# Project Report

## Establishing Spirulina Cultivation Facility & Humanitarian Aid Distribution Facility For Spirulina & Phycocyanin to Combat Severe Hunger and Malnutrition with IIMSAM

Hash BioTech Labs

IIMSAM


www.HashBioTech.com

www.IIMSAM.org

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# INTRODUCTION

# INTRODUCTION

- The purpose of this project is to establish a cultivation and distribution mechanism of Spirulina and Phycocyanin to achieve the mandate of Intergovernmental Institution for the use of Micro-algae Spirulina Against Malnutrition (IIMSAM) and United Nations Millennium Development Goals (UNMDGs).

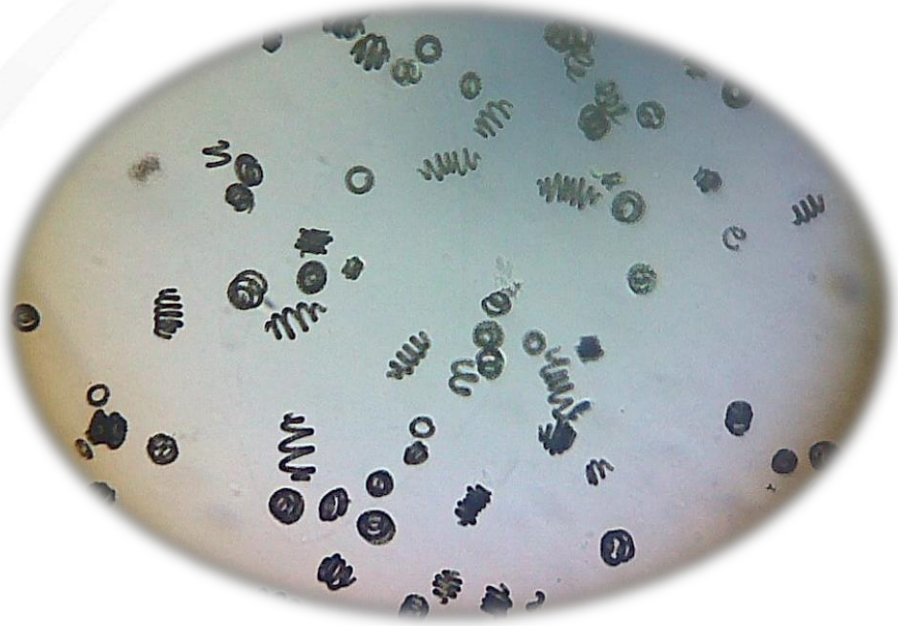
- IIMSAM along with Hash Biotech Labs has come up with a unique programme for the distribution of **IIMSAM- Hash Biotech Labs Humanitarian Lifesaver Spirulina** and **IIMSAM – Hash Biotech Labs Humanitarian Lifesaver Spirulina Extract - PHYCOCYANIN** for deserving and under privileged individuals worldwide.

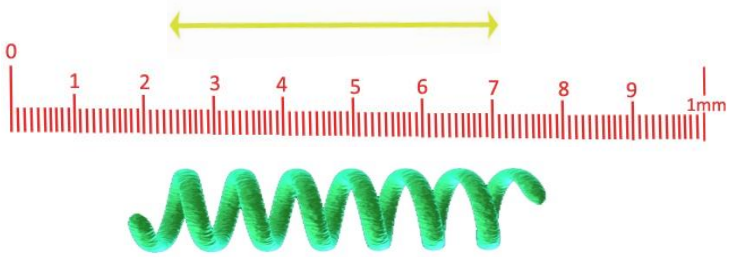
- Spirulina has multi-dimensional socio economic benefits. Spirulina has been documented by UN, WHO, UNESCO, USDA, DSIR and many reputed International organizations as the most ideal and one the best food for tomorrow.

# SPIRULINA

# SPIRULINA: An Introduction

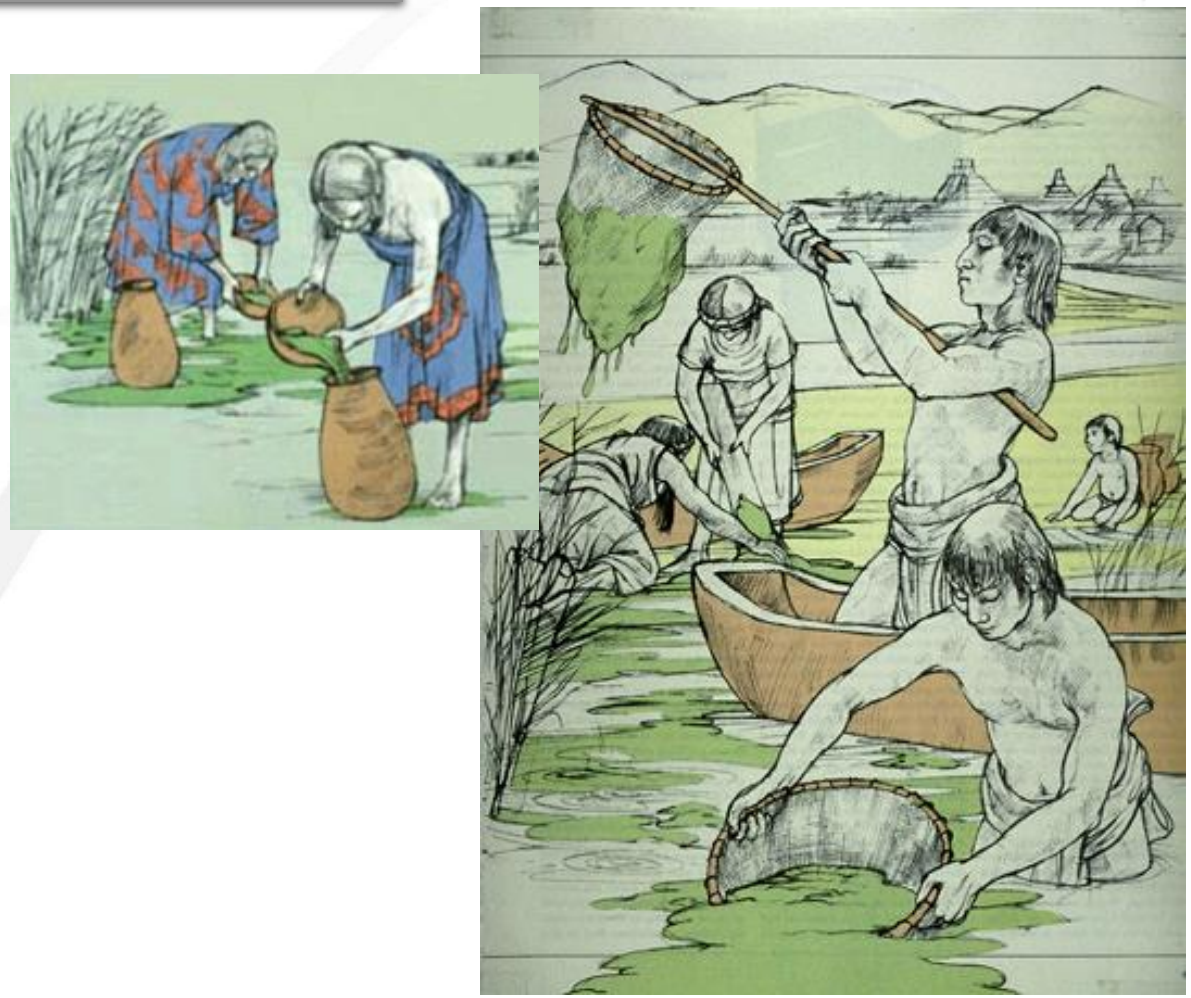
- First forms of life
- Evolved about 3.6 billion years ago
- Richest source of proteins, vitamins, minerals and carotenoids & antioxidants.
- Extremely digestible, high energy, gluten free, low calorie and low fat natural food.
- Spiral, microscopic, filamentous Photosynthetic blue-green algae (Cyanobacteria)
- About 0.1-0.5 mm long in size





# History of Spirulina

- Spirulina is thought to have been a food source for the Aztecs, Mexico in 16th century, as it was being harvested from Lake Texcoco where it grew naturally and was further sold as cakes, as described by one of Cortés' soldiers.
- The Aztecs called it Tecuitlatl, which means the stone's excrement. Spirulina was first found in abundance at the lake, by French researchers in 1960. The first large-scale Spirulina production plant was established in the early 1970's in Mexico which drew attention worldwide.
- Demand for this whole food source has sparked the cultivation of Spirulina in specially designed algae farms in open-channel raceway ponds, with paddle-wheels used to agitate the water.



Aztecs harvesting blue-green algae from lakes in the valley of Mexico. Drawing in Human Nature, March 1978. (by Peter T. Furst).

# WHAT THE WORLD SAYS ABOUT SPIRULINA!!!!

United Nations

# ROME 1974 - WORLD FOOD CONFERENCE

## SPIRULINA: “The most ideal food for mankind.”

IIMSAM

Hash BioTech Labs

WORLD HEALTH ORGANIZATION

SPIRULINA as “Mankind’s best health product in the 21st century”

United Nations Educational Scientific and Cultural Organization


## SPIRULINA as "The most ideal and perfect food of tomorrow"

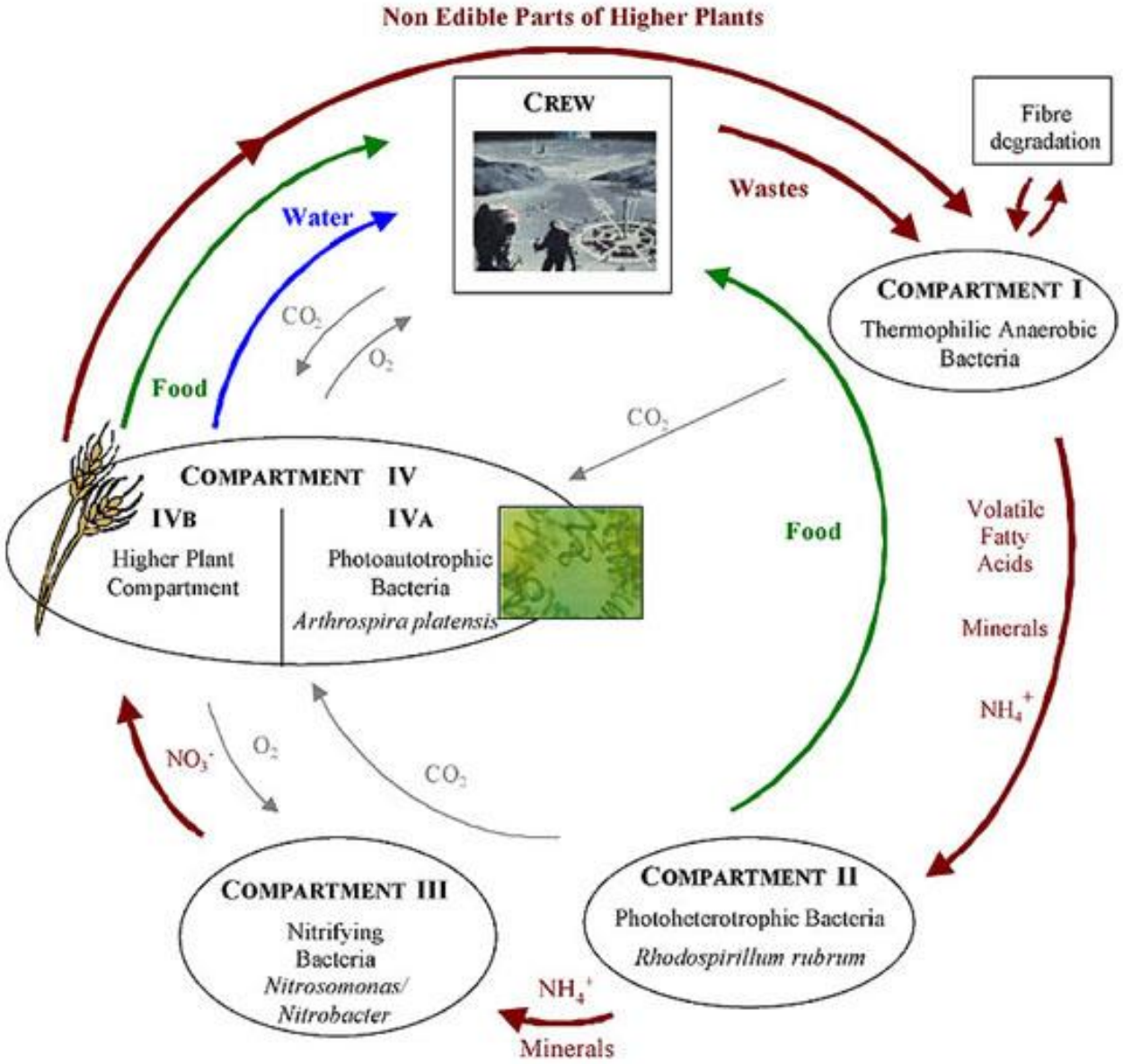
IIMSAM

Hash BioTech Labs

USDA

United States
Department of Agriculture

SPIRULINA as “Food for the Future”




MELiSSA (Micro-Ecological Life Support System Alternative)

IIMSAM

Hash BioTech Labs

IIMSAM

Intergovernmental Institution for the use of Micro-algae Spirulina Against Malnutrition

IIMSAM works to promote the use of Spirulina worldwide and also provides it to underprivileged so as to combat malnutrition.

Support IIMSAM Support Life!

Inter-Governmental Institution for the use of Micro-algae Spirulina Against Malnutrition

Inter-Governmental Observer to the United Nations Economic and Social Council

"There are people in the world so hungry that God cannot appear to them except in the form of bread"

"Hay personas en el mundo tan hambrientas que Dios no puede a parecerles a ellos más que en la forma de pan"

" Il y a des gens dans le monde qui sont si affamés que Dieu ne peut leur apparaitre que sous la forme d'un pain."

"هناك كثير من البشر يتضورون جوعا في العالم، حتى إن رحمة الله لا يمكن أن تظهر لهم إلا في شكل خبز"

Mahatma Gandhi

<<>>

IIMSAM OFFICIAL PRESS RELEASE

THE IIMSAM SPIRULINA PLEDGE CAMPAIGN
IN SUPPORT OF THE UN MDGs THROUGH THE IIMSAM MANDATE

IIMSAM Pictures from Left to Right: IIMSAM Ambassadors S. Rahimi, DG-R. Maradona, Principal-Adviser & Sr. Adviser to the Director-General: Mr. Vikk Sandal and Ms. Emma Hallberg. Pict-Rt: IIMSAM Spirulina Pledge Campaign MOU being signed.

