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The cross-talks between *Spirulina*, *Lagenaria siceraria* and glucocorticoids: A review

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ABSTRACT

It is the most comprehensive and abundant source of nutrition found in nature. *Spirulina* contains an assortment of nutrients that are not found in any other source. The algae are rich in prophylactic and therapeutic nutrients, including proteins, minerals, B-complex vitamins, γ-linolenic acid, and antioxidants including β-carotene and vitamin E. Additionally, it contains trace elements and several bioactive compounds that have yet to be fully investigated. *Spirulina* exhibits a multitude of beneficial and therapeutic properties, including antioxidant, antibacterial, antiviral, anticancer, anti-inflammatory, anti-allergic, and antidiabetic effects, due to its apparent capacity to stimulate the entirety of human physiology. It seems that the consumption of *Spirulina* also stimulates the development of intestinal microflora. *Lagenaria siceraria* (Molina) is more commonly referred to in Hindi and English as lauki and bottle gourd, respectively. As a vegetable, both the aerial parts and fruits of this plant are frequently ingested. In India, China, European nations, Brazil, the Hawaiian island, and other regions, it has been historically employed medicinally due to its cardiotonic, general tonic, and diuretic attributes. Oil, fruits, leaves, stem, and seeds of *Lagenaria siceraria* have been utilized historically to treat skin maladies, diabetes, ulcer, piles, colitis, insanity, hypertension, and congestive cardiac failure. Pectoral, emetic, sedative, purgative, cooling, diuretic, and antibilious are all properties of the fruit purée. Corticosteroids are among the effective treatments for several medical conditions. On long-term administration, adverse effects including osteoporosis, cataract formation, and muscle atrophy are widely acknowledged and have significant implications for public health. There are numerous reports available that address specific adverse effects. In this review, we would like to throw the light on the medicinal uses of *Spirulina*, and *Lagenaria siceraria*, and the adverse health effects of corticosteroids.

Introduction

Spirulina is a photosynthetic, filamentous, spiral-shaped and multicellular edible microbe. It has vast array of biological activities and nutritional significance due to its high concentration of natural nutrients, having bio-modulatory and immuno-modulatory functions. An increase in the phagocytic activity of macrophages, which stimulates the production of antibodies and cytokines, an increase in the accumulation of natural killer (NK) cells in tissues, and the activation and mobilization of T and B cells are all effects of various *Spirulina* preparations on the immune system. *Spirulina* has also demonstrated the ability to regulate carbohydrate and lipid metabolism in diabetic patients and experimental animals through the correction of glucose and lipid profiles. Antibodies against enveloped viruses, such as herpes virus, cytomegalovirus, influenza virus, and HIV, have been identified in preparations. Their capacity to impede carcinogenesis is attributed to their antioxidant properties, which safeguard tissues and diminish the toxicity of the liver, kidney, and testes (Khan *et al*., 2005).

Lagenaria siceraria, commonly referred to as bottle gourd, lauki, or ghiya, is an arboreal species that produces gourds in the shape of bottles with tough outer shells. For culinary purposes, *L. siceraria* fruit is cultivated in India, Japan, Sri Lanka, China, and Thailand. Blessed with minerals, vitamins, and iron, Ghiya constitutes an exceptional food source. Among all known vegetables, Lauki contains the highest concentration of choline, a precursor to the neurotransmitter acetylcholine, which is essential for memory retention and enhancement. In addition, *Lagenaria siceraria* is a vegetable that demonstrates potential in the treatment of various ailments, including cardiac disorders, hepatic diseases, and ulcers. Patients with hypertension can benefit from bottle gourd juice's blood pressure-regulating properties due to its elevated potassium content. It facilitates rapid weight loss due to its high dietary fiber content and low levels of fat and cholesterol. Given the numerous advantages it has been stated above, bottle gourd could be considered a natural disease preventative (Kumar *et al*., 2012).

