developed a genetically engineered SDA-enriched soyabean oil.

However, consumption of SDA will not increase the amount of DHA in the body, only direct consumption of DHA can do this. *Today's Dietitian* says that individuals who currently rely on ALA to increase their omega-3 intake "may benefit from adding SDA to their diet". In particular the study mentions vegetarians, vegans and people who do not consume fish as those who would benefit from an increased consumption of SDA.

According to Cumberland, "our specification is for an 18% to 20% SDA content in Ahiflower oil, which is the largest of any non-GM plant source such as Echium, blackcurrant seed or hemp".

Approval and safety

When a new supplement is proposed for the market, it must be approved in terms of safety, and assessed by relevant bodies to ensure the claims made about it are true. Although corn gromwell or Ahiflower



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oil initially faced challenges in certification and approval, since 2015 the process has been more fruitful.

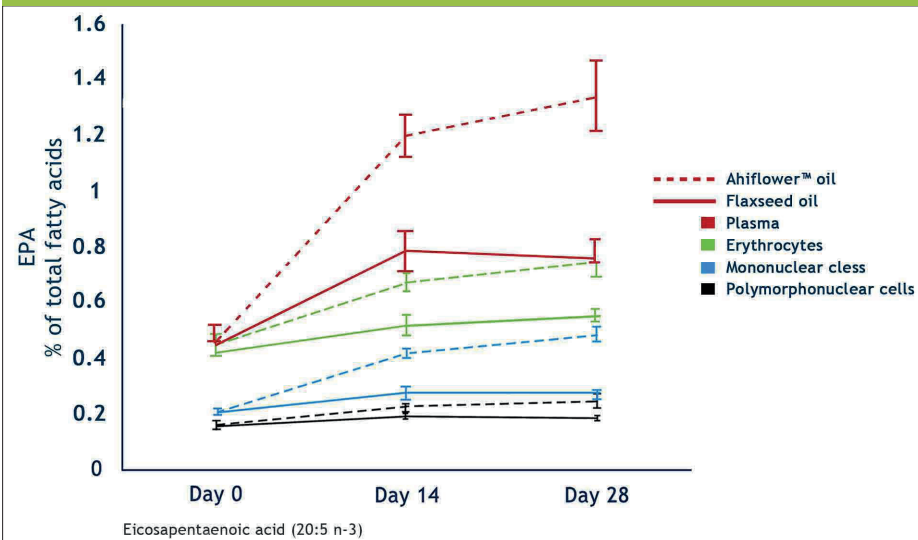
In November 2015, corn gromwell oil was awarded the status of a 'Novel Food' in the EU. A Novel Food is defined as being something that has not been consumed to a significant degree by humans in the EU prior to 1997, either newly developed, innovative or produced using new technologies. This status means that the oil is both safe and approved for consumption.

A UK government press release from 2011 describes corn gromwell oil as having 'hidden superpowers'. It reports on research carried out by the National Institute of Agricultural Botany (NIAB TAG) in collaboration with Technology Crops Limited (part of NCI), that investigated whether corn gromwell could be grown commercially. The trial concludes that the plant:

- Needs few inputs and a low amount of fertiliser;
- Does not suffer from many pests or diseases and is not palatable to pigeons or rabbits;
- Has a higher yield and is easier to harvest than the only commercial non-GM plant source of SDA, Echim.

Ahiflower oil produced exclusively by NCI received certification from NSF International under its NSF Non-GMO TrueNorth protocol in April, the company announced. NSF International is an independent, accredited organisation that tests, audits and certifies products and systems. The certification

FIGURE 1: THE RESULTS OF NATURE'S CROPS' FIRST CLINICAL TRIAL OF AHIFLOWER OIL IN 2014



AHIFLOWER OIL LEADS TO GREATER EPA ACCRUAL IN PLASMA AND CIRCULATING CELLS VERSUS FLEXSEED OIL. SOURCE: NCI

awarded shows that the oil complies with all elements of the verification process. According to NCI, Ahiflower oil is the first omega dietary oil to be verified by NSF International. NCI commented: "Since Ahiflower oil is already in commerce in the USA and EU in food and dietary supplements, it is important that Ahiflower oil comply with a globally meaningful third-party non-GMO verification standard. NSF True North achieves this goal and provides assurance to Ahiflower's licensed brand partners on this point."