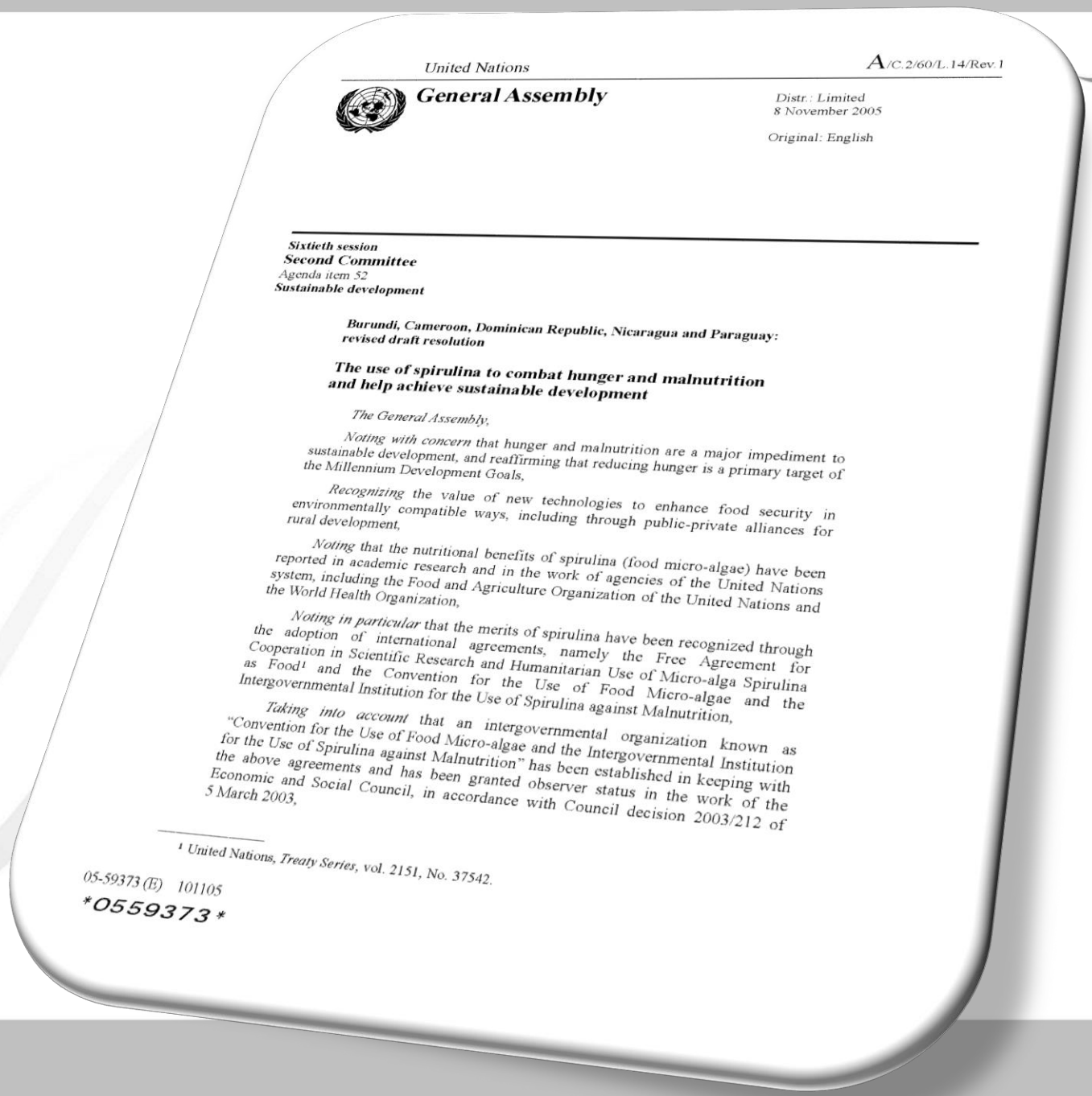
**(IIMSAM New York Headquarters, March 25, 2010)** To realize its ambition of a world free of malnutrition and hunger, IIMSAM's Official Working Partner and Technology Facilitator Hash Biotech Labs Private Limited from the Republic of India, shall help the organization carry and secure its mandate in India and South Asia- a region that has the worst malnutrition statistics in the world. Spirulina that was declared as the *best food for the future* by the United Nations World Food Conference in the year 1974 holds tremendous potential to eradicate malnutrition, achieve food security and bridge health divide. IIMSAM in conformity with UN GA Resolution 62/211 in promoting and in support of ***UN Global Partnerships*** particularly with the private sector to create an environment, at the national and global levels alike, that is conducive to sustainable economic growth, poverty alleviation and sustainable development

IIMSAM was granted an *Observer Status* with the United Nations Economic and Social Council (ECOSOC), in keeping with the Resolution Number E/2003/212, dated 5th of March, 2003. IIMSAM is registered under the United Nations Treaty Series Number 37542-37543 dated 7th of June2001, in accordance with the Article 102 of the Charter of the United Nations. IIMSAM has a *De Facto* diplomatic status in U.S. soil.

United Nations
2005

"……use of Spirulina to combat hunger and malnutrition….."

"….to encourage the production and use of Spirulina"



United Nations A/C.2/60/L.14/Rev.1

General Assembly

Distr.: Limited
8 November 2005

Original: English

Sixtieth session
Second Committee
Agenda item 52
Sustainable development

Burundi, Cameroon, Dominican Republic, Nicaragua and Paraguay: revised draft resolution

**The use of spirulina to combat hunger and malnutrition and help achieve sustainable development**

*The General Assembly,*

*Noting with concern* that hunger and malnutrition are a major impediment to sustainable development, and reaffirming that reducing hunger is a primary target of the Millennium Development Goals,

*Recognizing* the value of new technologies to enhance food security in environmentally compatible ways, including through public-private alliances for rural development,

*Noting* that the nutritional benefits of spirulina (food micro-algae) have been reported in academic research and in the work of agencies of the United Nations system, including the Food and Agriculture Organization of the United Nations and the World Health Organization,

*Noting in particular* that the merits of spirulina have been recognized through the adoption of international agreements, namely the Free Agreement for Cooperation in Scientific Research and Humanitarian Use of Micro-alga Spirulina as Food[1] and the Convention for the Use of Food Micro-algae and the Intergovernmental Institution for the Use of Spirulina against Malnutrition,

*Taking into account* that an intergovernmental organization known as "Convention for the Use of Food Micro-algae and the Intergovernmental Institution for the Use of Spirulina against Malnutrition" has been established in keeping with the above agreements and has been granted observer status in the work of the Economic and Social Council, in accordance with Council decision 2003/212 of 5 March 2003,

[1] United Nations, *Treaty Series*, vol. 2151, No. 37542.

05-59373 (E) 101105
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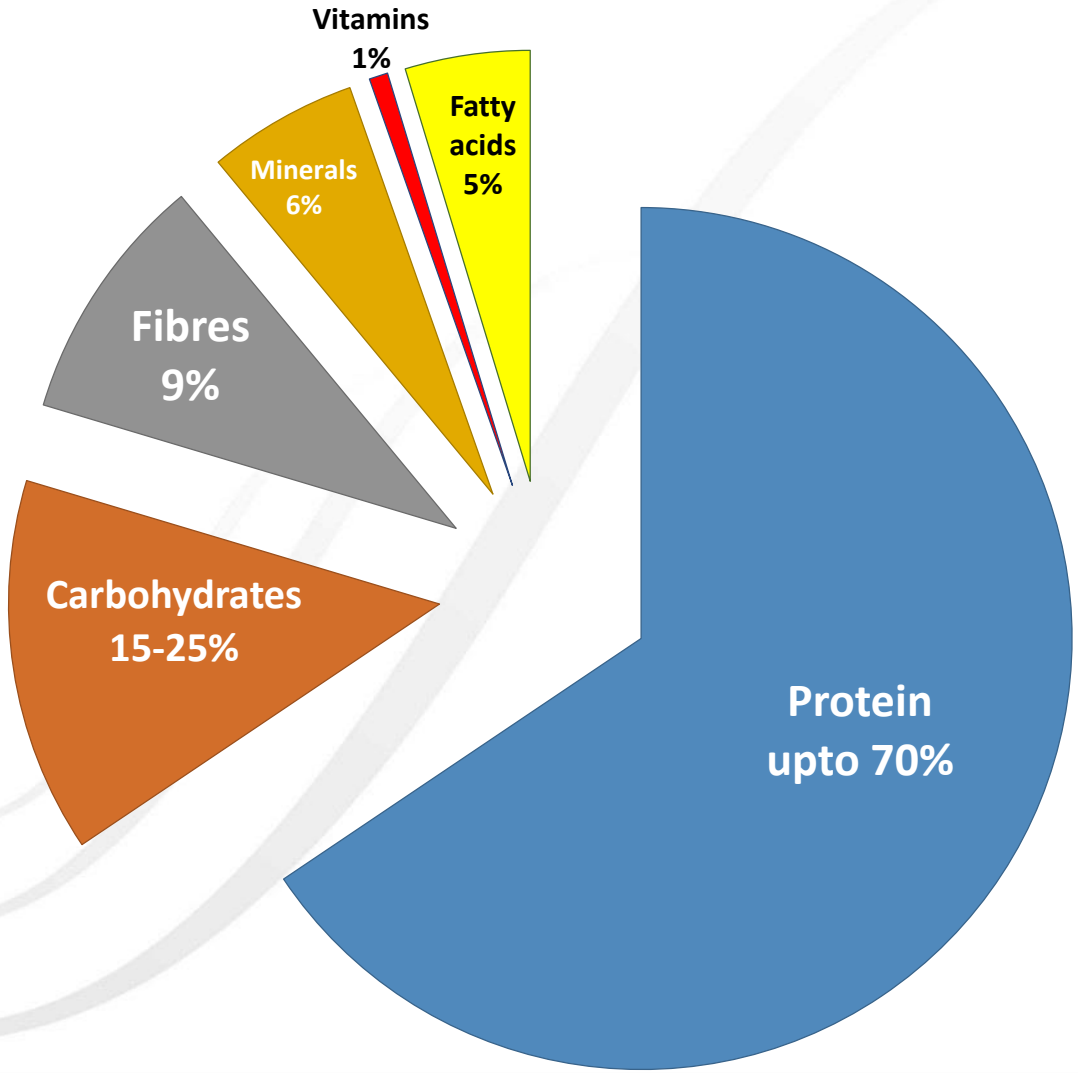
# NUTRITIONAL PROFILE OF SPIRULINA

# Nutritional Analysis (% Dry Matter)



# Spirulina Proteins

- **Protein:** Highest natural source of protein up to 70%
- **Digestibility:** Upto 98%
- **Complete protein:** Presence of 18 amino acids including all 9 Essential Amino acids

| Essential | g/100g |
|---|---|
| Histidine | 0.5-1.5 |
| Isoleucine | 3.0-4.0 |
| Leucine | 3.0-5.0 |
| Lysine | 3.0-6.0 |
| Methionine | 1.0-6.0 |
| Phenylalanine | 2.5-3.5 |
| Threonine | 1.5-3.0 |
| Tryptophan | 1.0-2.0 |
| Valine | 1.0-3.5 |

| Non-Essential | g/100g |
|---|---|
| Alanine | 4.0-5.0 |
| Arginine | 3.0-5.0 |
| Aspartic acid | 1.50-3.0 |
| Cystine | 0.50-0.75 |
| Glutamic acid | 6.0-9.0 |
| Glycine | 2.0-4.0 |
| Proline | 2.0-3.0 |
| Serine | 3.0-4.5 |
| Tyrosine | 1.0-3.0 |

## Role of Essential Amino acids

| | |
|---|---|
| ISOLEUCINE | Used for energy by muscle tissue, forms haemoglobin |
| LEUCINE | Increase cognitive functions of brain, reduces muscle protein breakdown. |
| LYSINE | Adequate absorption of calcium, helps form collagen, aids in the production of antibodies, hormones. |
| METHIONINE: | Prevents disorders of the hair, skin and nails, lowers cholesterol levels, reduces liver fat and protects the kidneys. |
| PHENYL-ALANINE | Stimulates metabolic rate and required by the thyroid gland, produces norepinephrine. |
| THREONINE | Prevents fat build-up in the liver, assists digestion & metabolism |
| TRYPTOPHAN | Natural relaxant, treatment of migraine headaches, works with lysine in reducing cholesterol levels. |
| VALINE | Promotes mental vigor, muscle coordination andand calm emotions. |
| HISTIDINE: | Restore tissues in the body and sustaining the myelin sheaths which shield the nerve cells. production of the red and white blood cells and protection from eczema. |

# Role of Non-Essential Amino acids

| | |
|---|---|
| ALANINE | Strengthens cellular walls |
| ARGININE | Important to male sexual health as seminal fluid is 80 percent arginine. Also helps detoxify the blood |
| ASPARTIC ACID | Aids transformation of carbohydrates into cellular energy. |
| CYSTINE | Aids pancreatic health, which stabilizes blood sugar and carbohydrate metabolism. Has been used to alleviate some symptoms of food allergy and intolerance. |
| GLUTAMIC ACID | With glucose, one of the principal fuels for the brain cells. Has been used to reduce the craving for alcohol and stabilize mental health. |
| GLYCINE | Promotes energy and oxygen use in the cells. |
| PROLINE | A precursor of glutamic acid |
| SERINE | Helps form the protective fatty sheaths surrounding nerve fibers. |
| TYROSINE | Slows aging of cells and suppresses hunger centers in the hypothalamus. Can be synthesized from phenylalanine. Involved in proper coloration of hair and skin, including protection from sunburn. |

# Vitamins

| Vitamins | mg/100g |
|---|---|
| Provitamin A<br>(β-carotene) | 2.330 IU/kg<br>140 |
| Vitamin E | 100 α-tocopherol equiv. |
| Vitamin K | 2.2 |
| Vitamin B1 (Thiamine) | 2.5-5.0 |
| Vitamin B2 (Riboflavin) | 4.0-7.0 |
| Vitamin B3 (Niacin) | 3.0-6.0 |
| Vitamin B5 (Pantothenic acid) | 0.1 |
| Vitamin B7 (Biotin) | 0.005 |
| Vitamin B9 (Folic Acid) | 0.05-0.3 |
| Vitamin B12 (Cobalamin) | 0.05-0.2 |

# Role of Vitamins in our Body

| Fat soluble | Functions |
|---|---|
| **Vitamin A** | Needed for vision, healthy skin and mucous membranes, bone and tooth growth, immune system health |
| **Vitamin E** | Antioxidant; protects cell walls |
| **Vitamin K** | Needed for proper blood clotting |

| Water soluble | Functions |
|---|---|
| **Vitamin B2 (Riboflavin)** | Part of an enzyme needed for energy metabolism; important for normal vision and skin health |
| **Vitamin B3 (Niacin)** | Part of an enzyme needed for energy metabolism; important for nervous system, digestive system, and skin health |
| **Vitamin B5 (Pantothenic acid)** | Part of an enzyme needed for energy metabolism |
| **Vitamin B6 (Pyridoxine)** | Part of an enzyme needed for protein metabolism; helps make red blood cells |
| **Vitamin B7 (Biotin)** | Part of an enzyme needed for energy metabolism |
| **Vitamin B9 (Folic acid)** | Part of an enzyme needed for making DNA and new cells, especially red blood cells |
| **Vitamin B12 (Cobalamin)** | Part of an enzyme needed for making new cells; important to nerve function |

# Minerals

| Minerals | mg/100g |
|---|---|
| Calcium | 300-500 |
| Phosphorus | 800-1000 |
| Magnesium | 400-800 |
| Iron | 60-80 |
| Sodium | 500-800 |
| Potassium | 1300-1650 |
| Zinc | 2.0-4.0 |
| Copper | 1.0-2.0 |
| Manganese | 1.0-3.0 |
| Chromium | 0.2-0.5 |
| Selenium | 0.05-0.2 |

# Role of Minerals in our Body

| | |
|---|---|
| **Calcium** | Important for healthy bones and teeth; helps muscles relax and contract; important in nerve functioning, blood clotting, blood pressure regulation, immune system health |
| **Phosphorus** | Important for healthy bones and teeth; found in every cell; part of the system that maintains acid-base balance |
| **Magnesium** | Found in bones; needed for making protein, muscle contraction, nerve transmission, immune system health |
| **Iron** | Part of a molecule (hemoglobin) found in red blood cells that carries oxygen in the body; needed for energy metabolism |
| **Iodine** | Found in thyroid hormone, which helps regulate growth, development, and metabolism |
| **Sodium** | Needed for proper fluid balance, nerve transmission, and muscle contraction |
| **Potassium** | Needed for proper fluid balance, nerve transmission, and muscle contraction |
| **Zinc** | Part of many enzymes; needed for making protein and genetic material; has a function in taste perception, wound healing, normal fetal development, production of sperm, normal growth and sexual maturation, immune system health |
| **Copper** | Part of many enzymes; needed for iron metabolism |
| **Manganese** | Part of many enzymes |
| **Chromium** | Works closely with insulin to regulate blood sugar (glucose) levels |
| **Selenium** | Antioxidant |

# FATTY ACIDS

| Fatty acids | g/100g |
|---|---|
| Myristic acid | 0.05-0.10 |
| Palmitic acid | 1.0-2.0 |
| Stearic acid | 0.10-0.20 |
| Oleic acid | 0.10-0.20 |
| Linoleic acid | 0.50-0.90 |
| Gamma Linoleic acid | 1.00-1.50 |
| α-Linoleic acid | Trace |
| Stearidonic acid | Trace |
| Eicosapentaenoic acid | Trace |
| Docosahexaenoic acid | Trace |

## Phytopigments

| Phytopigment | mg/100g |
|---|---|
| Phycocyanin | 15000-19000 |
| Total Carotenoids | 400-500 |
| Carotenes | 160-260 |
| •Alpha-carotene | Traces |
| •Beta-carotene | 170 |
| Xanthophyls | 170-240 |
| •Cryptoxanthin | 55.6 |
| •Echinenone | 44.0 |
| •Zeaxanthin | 31.6 |
| •Lutein | 29 |
| Chlorophyll | 1300-1700 |

# Roles of Phyto-pigments

**Phycocyanin**

- Related to the human pigment bilirubin, which is important to healthy liver function and digestion of amino acids.
- Significant for its Anti-inflammatory, Anti-oxidant & Anti-cancer activities.