Since their initial isolation in 1950, corticosteroids have demonstrated remarkable efficacy in the management of both acute and chronic inflammatory conditions. Notwithstanding their efficacy in clinical settings, oral corticosteroids (OCS) are administered with caution owing to a wide range of severe adverse effects, such as osteoporosis, bone fractures, hyperglycemia, and obesity, among others. While corticosteroids are commonly prescribed for a broad spectrum of patients suffering from inflammatory conditions, those with respiratory ailments such as asthma or chronic obstructive pulmonary disease are the most common recipients of these medications.

In this review, we highlighted the medicinal uses of *Spirulina*, and *Lagenaria siceraria*, and the adverse health effects of corticosteroids.

Spirulina: Geographical distribution, nutritional and medicinal benefits

Free-floating filamentous microalgae with spiral-shaped filaments are known as *Spirulina*. Formally known as *Arthrospira*, it is a member of the cyanobacteria class that possesses a distinctive capacity to photosynthesize (Sapp, 2005; Komárek and Hauer, 2009). *Spirulina*'s richness in plant pigments and capacity for photosynthesis led to its original classification within the plant kingdom. Subsequent research on its genetics, physiology, and biochemical characteristics led to its eventual classifica-

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tion in the kingdom of bacteria (Vonshak, 1997). In subtropical and tropical regions like America, Mexico, Asia, and Central Africa, *Spirulina* thrives naturally in high-salt alkaline water reservoirs. Out of the many species of *Spirulina*, three are the most studied because they are edible, have high nutritional value, and may have therapeutic applications: *Spirulina platensis* (*Arthrospira platensis*), *Spirulina maxima* (*Arthrospira maxima*), and *Spirulina fusiformis* (*Arthrospira fusiformis*) (Gershwin and Belay, 2008).

The primary focus of early research was on the nutritional benefits of *Spirulina* as a food source. *Spirulina* was consumed as food by the Mayas, Toltecs, and Kanembu in Mexico during the Aztec civilization as early as more than 400 years ago (Khan *et al*., 2005). The Lake Texcoco *Spirulina* was collected, dried, and used to manufacture *Spirulina* cake, which was consumed. In Central Africa, the Chadian people have been consuming *Spirulina* for millennia. *Spirulina* collected from Lake Kossorom (Chat) is marketed commercially and used to make cakes or broths for meals. Due to its unusually high protein content (60–70% by dry weight) and abundance in vitamins, minerals, vital fatty acids, and other elements, *Spirulina* is widely known for its nutritional value (Karkos *et al*., 2011). The Intergovernmental Institution for the Utilization of Micro-algae *Spirulina* against Malnutrition (IIMSAM) was established in the middle of the 1970s to promote *Spirulina* as a high-nutrient diet to combat starvation and malnutrition worldwide because of its exceptionally high nutritional content (Ciferri and Tiboni, 1985). Furthermore, the European Space Agency (ESA) and the National Aeronautics and Space Administration (NASA) also suggested *Spirulina* as one of the main meals for extended space missions because of its concentrated nutrition.

Since the mid-1980s, a considerable deal of research and effort has gone into creating nutraceuticals, or functional foods, to help prevent or treat a variety of ailments. *Spirulina* has emerged as a nutraceutical food that offers numerous health benefits for a wide range of illnesses. According to reports, taking *Spirulina* as a dietary supplement can help prevent or treat a number of conditions, including hypercholesterolemia, hyperglycemia, allergies, cancer, environmental and drug-induced toxicities, viral infections, cardiovascular disease, diabetes, and other metabolic diseases (Abdulqader *et al*., 2000). The potential benefits of *Spirulina* for cardiovascular illnesses, specifically highlighting the hypolipidemic, antioxidant, and antiinflammatory properties of *Spirulina* as demonstrated by preclinical and clinical research (Ahsan *et al*., 2008).

