Algae – the ultimate brain food?

Clinical studies demonstrate mood enhancement, neuromodulation and anti-inflammatory benefits from a Klamath Lake blue green algae, explains **Kirsten Brooks**, BSc (Hons), DN Med (Dist).

Klamath blue green algae from mineral-rich Upper Klamath Lake in Oregon, USA, is a wild green food long valued for a broad range of bioavailable nutrients and other molecules. Along with general health benefits, this microalgae has been associated with positive effects upon mental energy, attention, mood and anxiety which until now have been largely anecdotal. As a nutritionist who has used Klamath blue green algae herself and on patients for a number of years, I have explored the research on the many health benefits of this green food.

Algae were the first life form on the planet and the first to achieve photosynthesis with the by-product of oxygen; setting the stage for life for all organisms. Even now, algae are still responsible for up to 90% of all photosynthesis on earth. There are more than 20,000 species, ranging from unicellular to multicellular organisms such as the seaweeds – the largest and the most complex group of all. Algae have been used as a food supplement for thousands of years. Early civilisations including the Aztecs and African tribes used blue green algae as an additional source of protein.

Klamath blue green algae (Aphanizomenon flos-aquae or AFA) is one of the few edible microalgae and differs from others as it grows wild in an optimal mineral-rich environment which allows it to develop a unique nutritional profile. The considerable nutrient content of Upper Klamath Lake is thanks to a volcanic eruption at about the same time as the lake's formation. In this lake there is enough AFA to help nourish almost all the inhabitants of the Western hemisphere. In fact, if you could empty the lake of all of its algae, it would be able to regenerate itself within a few days; AFA is environmentally sustainable.

Absorption

As a single cell form, AFA is about 98% absorbable, comparing favourably to synthetic vitamin and mineral supplements. AFA contains a full spectrum of natural antioxidants, organic minerals and trace elements, plus all vitamins, all the amino acids (it is 60% protein – a higher level than meat), and all eight essential amino acids), plus essential fats and enzymes. In particular, it contains a high content of pro-vitamin A as beta-carotene, a high content of B vitamins, 100% RDA of vitamin K per gram, plus more than 50 minerals and a complete spectrum of the rarer trace elements, including organic fluorine and vanadium. Because the minerals are organic and naturally chelated, they are easily assimilable.

AFA also contains all 15 carotenoids – the family of natural, fat-soluble pigments which are powerful antioxidants. And unlike isolated beta-carotene, which can promote oxidation (1) this wider spectrum of carotenoids has a significant antioxidant capacity. It is also one of the original sources of omega-3 fatty acids in a balanced (3:1) proportion with omega-6s and has been shown to decrease plasma levels of arachidonic acid, giving it anti-inflammatory properties.(2) All these nutrients explain in part its value to the nervous system – for example the B vitamins and magnesium are important for stress tolerance and for its proper functioning, the amino acids are building blocks for neurotransmitter production and antioxidants and omega-3s are needed for healthy neurons.

Chlorophyll and detoxification

The algae contains a high quantity of chlorophyll, a powerful antioxidant, a natural antiseptic and a pH balancer. It also possesses anti-tumour abilities (3) and can bind to environmental chemicals, as recently confirmed by a Japanese study on chlorella. (19)

Given that each year, tonnes of chemicals, heavy metals and carcinogens are released into the atmosphere and can accumulate in our tissues, including our nervous system, it may be prudent to ingest something that can harmlessly bind with them to promote excretion. Like chlorella, AFA can chelate toxins and is often used as part of a protocol for heavy metal detoxification. It is routinely used with new patients at the Hippocrates Institute, USA, for this very reason.

In my practice, I have observed that AFA provides many potential health benefits in terms of energy, mood and relief from chronic fatigue, arthritis, PMS, menopausal symptoms and more. Many practitioners use it to support optimal nervous system function; for example Dr Gabriel Cousins uses it for Alzheimer's and memory loss. In Germany it has been used for children with ADHD in place of Ritalin. Nevertheless, for the algae to be taken more seriously, its benefits have needed to be substantiated with more detailed clinical research.

Depression and anxiety

More recently, Dr Stefano Scoglio of Nutritherapy Research Centre, a research institute affiliated with the Department of Natural Sciences at the University of Urbino, Italy, has been coordinating laboratory and clinical studies about Klamath algae. His clinical studies have demonstrated its ability to provide significant relief from mood disorders such as depression and anxiety, as well as alleviate symptoms of the menopause.

Two unique ingredients which explain AFA's particular value as a brain-supporting supplement are Phenylethylamine (PEA) and AFA phycocyanins. PEA is a natural endogenous amphetamine which is able to modulate mood. It is known as the 'love molecule', because it increases the natural endorphins usually produced when we're in love (and during exercise).