**Chlorophyll**

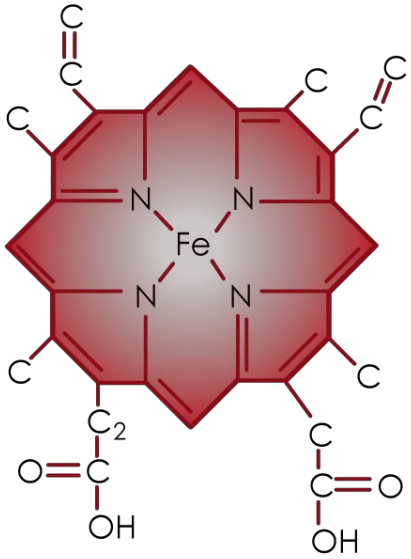
- It is believed that if chlorophyll is ingested with sufficient iron, the magnesium can be displaced to yield a hemoglobin molecule
- Increases peristaltic action and thus relieves constipation, and also normalizes the secretion of digestive acids
- Soothes the inflammation and reduces the excess pepsin secretion associated with gastric ulcers

**Porphyrin**

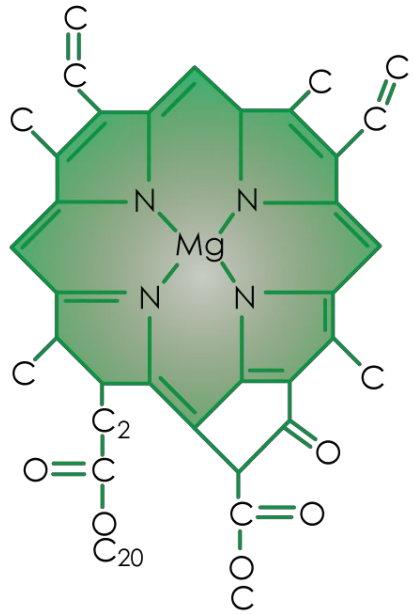
- A red compound that forms the active nucleus of hemoglobin. Related to this structure is the polypyrrole molecule of B12, which is essential to the formation of healthy red blood cells.

**Other Pigments:**

- Carotenoids, Phycoerythrin, Xanthophylls




Human Blood Hemoglobin

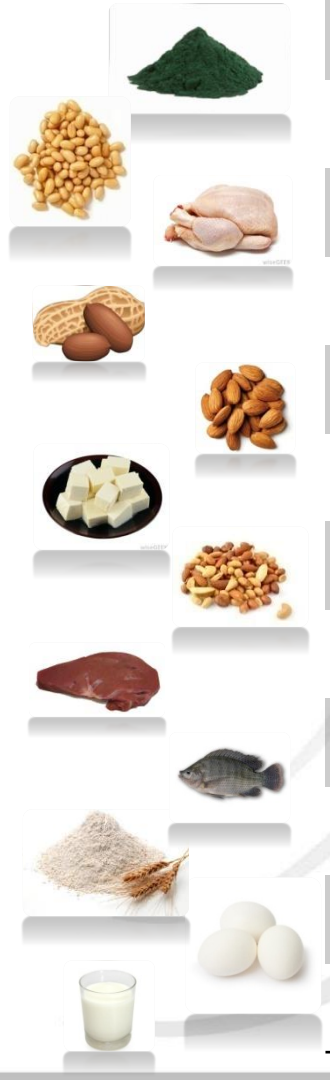



Plant Chlorophyll

# Why High Phycocyanin Spirulina?

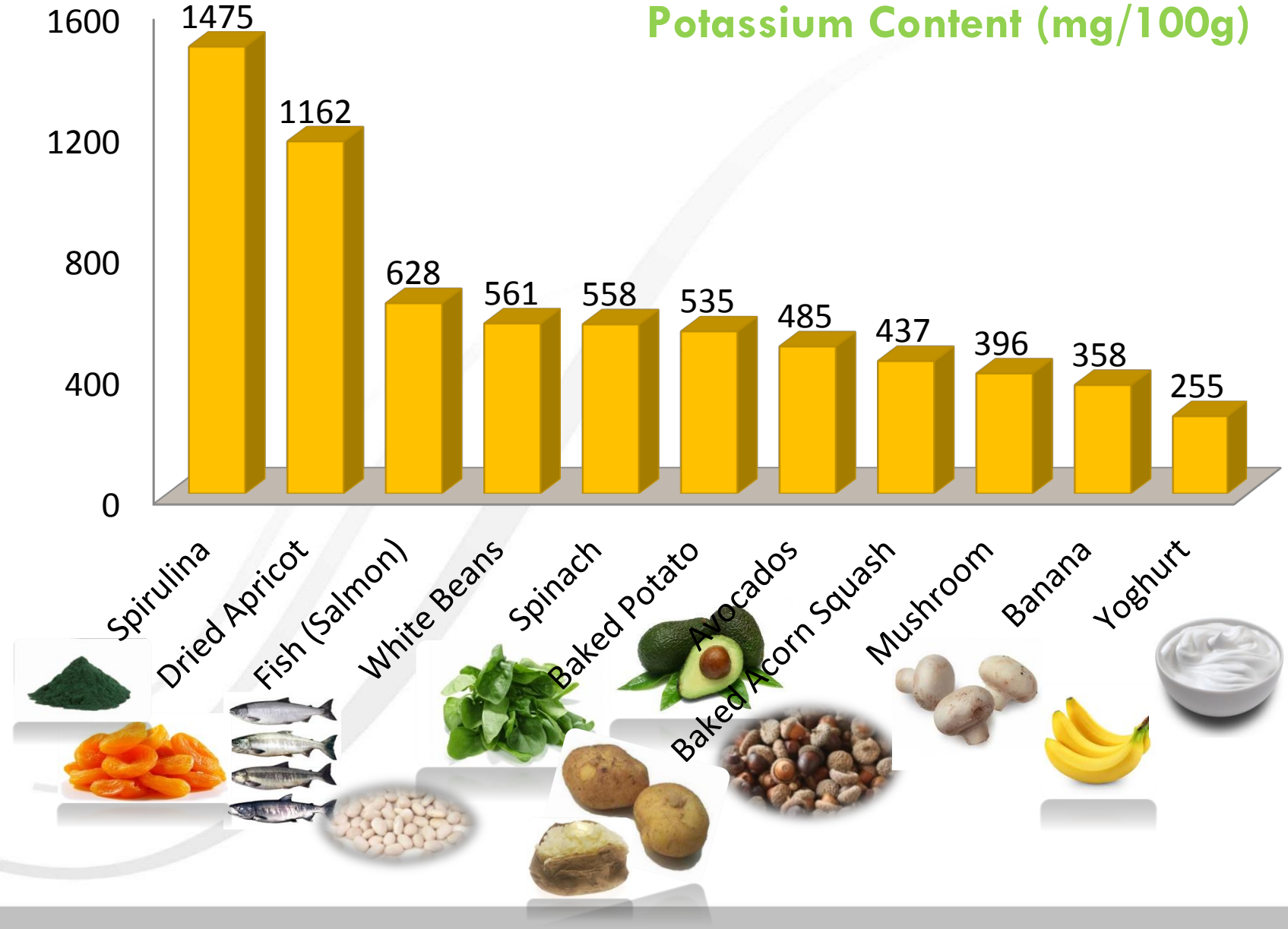
- Phycocyanin is a phycobilliprotein that gives *Spirulina* its unique colour and is believed to be the source of many of *Spirulina*'s positive actions.
- Phycocyanin is a novel anticancer molecule, which shows potent cancer preventive and cancer fighting properties.
- Phycocyanin also imparts its anti-inflammatory and neuro-protective properties to *Spirulina*.
- Rich Phycocyanin content in *Spirulina* demonstrates strong anti-oxidant profile, due to which it is helpful in suppressing unfriendly and drug resistant bacteria like *E. coli*, *Klebsiella pneumonia*, *Pseudomonas* etc, thus cleanses intestinal flora.
- Its anti-oxidant property improves the detoxification process of the body. High Phycocyanin *Spirulina* also plays a vital role in enhancing the immune system, thus strengthening the body enabling it to ward off infections and may reduce post treatment recovery time.
- Owing to these virtues of Phycocyanin, Hash Biotech Labs has optimised the Spirulina strain for higher Phycocyanin content.

# Comparison of Spirulina protein and other foods

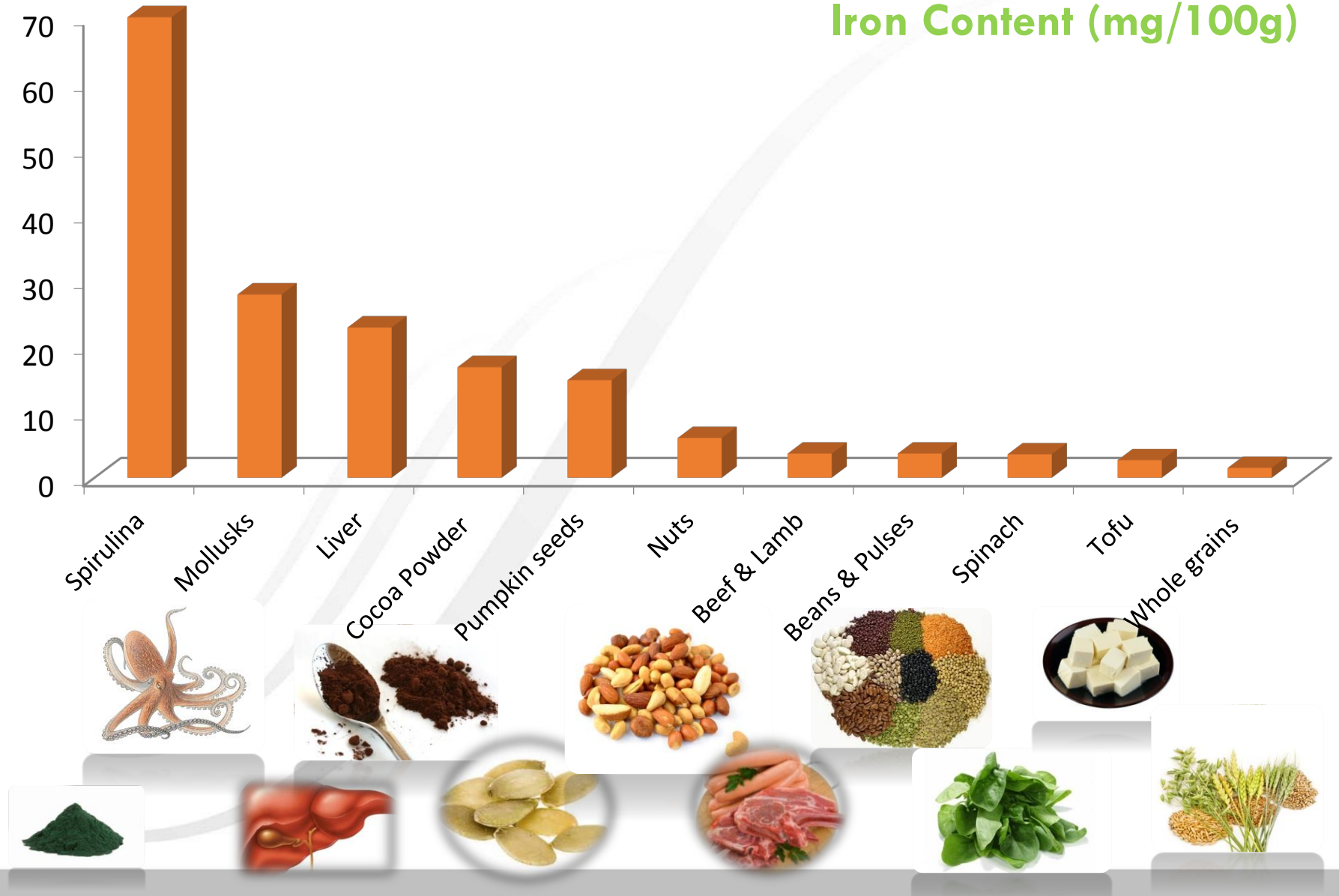


| Food Type | Crude Protein % |
|---|---|
| Spirulina | 65 |
| Soyabean | 36 |
| Chicken | 31 |
| Peanuts | 26 |
| Almond | 21 |
| Paneer | 21 |
| Nuts | 21 |
| Beef Liver | 20 |
| Fish (Telapia) | 19 |
| Whole Wheat Floor | 14 |
| Boiled Egg | 13 |
| Whole Milk | 4 |