Although *Spirulina* exhibits significant antioxidant potential, its actual health-protective value has only been revealed in recent times. Phycocyanobilin (PCB), the chromophore that is attached to the principal protein phycocyanin, has the ability to significantly inhibit NADPH oxidase, the complex of enzymes responsible for pathological oxidant stress in numerous medical conditions (McCarty, 2007). Its physiological activity seems to be mimicked by it (Jiang *et al*., 2006). The therapeutic potential of *Spirulina* in preventing and treating various vascular diseases (such as atherogenesis, hypertension, and congestive heart failure), cancers, complications of diabetes, and neurodegenerative, fibrotic, or inflammatory disorders has been suggested by the overactivity of NADPH oxidase in disorders (McCarty, 2007).

In rodent studies, central neuroprotective effects were observed upon oral administration of phycocyanin or whole *Spirulina*; this finding strongly suggests that PCBs are capable of traversing the blood–brain barrier (Chamorro *et al*., 2006).

Spirulina has been designated by the Food and Agriculture Organization (FAO) of the United Nations as an optimal food and dietary supplement for the twenty-first century (Pelizer *et al*., 2003). The authentication of food ingredients is a critical concern for food processors due to the susceptibility of unscrupulous suppliers to exploit the integrity of such ingredients (Ciferri, 1983; Reid *et al*., 2006). Current Technological Developments in Food Science and Technology for the Verification of Food Authenticity (Belay, 1997). *Spirulina* powder is an example of a food item that is particularly susceptible to manipulation.

Lagenaria siceraria (Molina): Geographical distribution, nutritional and medicinal benefits

Bottle gourd, or *L. siceraria* (Molina), is a member of the *Cucurbitaceae* family. This perennial climbing plant is widely cultivated for its vegetable produce around the world, especially in tropical countries like Thailand, Egypt, India, and Japan (Maddiboyina *et al*., 2023). The bottle gourd fruit can grow to be more than a meter long and can take on a variety of shapes, including large and spherical, small and bottle shaped, and narrow and sinuous. Generally, rounder types are referred to as calabash gourds. According to legend, the bottle gourd originated in Africa and traveled throughout the world before the arrival of the Spanish, maybe by floating on the water. From India, it spread to Indonesia, New Zealand, and China, where it underwent localized diversifications. It's a hardy annual vine that can be cultivated as a climbing or running vine, with large leaves and a rich appearance. In Asia and Africa, the fruit is widely used as a medical vegetable to treat a wide range of illnesses. Several parts of this plant, including the fruit, seed, leaf, and root, are used in alternative medicine (Hussein *et al*., 2021). The fruits of the plant were mentioned as potentially beneficial in Ayurveda and other folk treatments. Cardioprotective, antidote, aphrodisiac, cardiotonic, diuretic, and general tonic characteristics are among the fruit's traditional applications. Because the fruit juice had strong antioxidants, it had been used to treat liver conditions including jaundice (Upaganlawar, 2017). This plant has been linked to several health benefits for humans, including antioxidant, immunosuppressive, hypolipidemic, diuretic, laxative, hepatoprotective, analgesic, antihypertensive, cardioprotective, central nervous system stimulant, anthelmintic, and free radical scavenging (Panchal *et al*., 2013). The *Cucurbitaceae* family of plants has many medicinal uses, including anti-HIV, antipyretic, anthelmintic, anxiolytic, carminative, anti-diabetic, and antibacterial, antioxidant, laxative, anti-tuberculosis, anti-diarrheal, and purgative. It is also used as a diuretic, cardiotonic, and contraceptive. Additionally, there are anti-inflammatory, antitussive, cytotoxic, and expectorant properties. The fruit pedicles of *L. siceraria* exhibit notable alphaamylase inhibitory activity when dissolved in water. This workout is used to control blood sugar levels. In the small intestine, pancreatic alpha-amylase blockage slows the conversion of starch to glucose. Because of this, it produces less glucose and enters the bloodstream, making it suitable for use as an anti-diabetic medication (Kumari *et al*., 2015).