The US Food & Drug Administration (FDA) awarded the oil no-objection GRAS (generally recognised as safe) status in January 2015, according to *NutraIngredients*. In addition, in March 2015, after a process lasting two years, NCI succeeded in lifting the EFSA's (European Food Safety Authority) block on omega-3 buglossoides oil. *NutraIngredients* reports that the oil was originally blocked because the plant contains active substances such as pyrrolizidine alkaloids, which have been linked to antigonadotropic

► activity – meaning they affect hormones. Secondly there was concern over the method used to analyse the presence of the carcinogenic polycyclic aromatic hydrocarbons (PAHs) in the oil.

In response, the EFSA said that the oil's refining process reduced the levels of pyrrolizidine alkaloids to below the maximum levels set by the EU. The NCI submitted further information on the PAH analysis method, confirming that the oil registered safe levels.

Clinical trials

Alongside certification and recognition, clinical trials are taking place to determine whether or not Ahiflower oil does definitely boost the levels of EPA in the blood and if it is safe for consumption. A report published in the *Journal of Nutritional Science* led by Dr Marc Surette investigated the safety and efficiency of dietary Ahiflower oil using a parallel-group, randomised, double-blind, comparator-controlled phase I clinical trial. Subjects had their diets supplemented with either Ahiflower oil or flaxseed oil.

The trial found that "tissue ALA and EPA content increased in both groups compared with baseline, but EPA accrual in plasma and in all cell types was greater in the Ahiflower group" – in fact, Ahiflower oil showed up to four times better accrual of EPA compared to flaxseed (see *Figure 1, p27*).

Thus the study concluded that consumption of Ahiflower oil is safe and that it is more effective in enriching tissue with EPA than flaxseed oil. In addition to boosting EPA, the study also found that levels of omega-6 dihomo-gamma-linolenic acid (DGLA – an anti-inflammatory) were boosted in circulating cells.

It was also concluded that there were no safety concerns associated with consuming Ahiflower oil, and "the number of adverse events and adverse reactions were not different from that of subjects consuming flaxseed oil and all were mild in nature".

The company has confirmed that a second human clinical trial is underway, which is a dose response study.

What will the oil be used for?

Ahiflower oil is aimed at the food and supplements market, NCI told *NutraIngredients* in January 2015. In terms of price it said it "will be competitive with existing plant-based omega-3 sources, especially when the more efficient SDA conversion story is taken into account".

But could Ahiflower oil eventually replace fish oil as a source of long-chain omega-3 fatty acids? As the human body cannot convert SDA to DHA, this is unlikely.

Where will it be grown?

Due to being non-GM, there are more available locations for growing Ahiflower. The plan in early 2015 was to introduce the oil in the North American market, followed by the EU market, with longer term potential targets of Canada, South Korea, Australia and New Zealand.

In addition to its uses as an omega-3 source, the plant is also described by Cumberland, as a "break" crop in the UK's crop rotation system, and can also support a large number of insect pollinator species.

A report published by plant researcher NIAB on corn grown well made several statements regarding the positive planting and harvesting attributes of the crop. It describes *Buglossoides arvensis* as more "farmer friendly" than its plant-based omega-3 predecessor Echium. "It can be allowed to senesce (mature) naturally and then be harvested as a standing crop. It holds on to its seed very tightly so seed loss at harvest is minimal. Management input and variability are significantly reduced." Early trials had indicated that the yield of the crop would be around 0.7-1.0 tonnes/ha.

Due to being planted in early spring and harvested in June or July, it is unlikely to clash with other crops, NIAB concluded.

As of 2015, *Lipid Technology* reported that Ahiflower was being grown commercially on over 1,000ha in the UK on farms from East Sussex in

the far south of the country to the Black Isle of Scotland in the far north. An overall average yield of mature seeds was 65-750kg/ha, which the report said was improving steadily year to year.

Great potential as vegan supplement

As the best plant-based and non-GM source of omega-3 fatty acid SDA, Ahiflower oil has great potential for the health food and supplement markets. However, most research has concluded that this source is only really viable for vegetarians or vegans, or anyone who does not consume oily fish, as although SDA is significantly better than ALA at converting to EPA, it is still not as good a source of long-chain omega-3 as DHA – which is still only found in oily fish and algae. ●

Rose Hales is OFI's editorial assistant



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