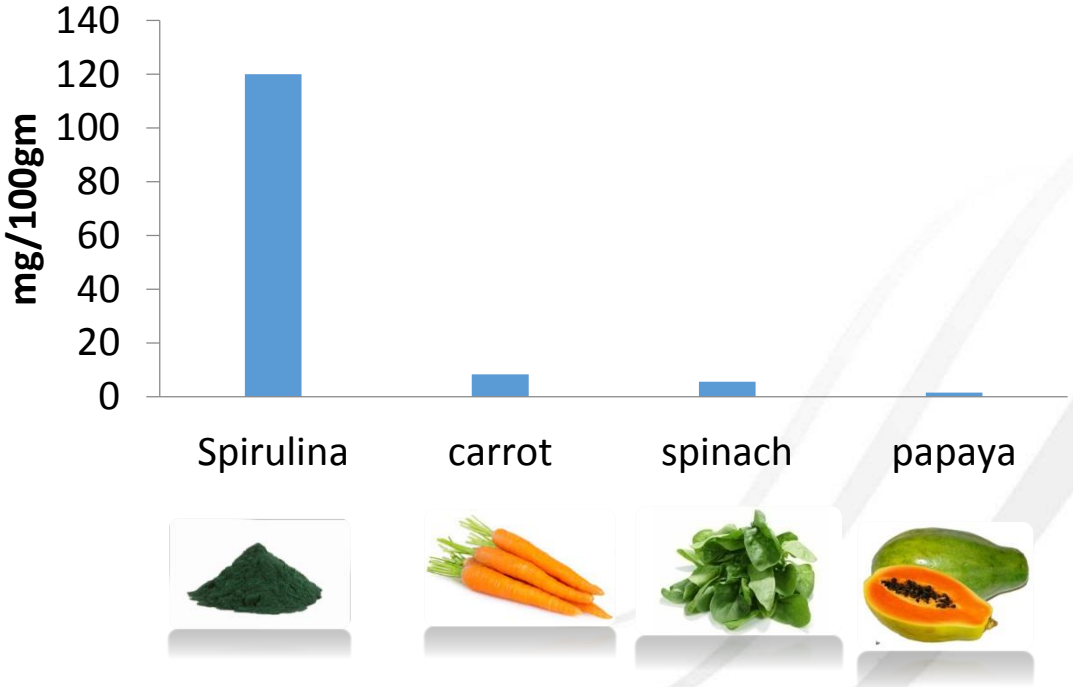
# Potassium Content (mg/100g)



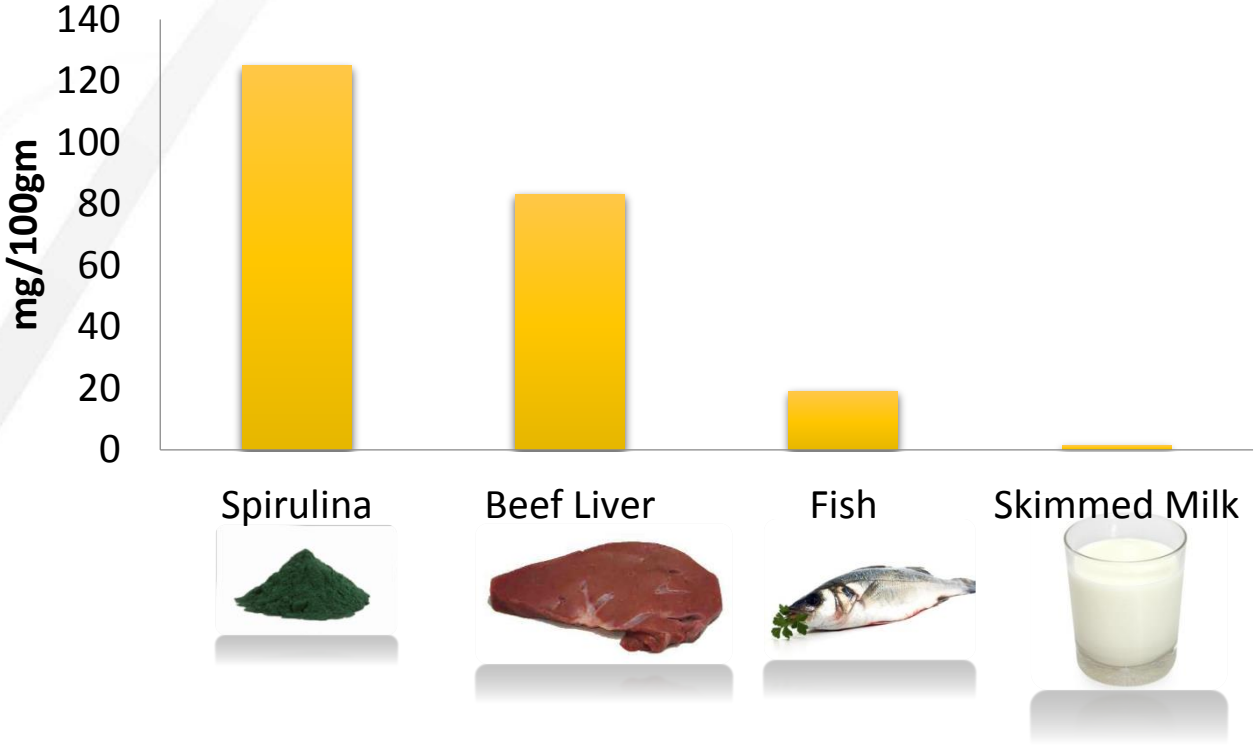
# Iron Content (mg/100g)



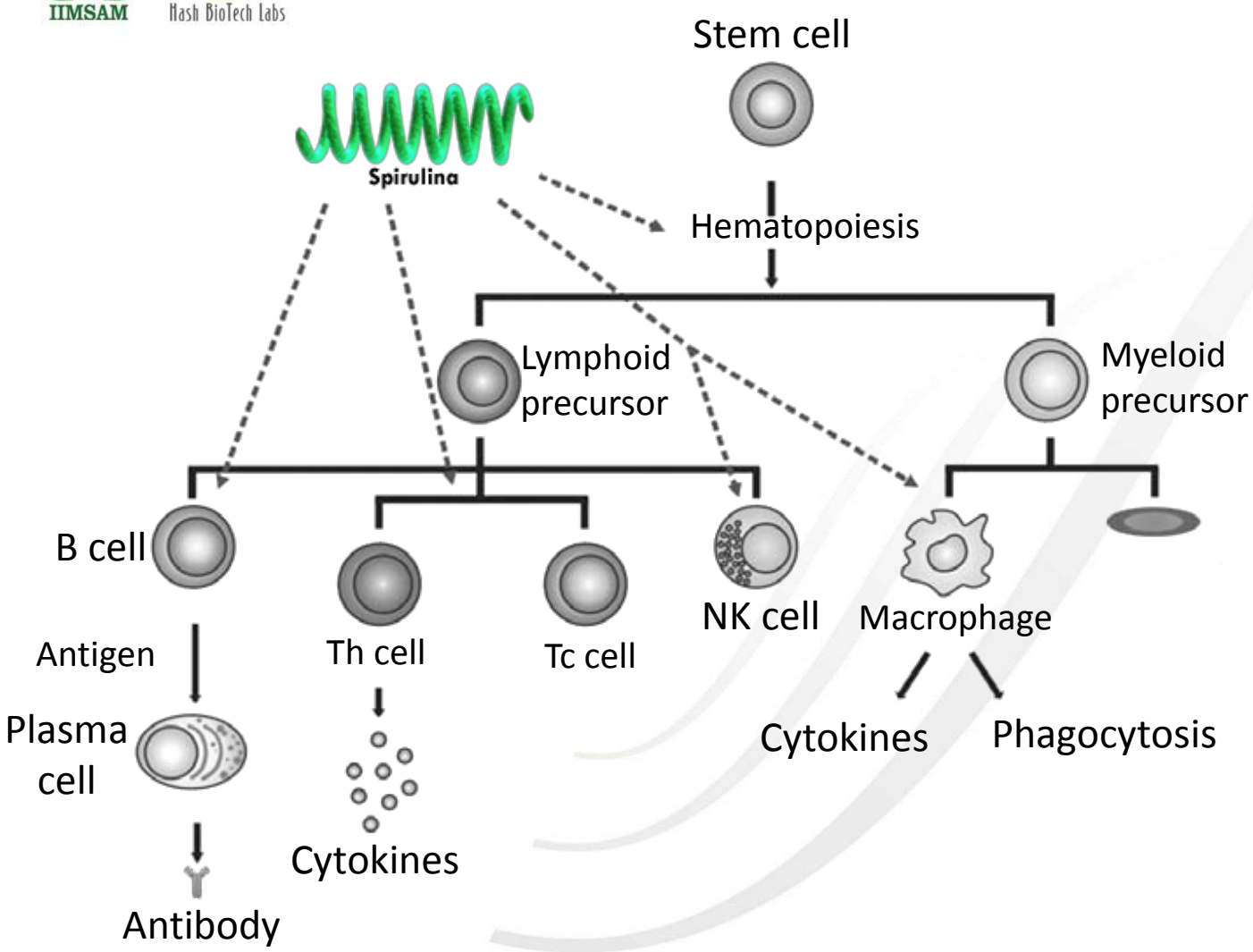
## beta carotene




## Vitamin B12



# Spirulina as Immunity Enhancer



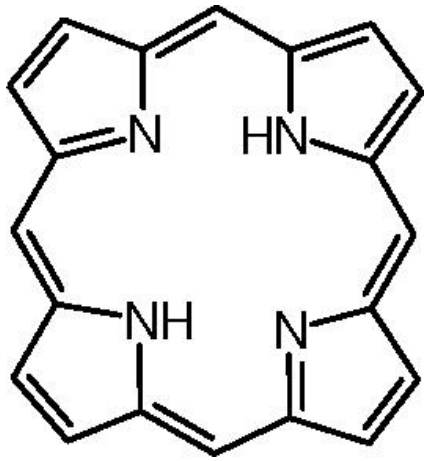

## ANTIBODY RESPONSE AND MACROPHAGE

- Spirulina enhances hematopoiesis to produce more erythrocytes and lymphocytes
- Spirulina shows direct effect on innate immunity by activating macrophages and NK cells
- Spirulina activates T-helper cells and T-cytotoxic cells
- Spirulina induces the maturity of B-cells for the production of antibodies

## MUCOSAL IgA RESPONSE

- Agglutination of micro-organisms
- Neutralization of bacterial enzymes, toxins, and viruses; immune exclusion
- Blocking adherence of bacteria to the epithelium
- Reduction of antigens or allergen absorption.

# Phycocyanin enriched Spirulina for Anaemia



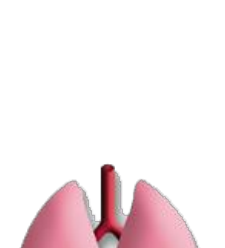

Porphyrin ring

## ANAEMIA

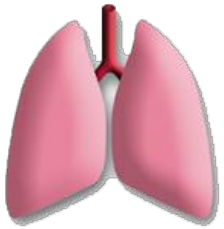
**PROBLEMS IN PRODUCTION OF BLOOD CELLS**

**INCREASED DESTRUCTION OR LOSS OF BLOOD CELLS**

Consequences of anaemia



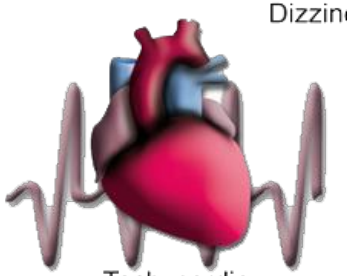
Fatigue



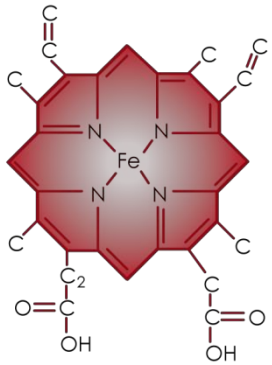
Breathlessness

Dizziness

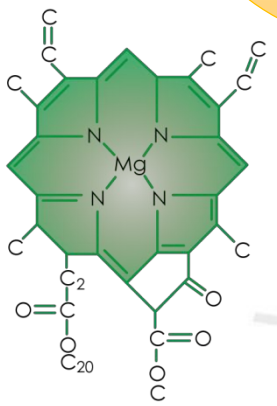
Pallor



Tachycardia
(Rapid heartbeat)




Human Blood Hemoglobin

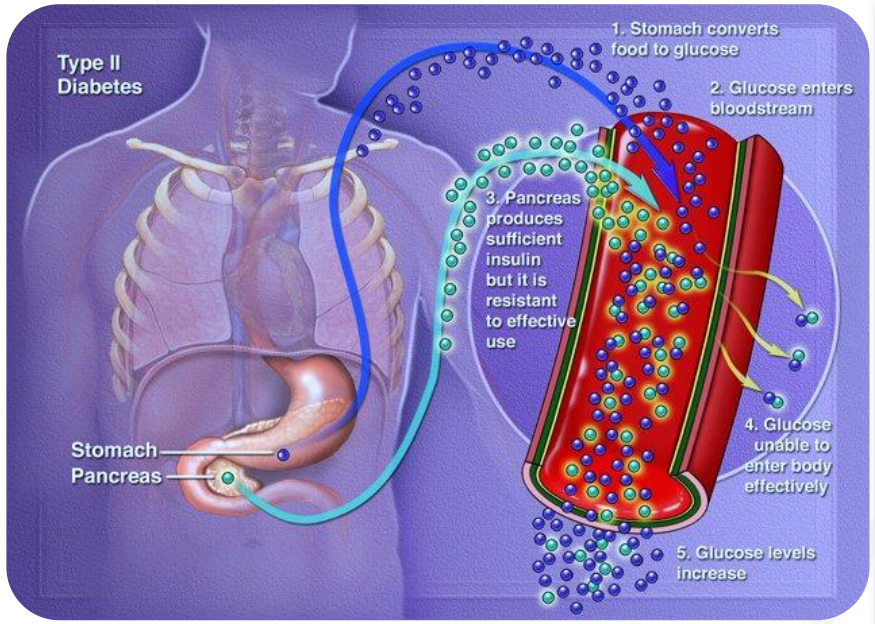


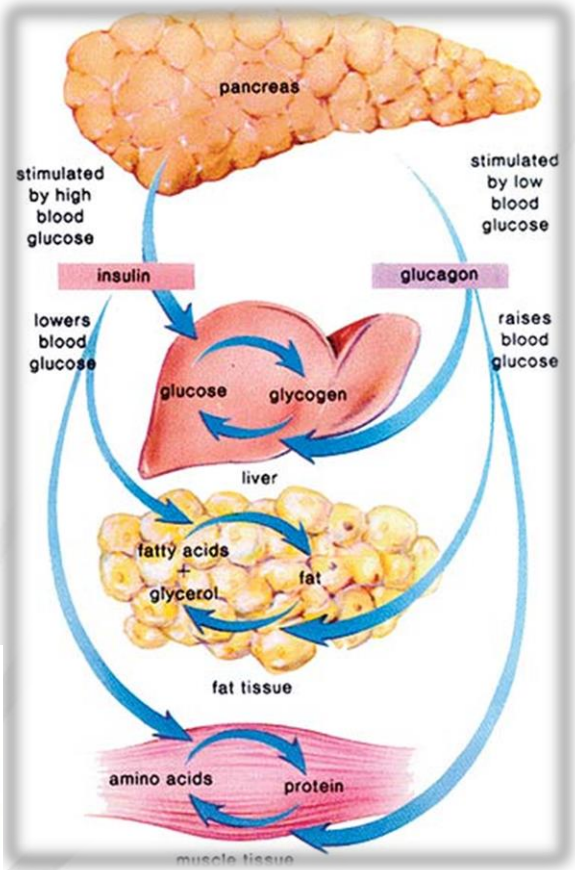

Plant Chlorophyll

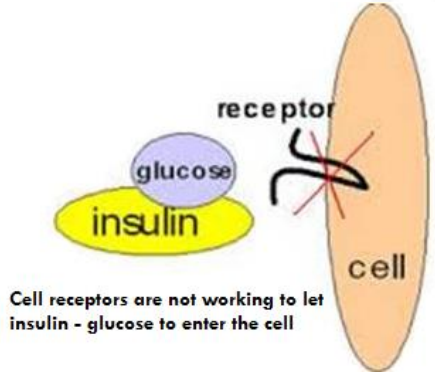
- ✓ Contains porphyrin and bio-chelated iron which help in curing anemia.
- ✓ High nutrient density, especially the easily assimilated protein, folic acid, vitamin E, blood-building vitamins B12, folic acid and the amino acids, make it an ideal food source for persons suffering from anemia. Its use is most encouraged for expecting and lactating mothers.