There is a cardioprotective effect of ethanolic extract. The ability of *L. siceraria* fruits to neutralize free radicals or to sustain the almost normal activity of these enzymes, which shield the heart membrane from oxidative damage by reducing lipid peroxidation, is most likely the source of their antioxidant properties. Improvements in antioxidant parameters, serum marker enzyme levels, and histological studies support the claim that the ethanolic extract of *L. siceraria* fruit has a strong hepatoprotective and antioxidant effect when antitubercular medicines induce hepatotoxicity (Vijayakumar *et al*., 2010).

Corticosteroids uses and adverse effects

Corticosteroids find application in the therapeutic management of an extensive array of ailments. Within the domain of palliative care, anorexia, exhaustion, and pain are among the distressing symptoms that corticosteroids are commonly prescribed to cases with advanced cancer (Nauck *et al*., 2004; Lundström and Fürst, 2006; Riechelmann *et al*., 2007). Nevertheless, corticosteroids have been linked to a number of adverse effects, including insulin resistance, proximal myopathy and catabolic effects, skin changes, susceptibility to infection, and adrenal insufficiency (Adcock and Ito, 2005). Cases that have advanced cancer are at an increased risk of experiencing adverse events (AEs) that are linked to the use of corticosteroids.

Glucocorticosteroids (GCs) are the most efficacious anti-inflammatory medications used to treat individuals with airways disease. They inhibit

airway inflammation or stop inflammatory cells from being recruited into the airway by acting on almost all of the cells in the airway. Reversing the effects of illness on the function of airway structure cells, they also have significant impacts on them. The glucocorticosteroid receptor (GR), a member of the nuclear receptor family, is the particular receptor through which glucorticosteroids operate. Thus, through a variety of unique and complementary methods, GCs influence gene transcription in many of their key roles. The majority of inflammatory mediators, including growth factors, cytokines, chemokines, and their receptors, are genes that are targets. For the majority of patients, inhaled GCs are quite effective and have minimal systemic side effects. But for certain patients, systemic or even large doses of topical GCs are insufficient to manage their illness. The inability of these patients to react appropriately to GCs has been attributed to several inflammatory pathways, which shed light on how GCs function in the airways. These individuals require new medications since the side-effect profile of GCs precludes them from continuing to take large doses of the medication. It may also be possible to restore GC responsiveness in these patients by focusing on the damaged pathways linked to GC function (Adcock and Mumby, 2017).

Potential beneficial effects of *Spirulina* and *Lagenaria siceraria* against the adverse effects of corticosteroids

Few reports had investigated the beneficial effects of *Spirulina* and *Lagenaria siceraria* against the adverse effects of corticosteroids. Chronic oral submucous fibrosis (OSF) is a pathological state characterized by permanent disability of the oral cavity. Antioxidants should be incorporated into the treatment of premalignant diseases, according to a number of studies. Consequently, an investigation was undertaken to assess the effectiveness of *Spirulina* as an antioxidant supplement to corticosteroid infusions for the treatment of forty patients with oral submucous fibrosis residing in the regions of north Kerala and south Karnataka. In OSF patients, *Spirulina* has the potential to induce clinical improvements, according to the authors. *Spirulina* may be utilized as an adjuvant therapy in the initial management of OSF patients, according to the observed effects (Shetty *et al*., 2013). Osteoporosis is a multifactorial skeletal disorder distinguished by a reduction in bone mass and a disruption in the microarchitectural integrity of bone tissue. The present investigation assessed the impact of *Spirulina plantensis* algae (SP) powder and *Cichorium intybus* L (CH) leaves on female rodents that had been induced osteoporosis by dexamethasone (DEX). Powdered dried SP algae and CH leaves contained elevated levels of calcium and phosphorus. In female Albino rats, the authors concluded that CH leaf powder and desiccated SP algae effectively treated osteoporosis (Gohari *et al*., 2022). In their study, Mali and Bodhankar (2010) assessed the antihypertensive properties of fruit powder derived from Langenaria siceraria (LS) (Family: Cucurbitaceae) in rats with hypertension induced by dexamethasone (Dex). In comparison to the control group, dexamethasone treatment did not significantly elevate mean arterial blood pressure. Pretreatment with Langenaria siceraria reversed hypertension induced by dexamethasone in part, while pretreatment with Langenaria siceraria decreased mean arterial blood pressure and heart rate. The results indicate that pretreatment of rodents with LS fruit powder (500 mg/kg) for 51 days partially reversed the hypertension induced by dexamethasone.

