The Nutritional Benefits of Spirulina for Birds

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Introduction

Spirulina is a concentrated source of many important nutrients including the B vitamins, β-carotene, γ-linolenic acid, calcium, iron, magnesium, manganese, potassium, selenium, zinc, bioflavanoids and protein. While promoted as a super food for humans for a number of years, its potential benefits for birds have only recently been explored. Its popularity as a nutritional supplement for birds is increasing, with a number of commercially formulated products now containing spirulina. The chemical composition and potential benefits for birds are explored in more detail.

What is Spirulina?

Spirulina (spy-rool-ee-na) is a planktonic blue-green algae (cyanobacteria) found in warm alkaline volcanic lakes. Wild spirulina sustains flocks of flamingos in the alkaline East African Rift Valley Lakes, with the most common commercially available species *Spirulina maxima* and *S. platensis*. It has a soft cell wall composed of complex sugars and protein and differs from other algae in that it is easily digested. It is not to be confused with chlorella, a green microalgae with cell walls composed of indigestible cellulose, that does not possess the same antiviral, anticancer and immune stimulating properties of spirulina.

Spirulina is a Rich Source of Protein

Spirulina is one of the richest sources of protein (65%) compared to eggs (50%), brewer's yeast (50%), soybeans (40%) dried skim milk (35%) and beef (45%). The proteins of spirulina are complete in that they contain all eight essential amino acids plus ten nonessential ones. In this regard, spirulina is similar to animal protein but does not contain saturated fats or residues of hormones and antibiotics that are common in meats. However, because spirulina is usually taken as a supplement (less than 1%) it is unlikely to contribute significant amounts of protein to the overall diet.

Phycocyanin

The deep colour of spirulina is derived from the green pigment of chlorophyll, with the blue from the polypeptide phycocyanin. Phycocyanin is structurally similar to β-carotene and thought to enhance the immune system through stimulation of stem cell production in bone marrow. It is a potent free-radical scavenger (hydroxyl and peroxyl radicals) and inhibits microsomal lipid peroxidation.

Phycocyanin stimulates haematopoiesis, emulating the renal hormone erythropoietin (EPO) that regulates bone marrow stem cell production of red blood cells. Phycocyanin also regulates production of white blood cells, even when bone marrow stem cells are damaged by toxic chemicals or radiation.

Renal Toxicity

Renal toxicity in rats caused by pain relievers (para-Aminophenol) and anticancer medication (Cisplantin) is significantly reduced by phycocyanin extracts of spirulina (Fukino et al 1990). It plays a protective role against renal failure caused by mercury and certain pharmaceutical drugs and may be applicable to the reduction of general renal dysfunction (Yamane et al, 1988).

γ-linolenic Acid

γ-linolenic acid (GLA) is found in the seeds of a few flowers, with spirulina the only green food rich in this fatty acid. GLA stimulates growth in some animals and acts as an anti-inflammatory, sometimes alleviating symptoms of arthritic conditions and diabetic neuropathy. It stimulates the production of prostaglandins, which regulate growth and function of the heart, blood and musculature. Cells deficient in GLA are fragile and subject to a variety of degenerative diseases. GLA may prevent dietary hypercholesterolemia and arteriosclerosis, lowering plasma triglycerides and LDL cholesterol and increasing HDL cholesterol (Nayaka et al, 1988). Diet induced fatty liver in spirulina is rapidly reversed in rats supplemented with spirulina (Kato and Takemoto, 1984).

Antioxidants

Spirulina is a concentrated source of antioxidants such as vitamins C/E and the B complex that counter damaging free radicals. Minerals such as manganese, copper and selenium, sulfo-glycolipids and various polysaccharides also contribute to the antioxidant system. The major carotenoids of spirulina include β-carotene, β-cryptoxanthin and zeaxanthin. Spirulina also has the highest concentration of evercetin found in a natural source, which possesses potent antioxidant and anti-inflammatory properties that alleviate symptoms of sinusitis and asthma in humans.

Vitamins

Vitamin B_{12}

Spirulina is one of the richest sources of vitamin B_{12}. However, most of this vitamin is in a form that is unavailable to humans and it is possible that it is also unavailable to birds.

Vitamin A

The high concentration of β-carotene makes spirulina a valuable source of provitamin A. Studies of vitamin A nutrition of cockatiels indicate that 2.4 mg/kg β-carotene is sufficient to support vitamin A requirements in this species (Koutsos and Klasing, 2002). This can be achieved by supplementing diets with approximately 0.15% spirulina.

Minerals

Spirulina is a concentrated source of calcium (0.7%), iron (1,000 mg/kg) and zinc (30 mg/kg). These minerals are chelated to amino acids, increasing their bioavailability. However, because of

the low supplementary concentrations, the contribution of these nutrients to the overall dietary nutrient composition is minimal.

Polysaccharides

Calcium Spirulan

Calcium Spirulan (Ca-SP) is a polymerised sulfated polysaccharide unique to spirulina (Koslenko, 1988), with potent antiviral properties (Hayeshi et al, 1996). The polysaccharide is composed of rhamnose, ribose, mannose, fructose, galactose, xylose, glucose, glucuronic acid, galacturonic acid sulphate and calcium.

Antiviral Properties of Calcium Spirulan

When attacking a cell, a virus first attaches itself to the cellular membrane. While Ca-SP does not possess viricidal properties, nor does it interfere with adsorption to host cells, it inhibits replication of several enveloped viruses by selectively inhibiting the penetration of the virus into host cells. The virus is stuck, unable to replicate and is eventually eliminated by the body's natural defences.

Anticancer Properties of Calcium Spirulan

Some common forms of cancer are thought to be a result of damaged cell DNA running amok, causing uncontrolled cell growth. A system of Endonuclease enzymes repair the damaged DNA and keep cells alive and healthy. When these enzymes are deactivated by radiation or toxins, errors in DNA go unrepaired and cancer may develop. The unique polysaccharides of spirulina enhance cell nucleus enzyme synthesis and repair activity.

Stimulation of Microfloral Populations

Maintaining healthy populations of beneficial intestinal flora such as *Lactobacillus* spp. and *Bifidus* spp. reduces potential invasion from opportunistic pathogens such as *E. coli* and *Candida albicans*. Spirulina stimulates the growth of beneficial gut flora and increases levels and absorption of caecal vitamin B_1 (Tokai et al, 1987).

Summary

In summary, spirulina is a concentrated source of a variety of nutrients, having potent antiviral, anticancer and immune stimulating properties. Supplementation rates of up to 1% enhance disease resistance potentials, with 0.15% sufficient to support provitamin A requirements in cockatiels.

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