(Tietze, 2004)

# Spirulina for Diabetes




## Role of Insulin:

Insulin is a peptide hormone produced by β cells of Pancreas. It aids in:

- Entrance of glucose in cells.
- Regulation of glucose level in blood.

## Causes of Diabetes:

- Insufficient production of Insulin.
- Production of defective Insulin.
- Inability of cells to use insulin properly and efficiently.

# Deficiency of Nutrients & Diabetes

**Chromium**
- Helps insulin to attach with cell's receptors

**Magnesium**
- Increase insulin sensitivity

**Zinc**
- Needed in the synthesis, storage and secretion of insulin

**Vit $B_7$ (Biotin)**
- Stimulates glucose-induced insulin secretion in pancreatic B-cells

**Vit-C**
- Lowers glycolysated hemoglobin (HbA1c) and fasting and post-meal glucose levels

**Vit-D**
- Suppresses inflammation of pancreatic B-cells

**Vit-E**
- Protect Beta cells from oxidative stress

**Vit-B12**
- Deficiency is prevalent in diabetics because metformin used in diabetes treatment depletes B12

**Carnitine (Lysine & Methionine)**
- Reduces and even prevents pain from diabetic neuropathy
- Improves insulin sensitivity

**Glutamine**
- Triggers and potentiates glucagon-like peptide-1 secretion

**Taurine (Methionine& Cysteine)**
- Reduces and prevents pain from diabetic neuropathy
- Improves insulin sensitivity

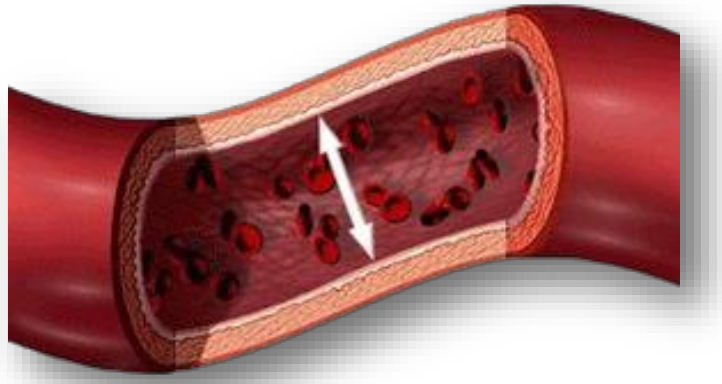
**Glutathione**
- Protect Beta cells from oxidative stress

# Role of Spirulina in Diabetes

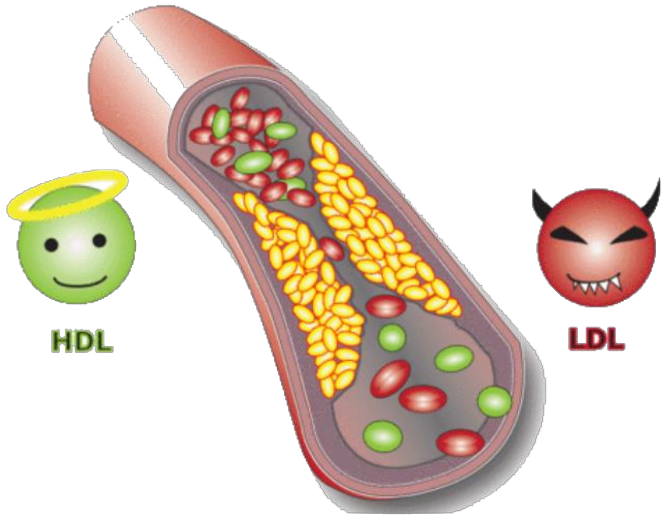
- Spirulina helps to fulfil all the deficiencies, the accumulation of which leads to diabetic condition.
- Possesses hypoglycemic and hypolipidemic properties and reduces insulin resistance.
- Increases glucose metabolism in Type II diabetic patients
- Activates pancreatic beta cells for insulin production in Type I diabetic patients.
- Stimulate glycogenesis in the liver & Greater uptake of glucose from blood by liver cells (Fayzunnessa et al., 2011).
- Lower risk of the tissues for oxidation stress and high resistance for diabetes (Layam and Reddy et al., 2007).
- Inhibition of endogenous synthesis of lipids & down regulation of lipogenesis.
- Spirulina prevents diabetic retinopathy.
- Spirulina helps to mitigate the effects of unbalanced nutritional condition in diabetic patients.

# Role of Spirulina in Hypertension and Cholesterol

- Spirulina helps in electrolytic balance by providing Potassium to body
- Spirulina boots the synthesis of Nitric Oxide, which helps in dilation of blood vessels, thus in turn improves blood flow through them.



- Spirulina prevents blood clots in arteries by preventing platelets aggregation
- Spirulina helps in significant reduction in serum cholesterol, blood cholesterol, triglycerides and LDL levels.
- Spirulina increase HDL levels.
- Spirulina reduces hypercholesterolemic Atherosclerosis.

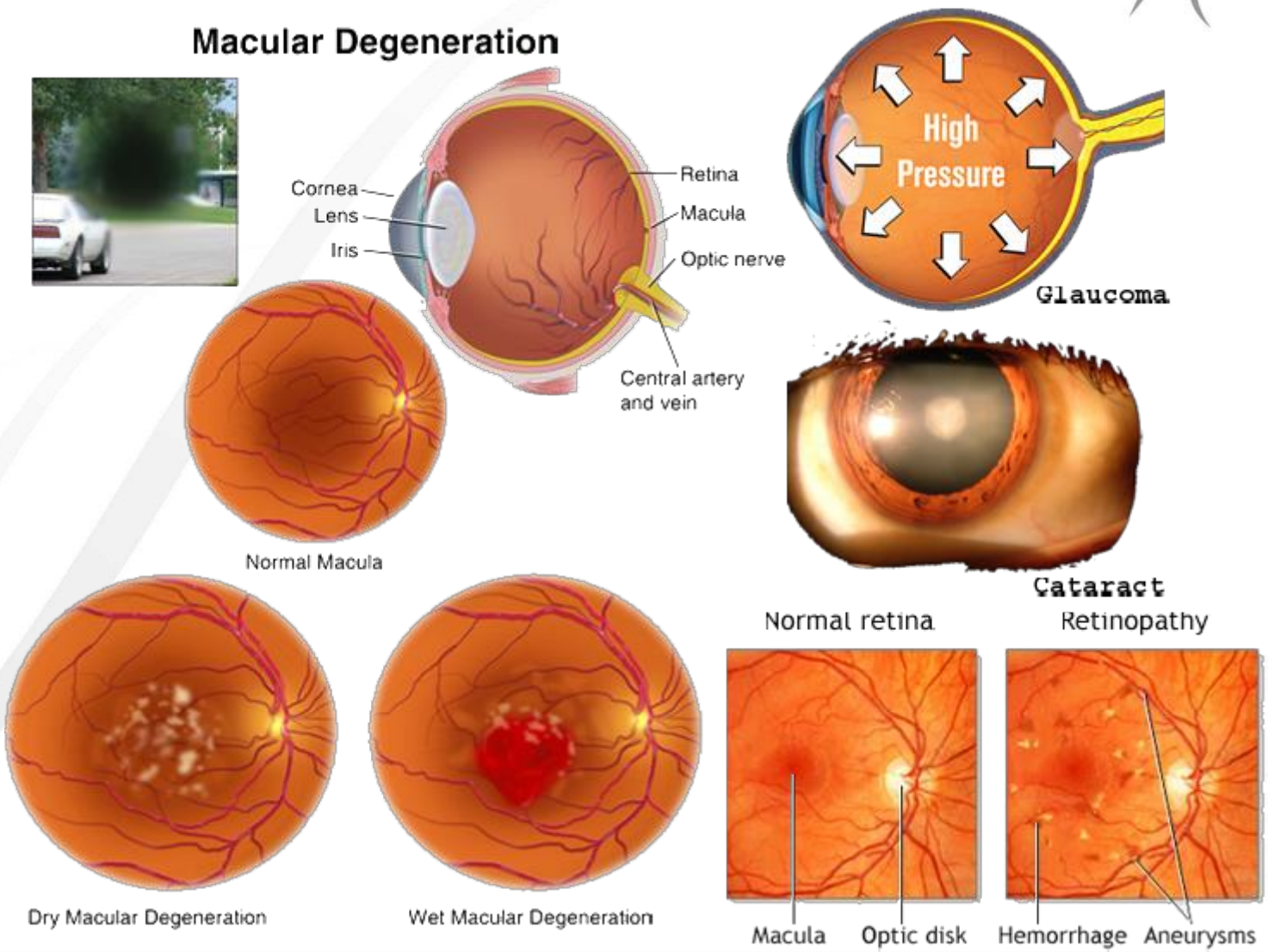


# Spirulina for Eye Health

- Spirulina is a rich dietary source of **zeaxanthin**, a xanthophyll, which are substances similar to **carotenes**, the pro-eye compounds.

- Help protect your eyes from damage due to ultraviolet-induced oxidation of lipid membranes and high blood glucose level by slowing down the oxidation and thereby helping prevent degeneration of macula.

- Thus, its intake may have benefit in reducing risk of glaucoma, cataract and age-related macular degeneration.

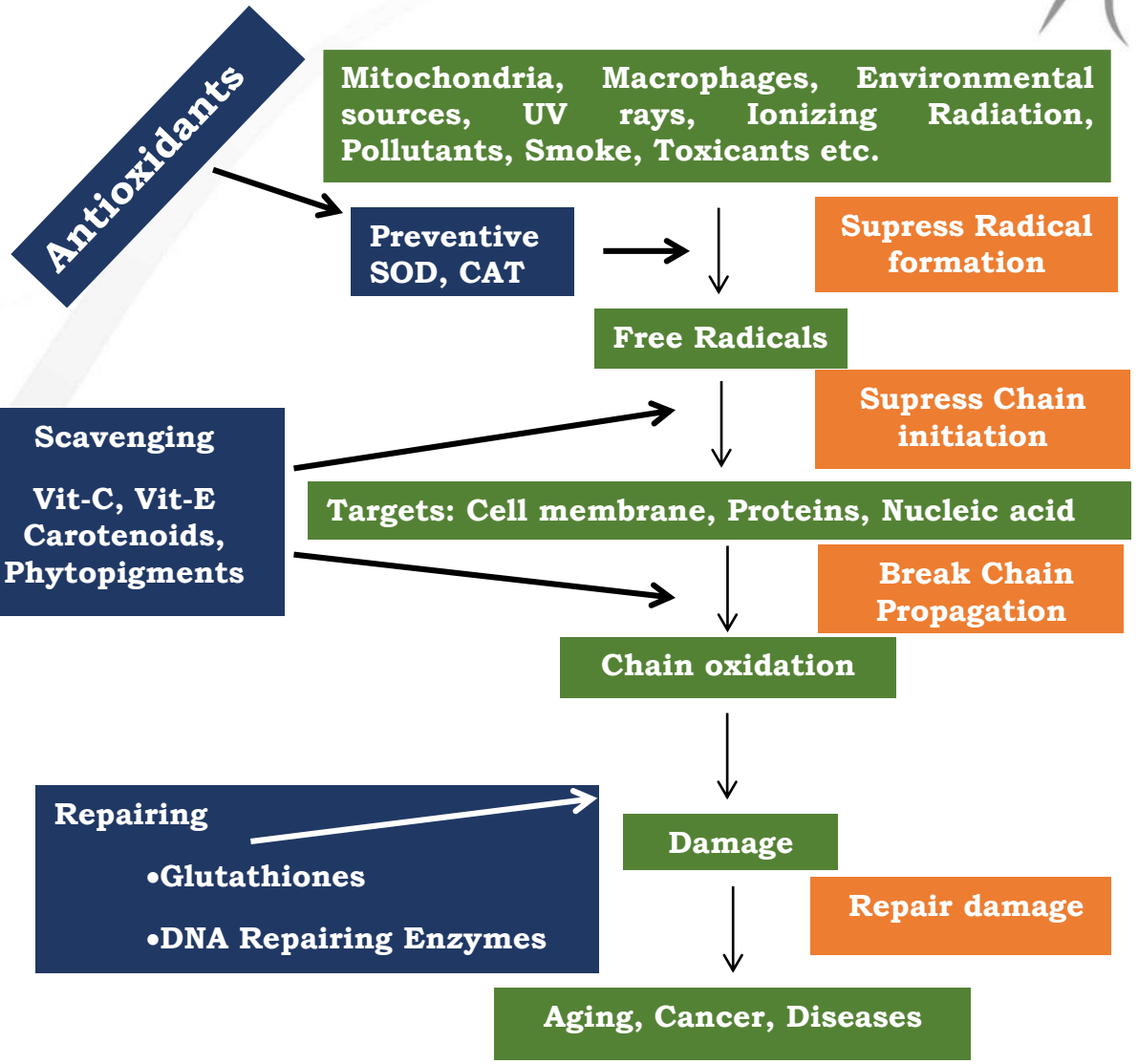


# Spirulina for Anti-Aging

Aging results from the gradual decline in cellular repair and housekeeping mechanisms, which leads to an accumulation of damaged cellular constituents and ultimately to the degeneration of tissues and organs (Gelino and Henson, 2012).

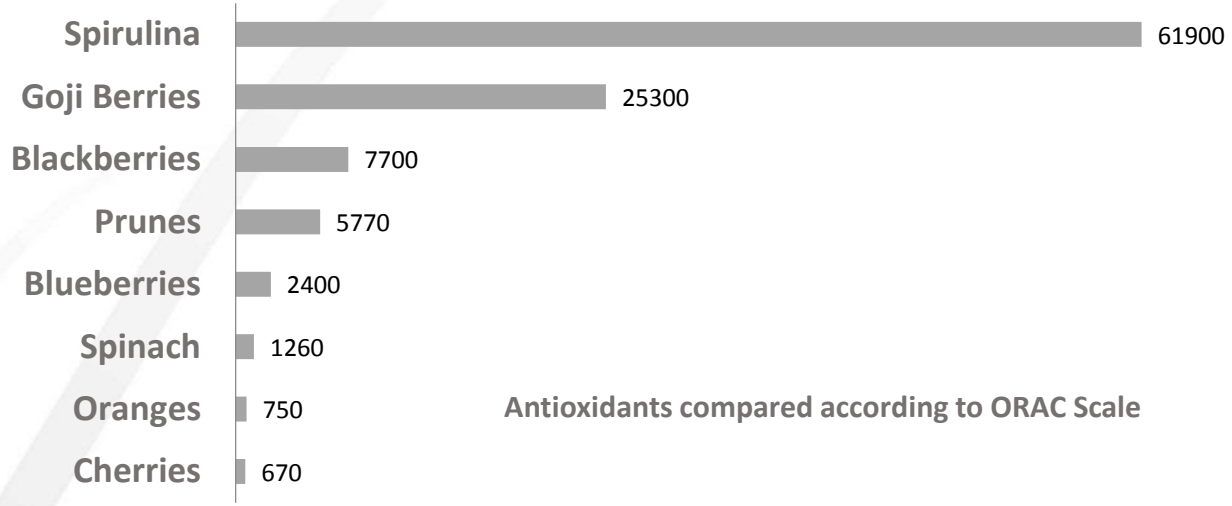
**Possible causes of aging can be divided into:**

- ✓ Those that are built into the system as specific DNA or RNA coding (or catalytic) sequences.
- ✓ Those that are the result of controllable or uncontrollable environmental factors including radiation, nutrition, and lifestyle (Barnett and Barnett).
  - ➢ Since the mitochondria are the site of production of reactive oxygen species, and so might lead to a significant over-estimation of nuclear DNA damage (Barnett and Barnett).
  - ➢ For any product to act as anti aging, it must improve the protection of DNA that further guides the protein production.