Conclusion

Spirulina and *Lagenaria siceraria* have several beneficial health and medicinal effects that can be of value for lowering the adverse health effects of corticosteroids.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Abdulqader, G., Barsanti, L., Tredici, M.R., 2000. Harvest of *Arthrospira platensis* from Lake Kossorom (Chad) and its household usage among the Kanembu. J. Appl. Phycol. 12, 493-498.

Adcock, I.M., Ito, K., 2005. Corticosteroids. In: Nijkamp FP, Parnham MJ (eds) Principles of Immunopharmacology. Birkhäuser, Basel, pp. 483–497

Adcock, I.M., Mumby, S., 2017. Glucocorticoids. Pharmacology and Therapeutics of Asthma and COPD, pp.171-196.

Ahsan, M., Habib, B., Parvin, M., Huntington, T.C., Hasan, M.R., 2008. A review on culture, production and use of *Spirulina* as food for humans and feeds for domestic animals. FAO Fisheries and Aquaculture Circular (FAO), (1034).

Belay, A. 1997. Mass culture of *Spirulina* outdoors – The Earthrise Farms experience. In: Vonshak, A., Ed. *Spirulina* platensis (*Arthrospira*): Physiology, cell-biology and biotechnology. Taylor and Francis. London. pp. 131-158.

Chamorro, G., Pérez-Albiter, M., Serrano-García, N., Mares-Sámano, J.J., Rojas, P., 2006. *Spirulina* maxima pretreatment partially protects against 1-methyl-4-phenyl-1, 2, 3, 6-tetrahydropyridine neurotoxicity. Nutr. Neurosci. 9, 207-212.

Ciferri, O., 1983. *Spirulina*, the edible microorganism. Microbiol. Rev. 47, 551-578.

Ciferri, O., Tiboni, O., 1985. The biochemistry and industrial potential of *Spirulina*. Annu. Rev. Microbiol. 39, 503-526.

Gershwin, M.E., Belay, A., 2008. *Spirulina* in human nutrition and health. Boca Raton: CRC Press; 2008.

Gohari, S.T., 2022. 'Effect of *Cichorium intybus* L leaves and *Spirulina plantensis* Algae powder against Osteoporosise in Female Rats induced by Dexamethasone', Sci J. Spec. Edu. Appli. Sci. 5, 117-155.

Hussein, M.M.A., Arisha, A.H., Tayel, E.M., Abdo, S.A., 2021. Effect of long-term oral exposure to carmoisine or sunset yellow on different hematological parameters and hepatic apoptotic pathways in mice. J. Anim. Health Prod. 9, 80-86.

Jiang, F., Roberts, S.J., Datla, S.R., Dusting, G.J., 2006. NO modulates NADPH oxidase function via heme oxygenase-1 in human endothelial cells. Hypertension 48, 950-957.

Karkos, P.D., Leong, S.C., Karkos, C.D., Sivaji, N., Assimakopoulos, D.A., 2011. *Spirulina* in clinical practice: evidence-based human applications. Evid. Based Compl. Altern. Med. 2011, 531053.

Khan, Z., Bhadouria, P., Bisen, P.S., 2005. Nutritional and therapeutic potential of *Spirulina*. Curr. Pharm. Biotechnol. 6, 373-379.