PEA works by activating the neurotransmission of dopamine and other catecholamines in the brain. (4) Unlike synthetic amphetamines, which are not easily metabolised and continue over-activating the

nervous system to the point of damage (5), PEA is considered a natural neuro-modulator, used according to our homeostatic needs and quickly eliminated when it is no longer required. That's why PEA can be safely taken indefinitely by Parkinson's or Alzheimer's patients, where it is not just a case of poor metabolism of neurotransmitters but also low production of neurotransmitters due to the degeneration of neurons.

The role of dopamine has been implicated in Parkinson's and Alzheimer's disease; Parkinson's patients have in fact found to be PEA deficient.(6)

Serotonin pathway

L-tryptophan
↓
5-hydroxytryptophan (5HTP)
↓
Serotonin (5-hydroxytryptamine)
↓

Catecholamine pathway

L-phenylalanine
↓
L-tyrosine
↓
L-dopa (dihydroxyphenylalamine)
↓
dopamine
↓
noradrenalin (norepinephrine)
↓
adrenalin (epinephrine)
↓

Research shows that oral intake of PEA stimulates concentration, provides mental energy and increases libido through its effect on the dopaminergic cascade, and it can also reduce pain by increasing production of pain-killing endorphins. Due to its effect on serotonin, it can also reduce stress and anxiety. Additionally PEA is involved in the response to stress of the hypothalamic-pituitary-adrenal axis and therefore has a general anti-stress effect.(7)

MAO-B inhibition

AFA is not the only food to contain PEA; it is present in many well-known foods and as a very small molecule easily passes through the intestinal membrane and the blood-brain barrier. However, PEA is usually broken down by specific enzymes known as monoaminoxidase-B (or MAO-B) within the liver and intestines, rendering it ineffective. But the PEA in AFA is naturally protected from this phenomenon by powerful phyco (algae) antioxidants. These function as natural MAO-B inhibitors, allowing PEA to enter the brain. The MAO-B inhibitors within AFA have a similar inhibitory power to that of the drug segeliline, used in Parkinson's disease, but without the side-effects. Segeliline is an irreversible MAO-B inhibitor which destroys the enzymes, while natural inhibitors are reversible and only slow down their action.

Not only do these natural antioxidants – known as AFA phycocyanins – protect PEA, but they also provide a significant degree of neuroprotection. This is important because →

→ oxidative damage caused by emotional, nutritional and environmental stress is at the root of the progressive development of neurodegenerative conditions such as Alzheimer's and Parkinson's and are also a feature of mood disorders such as depression. (8) Also as we age, dopamine concentrations in our bodies decrease 12% every 10 years after age 45, while MAO-B enzyme activity on the hypothalamus of individuals over 50 years and older is about 2.5 times greater than younger individuals.(9)

Effects on menopause symptoms

In his clinical studies, Dr Scoglio used a concentrated extract of AFA known as Klamin, which contains approximately 15mg per gram of PEA. In a 2009 study published in *Gynecological Endocrinology*, 21 women with typical menopausal symptoms such as mood swings, depression, anxiety and lack of self-esteem took Klamin for two months.(10) Improvements ranged from 30% to 40% in the specific measuring scales for depression, anxiety and self-esteem. Furthermore, all the women reported a significant increase in general well-being and energy levels.
As oestrogen levels fall at the menopause there is a parallel change in the level of neurotransmitters (dopamine and serotonin decrease, while noradrenaline increases), which causes many of the menopausal symptoms. The subsequent mood disorders, memory loss and reduced libido are all linked to the fall in dopamine.(11)

Depression and oxidation

In another study at the Department of Psychiatry, University of San Raffaele Hospital in Milan, 20 patients with major depression who were using anti-depressant medications with limited results, were administered two tablets of Klamin a day for a month. The results were very encouraging with statistically significant improvements on the specific depression scales. Furthermore, in spite of the increase in lipoperoxidation – oxidation of our fatty tissues – generated by the use of drugs, the patients using the extract had a decreased level of lipoperoxidation (-22% plasma MDA reduction) due to its antioxidant protection. A further unpublished pilot study at an Italian cancer centre on 18 patients with terminal cancer requiring palliative therapies who were no longer on chemotherapy also had significant improvements in depression, anxiety and fatigue after taking the extract for two months.(12)

Dr Scoglio has also carried out a small study with vegans to determine the bioavailability of the vitamin B12 contained in AFA. Vitamin B12 is an important nutrient needed for a healthy nervous system; levels tend to drop after the age of 50. Although animal products are normally considered to be the only reliable source of vitamin B12, AFA may contain a useable source, because there was an increase in blood levels of B12 and a decrease in homocysteine in the majority of participants.(13)

Antioxidant

AFA phycocyanins give the algae its blue pigmentation. Phycocyanins from spirulina have been shown, in many animal models, to have strong antioxidant action. In vitro studies on lipoperoxidation (LPO) which have compared spirulina and AFA phycocyanins have shown that AFA's can inhibit LPO more effectively – typically by 50% at very low doses.(14)