# Role of Spirulina as Anti aging

- Spirulina is rich in antioxidants:
  - ✓SOD
  - ✓Catalases
  - ✓Phenolic compounds
  - ✓Phycocyanin
  - ✓Vitamin E
  - ✓β-Carotene




- Free- radical reactions have been implicated in the pathology of many human diseases.
- A high level of antioxidants present in Spirulina help in neutralisation or scavenging of these free radicals.
- ORAC (Oxygen Radical Absorbance Capacity) value is about 50 times that of Spinach.



*Estrada et al., 2001; Colla et al., 2007; Bakky et al., 2007; Dartsch, 2008; Kalafati et al., 2009; Shanmugapriya and Ramanathan, 2012; USDA*

# Antioxidant effects of Spirulina

Spirulina and Exercise-induced oxidative damage - prevents skeletal muscle damage
Spirulina and Metal-induced oxidative damage
Spirulina and Drug-induced oxidative damage
Spirulina and Hepatotoxin-induced oxidative damage
Spirulina & Neuronal oxidative damage

**Mechanisms of Antioxidant activity of Spirulina**

Free radical scavenging
Inhibition of lipid peroxidation
Superoxide anion (an ROS) hydroxyl, alkoxyl, and peroxyl radicals
Reduced Malondialdehyde & conjugated diene
Enhancement of glutathione, glutathione reductase, glutathione peroxidase, superoxide dismutase (SOD) and catalase

**Neuro-Hepato-Nephro Protective:**

- Spirulina's enriched antioxidant profile helps to protect us from neuro-degenerative diseases like Alzhiemer's, Parkinson's and other forms of age related dementia.
- Improves overall cognitive functions
- Protects the liver and kidney cells from lipid peroxidation and ROS.
- Protects liver and kidney cells from metal induced toxicity.

# Allergy and Inflammation

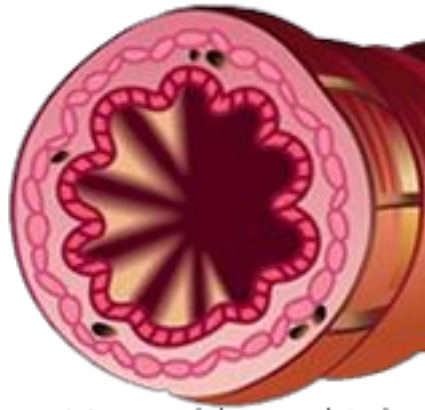
**Vasoactive and Inflammatory mediators**

- Cytokines
- Chemokines
- Histamines
- Prostaglandins
- leukotrienes
- Reactive oxygen species
- Nitrogen species

→

**Allergy & Inflammation**

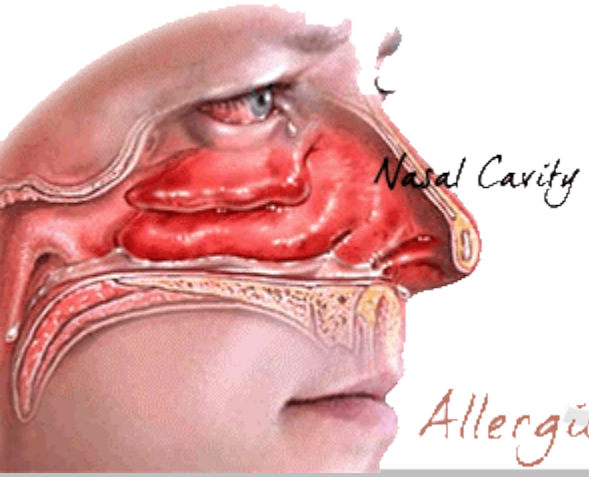
- Asthma
- Rhinitis
- Anaphylactic Shock
- Dermatitis



Normal bronchiole

Asthmatic bronchiole

**Anti-inflammatory effect of Spirulina**

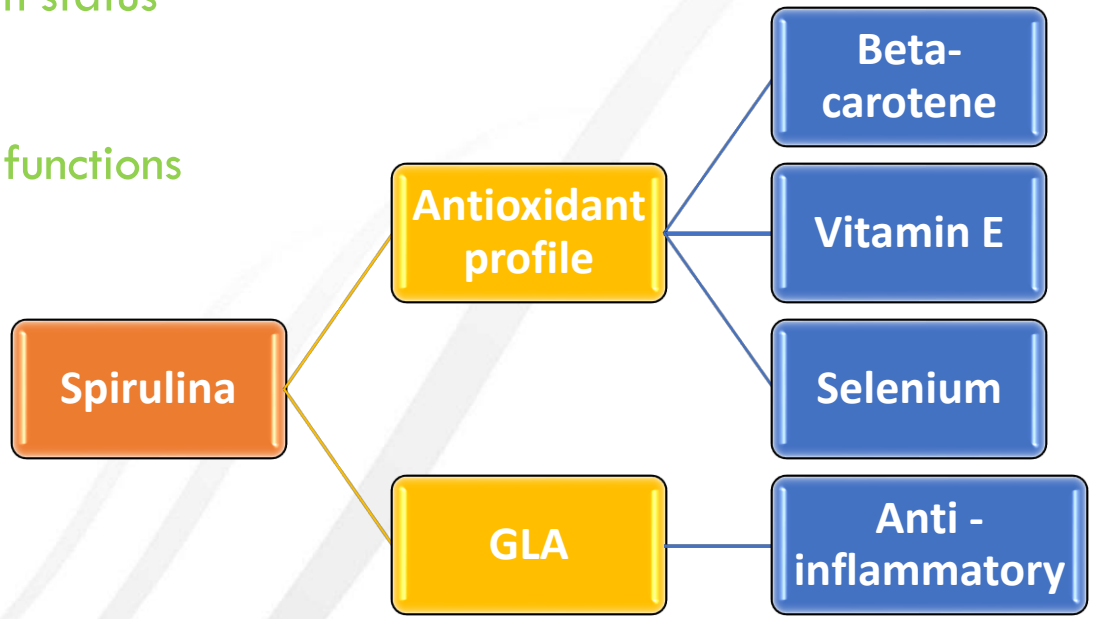



Allergic Rhinitis

- ✓Decreasing leukotriene B4 & prostaglandin E2 in inflamed tissue
- ✓Significantly inhibits histamine release and TNF-$\alpha$ production mediated by IgE.
- ✓Alleviate the symptoms of Allergic Rhinitis and Asthma.
- ✓Relieve inflammation associated with Arthritis and various Allergies.

# Spirulina and Asthma

- Asthma is characterized by the following
  - Poor protein status
  - IgE levels
  - Pulmonary functions




- Beta-carotene, Vitamin E and Selenium content of Spirulina help in scavenging endogenous and/or environmental oxidant sources

# Spirulina and Skin Health

- Spirulina is very rich in β-carotene, which protects the skin by providing elasticity.
  - Together with vitamin E, Selenium and Zinc, β-carotene helps to deep cleanse the skin.
- Chlorophyll in Spirulina is very beneficial for a healthy skin, due to its cell building factor and oxygen storing ability.
  - It is also beneficial against skin inflammations.
- Gamma Linolenic acid (GLA) present in Spirulina protects the skin against UV radiation, dehydration and activates the blood circulation of the skin.
- The high content of the natural amino acid like Tyrosine in Spirulina slows down the ageing process of cells.
  - It is also involved in the coloration of hair and skin, and helps with sun burn protection.
- Vitamins presence is suitable as a nourishing moisturizer for dry older skin with under active sebaceous glands. Minerals are easily absorbed by the skin and are beneficial for an optimal function of the skin.
- As a natural antioxidant, Vitamin E promotes the formation of skin cells, improves blood circulation and helps relieve symptoms of dermatitis and acne in teenagers (Moorhead et al., 1993; Tietze, 1999).

# Spirulina and Hypothyroidism

- Within the endocrine system, thyroid is the biological engine that ultimately directs hormonal function and, therefore, metabolism. Therefore, its proper functioning is critical to the body's over all metabolic rate, energy (ATP) production, digestion, and many other functions.

- The elements most closely associated with the thyroid are:
  - Iodine
  - Tyrosine
  - Selenium

- Thyroid hormones (T3 and T4) consist of a tyrosine compound (made from the amino acid phenylalanine) to which atoms of iodine are added.

- Selenium is the most important nutrient required for the conversion of extra T4 to T3, as T3 is a more active form.

- Spirulina is having natural iodine and Selenium, which nourishes the thyroid, protects all glandular tissues and ultimately supports both immune and metabolic function.

- Phenylalanine present in it is used by the thyroid for the production of tyrosine (Triggiani et al., 2009; Kharrazian, 2010; Shames and Shames, 2002, Tietze, 1999).

# Spirulina in Pregnancy & Overall Child development

- Spirulina is recommended for pregnant and nursing mothers as they need Spirulina's extra easy-to-digest complete protein and bioavailable iron and folic acid.
- Spirulina is also a source of essential fatty acids including DHA and EPA.
- Moreover Spirulina is the only available plant source of vitamin-B12 and rich food source of GLA the main precursor to the body's prostaglandins, the chemical which control many of body functions. (Umesh, 2002).
- Spirulina high content of protein (56-69%) is easily digestible and available to body.
- Sufficiently high intake of Spirulina may have potential for prevention and control of preeclampsia.
- Intake of Spirulina is helpful in increasing fat content in milk of lactating mothers.
- National Institute of Nutrition (NIN), Hyderabad has conducted several studies for Spirulina effect against anaemia and reports suggested that intake of Spirulina can plug iron deficiency among anaemic pregnant women.

# Weight Management

- **Phycocyanin enriched Spirulina** can be used for weight management.
- It is low in calories, fat, highly digestible and what is very important, it is in its natural balance
- Spirulina contains both Tyrosine and Phenylalanine, which directly influence the neurotransmitters (norepinephrine and dopamine) in brain which control appetite
- It is a rich source of GLA, which has a specific effect on the endocrine system, helping restore hormone, health and prevents insulin resistance, which is one of the cause of Obesity in diabetic patients.




Tietze, 2004, Ramamoorthi and Premakumari, 1996

# Anticancer and Antiviral properties of Spirulina

- Anticancer properties of Spirulina are due to high content of Phycocyanin present in it.
- Phycocyanin enriched Spirulina induces apoptosis in tumour cells by fragmentising damaged DNA.
- The unique polysaccharides of Spirulina improve the immune system to combat against cancer-drug resistance.
- Spirulina has shown antiviral effects in laboratory and animal studies. It appeared to block the entrance of viral cells in to host cells.
- Several viruses, including HIV- the virus that causes AIDS – were apparently killed or damaged by Spirulina or chemicals (cyanovirin-N protein) derived from it.

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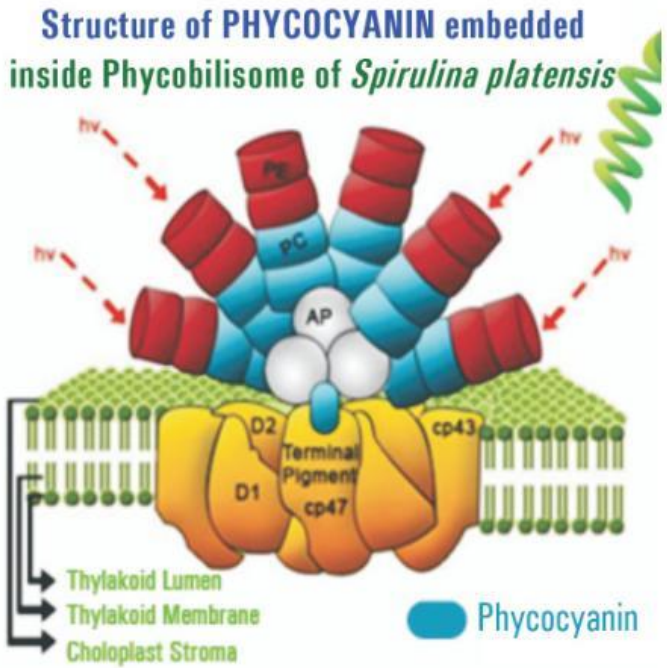
# IIMSAM – HASH BIOTECH LABS HUMANITARIAN LIFESAVER SPIRULINA EXTRACT

# PHYCOCYANIN

# Therapeutic values of Phycocyanin

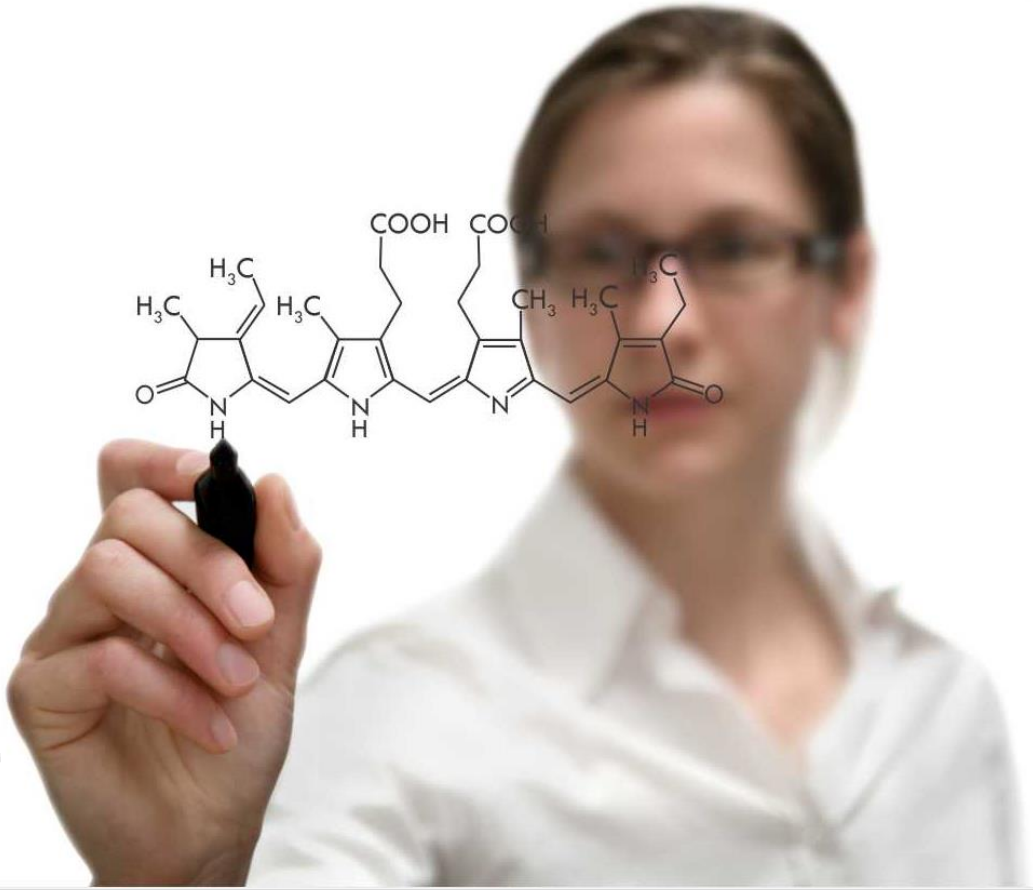
IIMSAM Hash BioTech Labs




*The structure of phycocyanin consists of 2 dissimilar α and β protein subunits of 17kDa and 19.5kDa respectively with one bilin chromophore attached to the α subunit and two to the β subunit (Mc Carty 2007).*