Komárek, J., Hauer, T., 2009. Worldwide electronic publication. Univ. of South Bohemia and Inst of Botany AS CR. CyanoDB. cz-On-line database of cyanobacterial genera. http://www.cyanodb.cz.

Kumar, A., Partap, S., Sharma, N.K., 2012. Phytochemical, ethnobotanical and pharmacological profile of *Lagenaria siceraria*: A review. J. Pharmacogn. Phytochem. 1, 24-31.

Kumari, N., Tajmul, M., Yadav, S., 2015. Proteomic analysis of mature *Lagenaria siceraria* seed. Appl. Biochem. Biotechnol. 175, 3643-3656.

Lundström, S.H., Fürst, C.J., 2006. The use of corticosteroids in Swedish palliative care. Acta Oncologica 45, 430-437.

Maddiboyina, B., Vanamamalai, H.K., Roy, H., Ramaiah, Gandhi, S., Kavisri, M., Moovendhan, M., 2023. Food and drug industry applications of microalgae *Spirulina* platensis: A review. J. Basic Microbiol. 63, 573-583.

Mali, V.R., Bodhankar, S.L., 2010. Effect of *Lagenaria siceraria* (LS) powder on dexamethasone induced hypertension in rats. Inter. J. Adv. Pharmac. Sci. 1, 50-53.

McCarty, M.F., 2007. ''Iatrogenic Gilbert syndrome''–A strategy for reducing vascular and cancer risk by increasing plasma unconjugated bilirubin. Med. Hypoth. 69, 974-994.

Nauck, F., Ostgathe, C., Klaschik, E., Bausewein, C., Fuchs, M., Lindena, G., Neuwöhner, K., Schulenberg, D., Radbruch, L., 2004. Drugs in palliative care: results from a representative survey in Germany. Palliative Med. 18, 100-107.

Panchal, C.V., Sawale, J.A., Poul, B.N., Khandelwal, K.R., 2013. Hepatoprotective activity of *Lagenaria siceraria* (Molina) Standley fruits against paracetamol induced hapatotoxicity in mice. Inter. J. Pharm. Sci. Res. 4, 371.

Pelizer, L.H., Danesi, E.D.G., de O Rangel, C., Sassano, C.E., Carvalho, J.C.M., Sato, S., Moraes, I.O., 2003. Influence of inoculum age and concentration in *Spirulina* platensis cultivation. J. Food Engin. 56, 371-375.

Reid, L.M., O'donnell, C.P., Downey, G., 2006. Recent technological advances for the determination of food authenticity. Trends Food Sci. Technol. 17, 344-353.

Riechelmann, R.P., Krzyzanowska, M.K., O'Carroll, A., Zimmermann, C., 2007. Symptom and medication profiles among cancer patients attending a palliative care clinic. Support. Care Cancer 15, 1407-1412.

Sapp, J., 2005. The prokaryote-eukaryote dichotomy: meanings and mythology. Microbiol. Mol. Biol. Rev. 69, 292-305.

Shetty, P., Shenai, P., Chatra, L. and Rao, P.K., 2013. Efficacy of *Spirulina* as an antioxidant adjuvant to corticosteroid injection in management of oral submucous fibrosis. Ind. J. Dental Res. 24, 347-350.

Upaganlawar, A., 2017. *Lagenaria siceraria* (Bottle Gourd) in various cardiovascular complications. Cardiovas. Dis. 1, 44-56.

Vijayakumar, M., Selvi, M., Krishnakumari, S., 2010. Cardioprotective effect of *Lagenaria siceraria* (Mol) on antioxidant tissue defense system against isoproterenol-induced myocardial infarction in rats. Ethnopharmacol. 1, 207-210.

Vonshak, A., 1997. *Spirulina* platensis *Arthrospira*: physiology, cell-biology and biotechnology. CRC press.