In vivo studies in humans have showed that the level of MDA (malonyldialdehyde), a byproduct of LPO), has a direct link to the health of the cardiovascular system, the bones, joints, eye and the nervous system. A reduction of LPO may also be another contribution to the neurological protection of the AFA extract, since those with depressive symptoms tend to have higher rates of LPO.(15)

In conclusion, Klamath blue green algae provides a broad range of bioavailable nutrients including chlorophyll, to chelate heavy metals and other toxins, as well as key molecules such as PEA and AFA phycocyanins which have been shown to provide particular support to the nervous system. AFA also provides significant antioxidant protection. cam

About the author

Kirsten Brooks, BSc (Hons), DN Med (Dist) is an experienced nutritional therapist with a degree in Nutritional Medicine. She practises in south east and south west London and has a special interest in green foods, especially Klamath blue green algae, which she has been using for many years in clinical practice.
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Algae as a first-line treatment?

Should a multifunctional supplement such as a green superfood like algae be a staple supplement recommended at most initial consultations?

The manufacturers would obviously like us to think so, and this is very much the line taken by the Sun Chlorella Corporation, UK distributors of Sun Chlorella® "A". As this is a consistently best-selling product, rated "Most Beneficial Product" by the Institute for Optimum Nutrition soon after its launch in 2009, we let Penny Hatzis, BHlthSc (CompMed), AdvDipNat, make the case.

She says: "When starting treatment with a new patient it is standard good practice to sort out any gut issues and address nutritional deficiencies in the first instance. For example, 90% of the population are said to be vitamin D deficient, and most patients will present with some form of digestive complaint.

"Supplementing with chlorella helps to maintain normal colonic function and digestive health. It acts as an intestinal broom, cleansing the gut by clinging onto toxins and eliminating them as waste. A recent study found people taking it had less constipation and more regular bowel movements. (1) The researchers also found that chlorella changes the intestinal microflora and thereby contributes to improvement of the intestinal environment. Overgrowth of pathogenic bacteria in the gut has been linked to IBS and other problems. Prebiotic foods such as chlorella feed the friendly bacteria in the gut, helping it to proliferate and reduce the pathogenic bacteria.

A component of chlorella known as Chlorella Growth Factor (CGF) is a nucleotide-peptide complex which contains an abundance of nucleic acids as well as glucose, mannose, rhamnose, arabinose, galactose and xylose. Among other benefits, CGF allows Sun Chlorella "A" to re-stimulate the growth and repair of cells. CGF has a primarily prebiotic effect and consequently encourages the growth and protection of *Lactobacilli*."

From an ongoing treatment perspective, Prof Randall Merchant, PhD, professor of anatomy and neurobiology at Virginia Commonwealth University, has studied the use of chlorella in a range of conditions from metabolic syndrome to fibromyalgia.(2)

In a presentation to the Anti-Ageing Conference London he reported: "In this presentation, a number of laboratory research and clinical trials we and others have conducted in Japan and the United States will be described which show that daily ingestion of chlorella helps ameliorate the symptoms of Syndrome X by reducing body fat percentage, blood pressure, total serum cholesterol, and fasting glucose levels.

"A recent clinical study by Mizoguchi and colleagues examined serum components and used a DNA microarray to examine expression of several thousand genes in white blood cells of 17 subjects diagnosed with Syndrome X consuming 8.5g of chlorella per day for two months.(3) Consumption of chlorella led to reductions in percentage body fat, total serum cholesterol and fasting glucose levels. Gene expression analysis identified an activation of genes related to both fat metabolism and insulin signalling pathways. Variations in the expression of genes directly involved in the active uptake of glucose before, during, and after consuming chlorella provide an explanation for reduced serum glucose; substantiating with physiologic and genetic evidence the findings of numerous clinical studies that showed consumption of chlorella lowered blood sugar."

Chlorella pyrenoidosa is a unicellular green algae that grows in fresh water and consists of 60% protein, 20% carbohydrate and about 11% unsaturated fats. These proteins and carbohydrates can provide a steady energy stream to the body without spiking insulin secretion and can also suppress appetite. Chlorella has the highest content of chlorophyll of any known plant and chlorophyll is a well-known detoxifier, removing toxins stored in the body and preventing the uptake of toxins by the cells of the intestines.

Chlorella also contains high concentrations of certain vitamins, minerals, dietary fibre, nucleic acids, amino acids, enzymes, and other substances.

The algae have strong cell walls that prevent their native form from being adequately digested so that only after drying and breaking its cell wall can these organisms be digested by humans. The DYNO®-Mill processing method, used in the manufacture of Sun Chlorella "A", has proven the best method for breaking the cell wall while preserving its nutritional value.

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