- Natural dietary supplement
- Extracted from *Spirulina platensis*
- Water soluble and Non-toxic

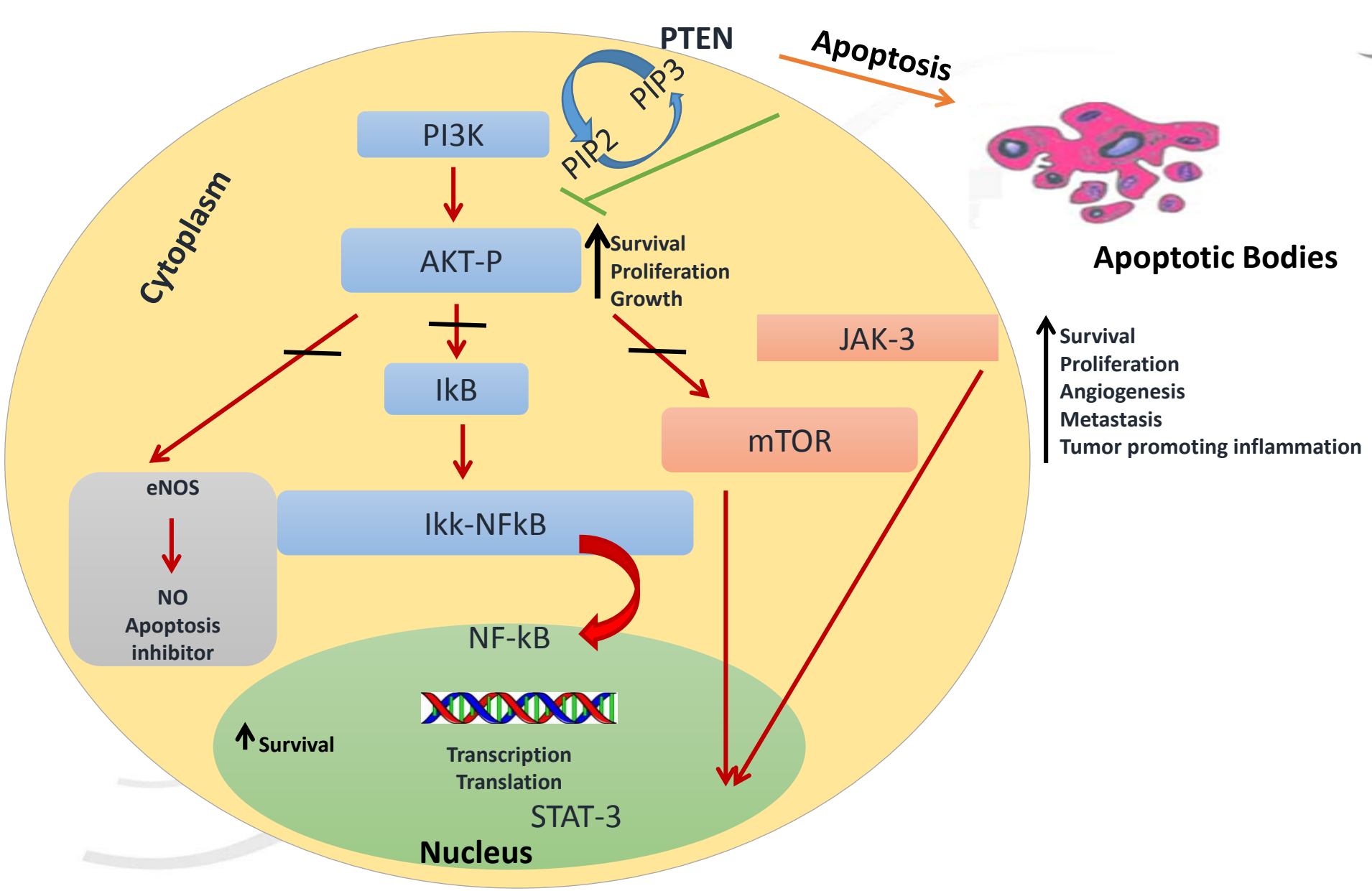
- Anticancer
  - Adjuvant Therapy
  - Palliative Care
  - Cancer Preventive
- Anti-inflammatory
- Anti-Oxidant
- Hepato-protective
- Neuro-protective
- Nephro-protective
- Cardio-protective



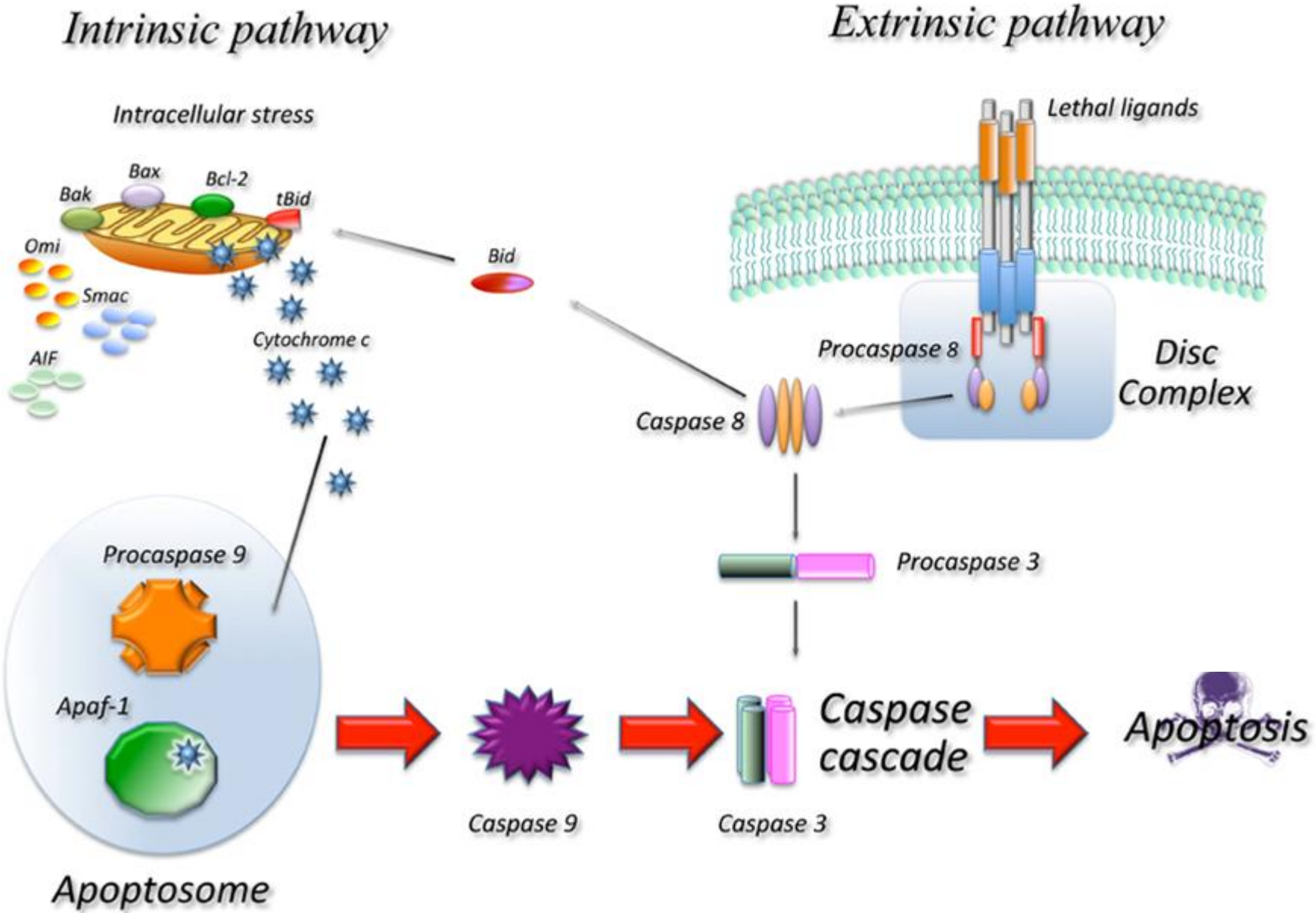
# Attributes of Phycocyanin

| Anti-Cancer | Cancer Prevention | Immuno Enhancer |
|---|---|---|
| Inhibit Tumor cell proliferation | Activate anti inflammatory modulators | Hepato-Protective |
| Induce Tumor cell differentiation | Anti-Oxidant capacity | Neuro-Protective |
| Induce Apoptosis | Induce Phase II enzymes | Nephro-Protective |
| Anti metastatic | Modulate Phase I enzymes | Adjuvant cancer therapy |

# Signal Transduction Pathway activated in cancer



# Apoptosis Pathway

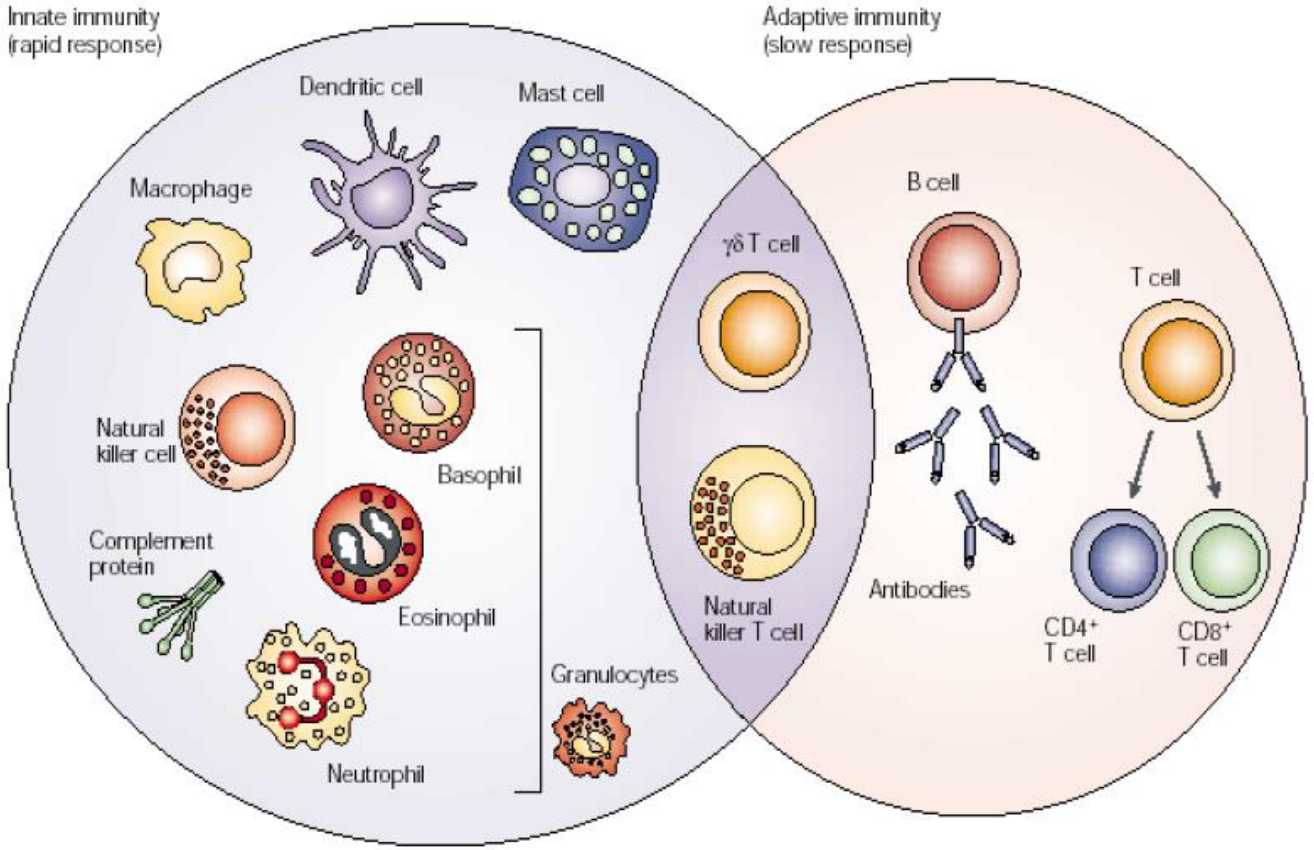


# Anti-Cancer Mechanisms of Phycocyanin

- **In Colon Cancer**
  - Down regulation of PI3K/AKT Pathway
  - Down regulation of JAK3/STAT3 Pathway
- **Breast Cancer**
  - Down regulation of Bcl-2
  - Down regulation of NF-kB
  - Up regulation of FAS-TRAIL Ligands
- **Hepatocellular Carcinoma**
  - Down regulation of AKT Pathway
  - Down regulation of NF-kB
- **Cervical Cancer**
  - Cell Cycle arrest at S/G2 Phase
  - Up regulation of FAS
- **In Leukemia**
  - Down regulation of anti apoptotic Bcl-2
- **In Prostate Cancer**
  - Caspase activation & DNA Fragmentation
- **In Lung Cancer**
  - Cell cycle arrest in G0/G1 phase

# Immune System

The immune system is the body's defence against infectious organisms and other invaders through a series of steps called the immune response. It is mainly comprises of Innate or Nonspecific immune system and Adaptive or Specific immune system.




Male et al., 2006

# Phycocyanin as Immunity Enhancer

- Reason for using Phycocyanin in cancer therapy is that the regular intakes of this molecule have been shown to boost immune responses.
- Improved response of cancers to chemotherapy is observed when used as an adjuvant to chemotherapy.
- Affects the stem cells found in bone marrow, which produce white blood cells that make up the cellular immune system and red blood cells that oxygenate the body.
- Emulates the affect of the hormone erythropoetin, which is produced by healthy kidneys and regulates bone marrow stem cell production of red blood cells (Kozlenko and Henson, 1998).
- Enhances secretary IgA antibody response and suppresses allergic IgE antibody response in mice immunized with antigen-entrapped biodegradable microparticles (Nemoto-Kawamura et. al., 2004).
- The particular types of immune cells involved in cancer control, cytotoxic T lymphocytes and NK cells, function more effectively with increased intakes of Phycocyanin (Arias et. al., 2011).

# Inflammation

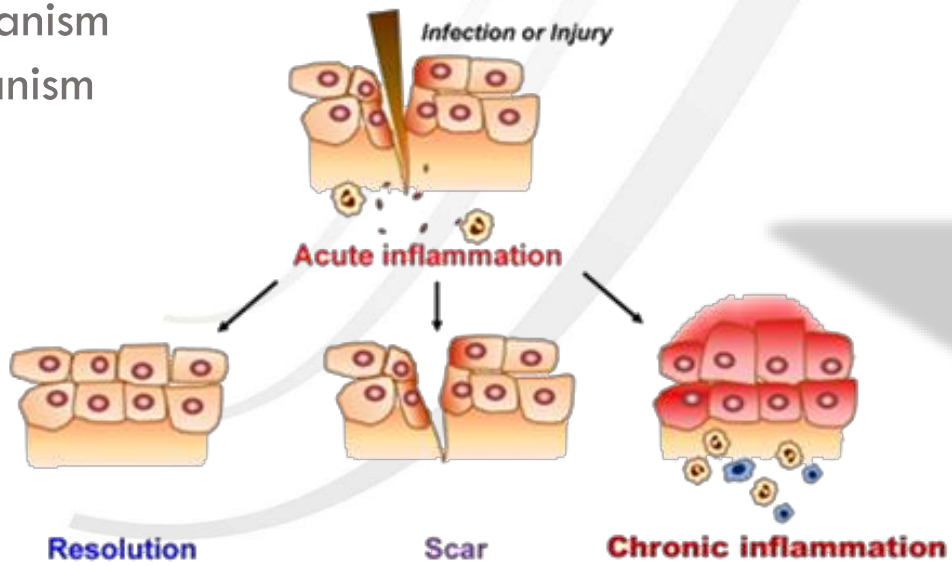
➢ Inflammation is the body's attempt at self-protection & characterized by heat, redness, swelling, and pain.

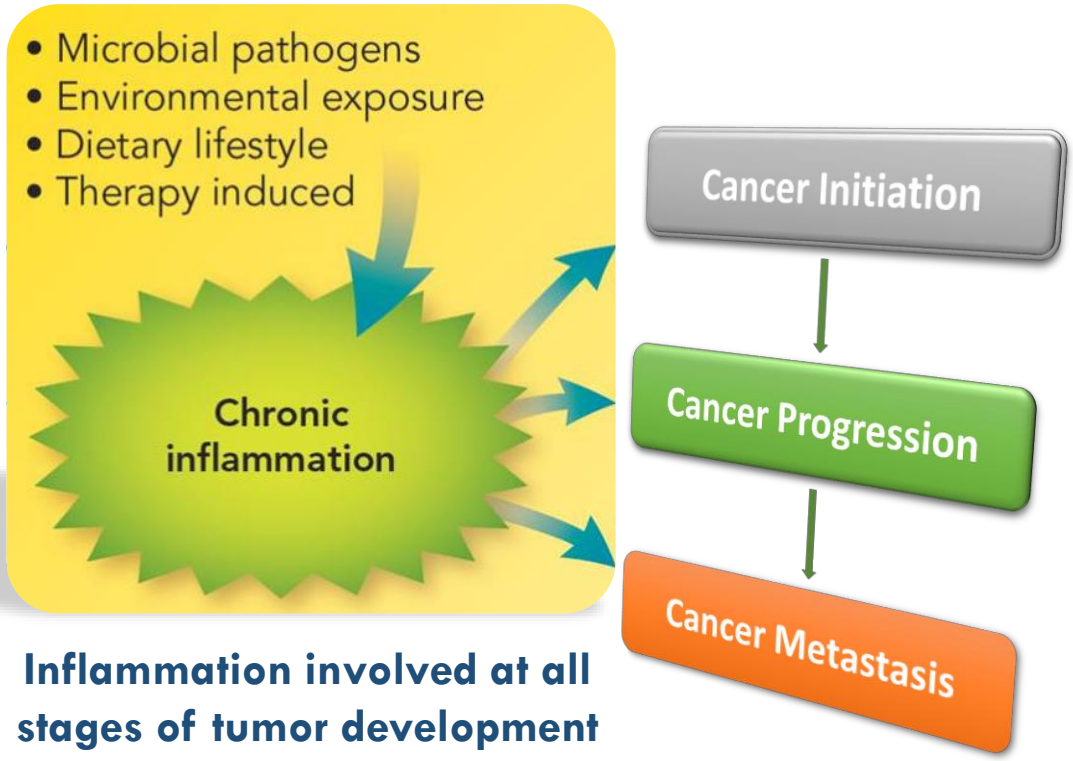
**Cancer related inflammation can fall into one of two categories:**

- Precancerous inflammation lesions
- Inflammation that is present in almost all cancer tissues

**The connection between inflammation and cancer can be thought of as consisting of two pathways:**

- Extrinsic mechanism
- Intrinsic mechanism



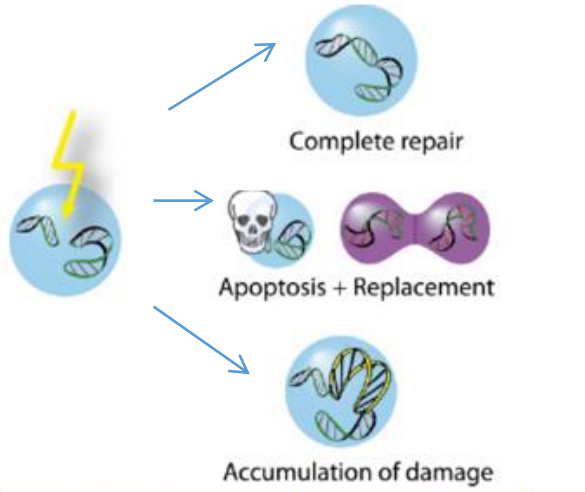

**Inflammation involved at all stages of tumor development**

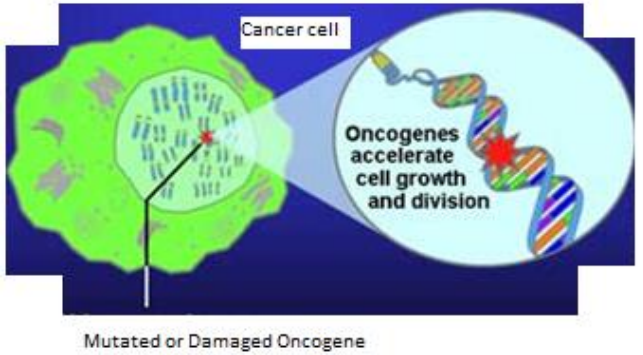
# Inflammation and Cancer

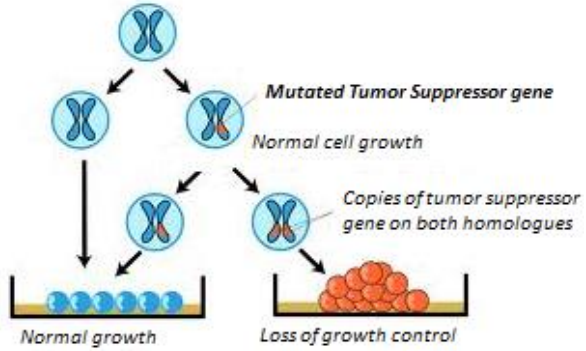
- Chronic inflammation can cause genetic damage via production of oxidizing compounds, such as reactive oxygen and nitrogen species.

- Oncogenes, known for decades as responsible for cell neoplastic transformation.
- Responsible for building up an inflammatory pro-tumorigenic microenvironment.

- Tumor suppressor genes PTEN, p16, p53 and VHL have also been implicated in the induction of inflammatory mediators that may contribute to tumor progression.



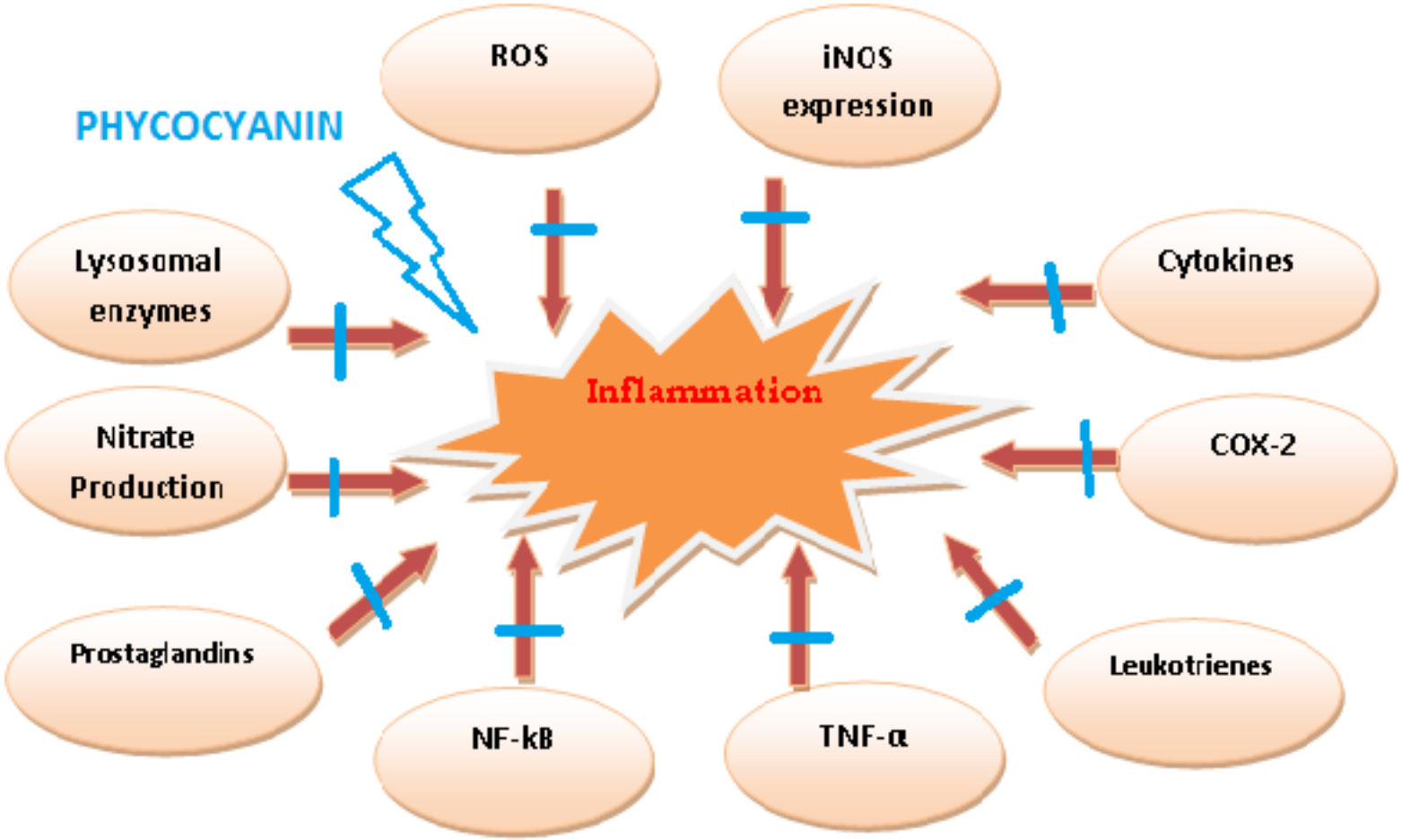



# How Inflammation promotes Cancer

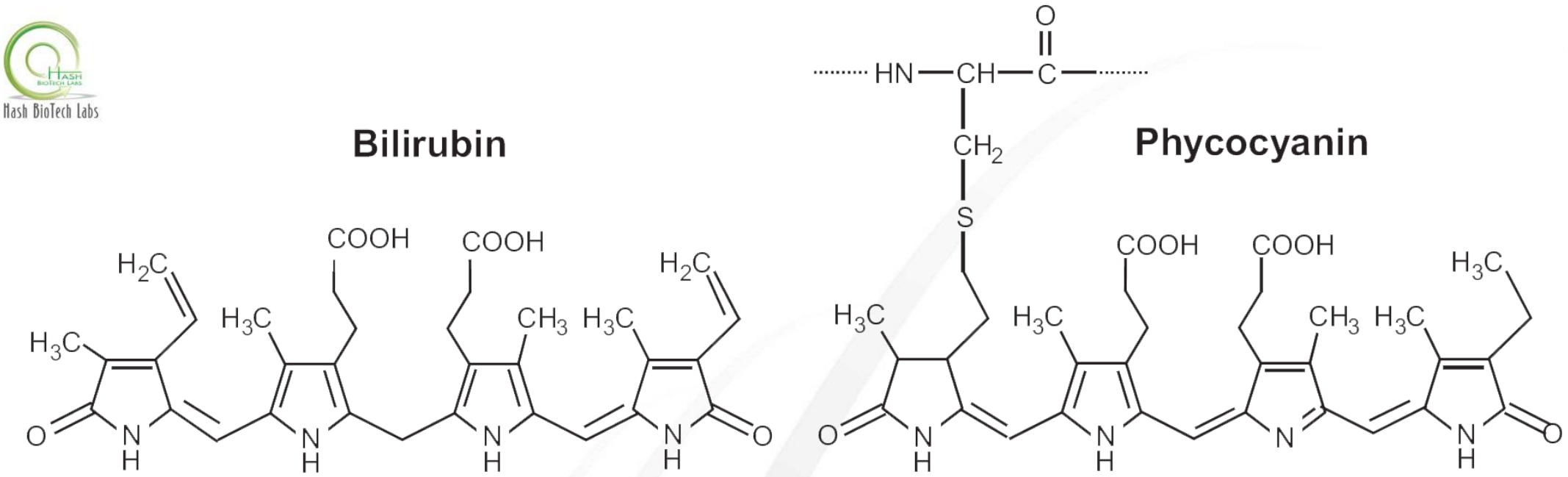
- Unchecked activation of immune associated signalling pathways has been associated with the development and maintenance of the tumor phenotype.

- The NFκB signalling pathway is a key coordinator of innate immunity and inflammation & plays crucial roles in both precancerous chronic inflammation as well as cancer induced inflammation.
- **Activation of this pathway induces:**
  - Expression of inflammatory cytokines
  - Enzymes in the prostaglandin-synthesis pathway (COX2) & Inducible nitric oxide syntheses (iNOS)
  - Angiogenic factors
  - Anti-apoptotic genes (such as Bcl-2)
- The activation of STAT3 in tumor cells has also been implicated in immune evasion via inhibition of dendritic cell maturation and the subsequent immune response.
- STAT3 - TGFβ signalling pathway is involved in numerous oncogenic signalling pathways.

Phycocyanin has a preventive effect against inflammation by following mechanisms (Pardhasaradhi et al., 2000; (Romay et al., 2003; Deng and Chow, 2011; Joventino et al., 2012).



# Phycocyanin as a Strong Anti-Oxidant




**Chemical structures Similarity of Bilirubin and Phycocyanin**

- Anti-oxidant potential of phycocyanin is mainly attributed to its phycobilisome (chromophore) moiety (Patel et. al., 2006) and partially to its apoprotein counterpart (Apt et. al., 1995).
- The chemical structure of the bilin chromophores in Phycocyanin is very similar to bilirubin, a heme degradative product.
- Bilirubin is considered to be a physiologically important antioxidant against reactive species. It inhibits oxidative modification of plasma proteins and aromatic amino acid residues. Scavenging of oxygen radicals by bilirubin has been shown to protect serum albumin as well as other biological targets.

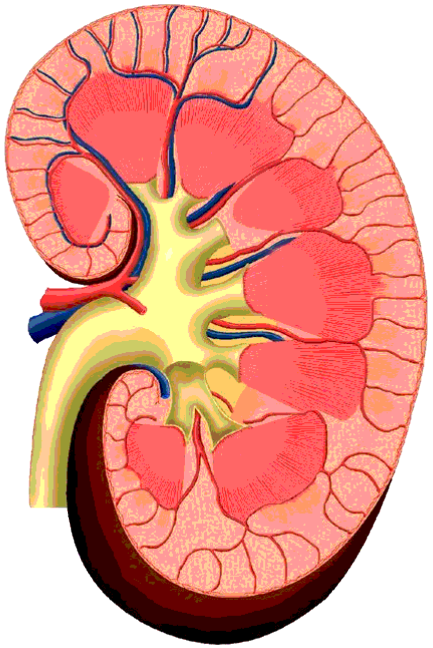
# Phycocyanin as Neuro-Protective

- A scientific study demonstrates that either the prophylactic or the therapeutic application of Phycocyanin was able to significantly reduce the infarct volume, and also protect hippocampal neurons from death, induced by global cerebral ischemia/ reperfusion injury in gerbils (Penton-Rol et al, 2011).

- Phycocyanin prevents cell death caused by low potassium levels in serum of cerebellar granules cells by suppressing the neurotoxic impact of the excitotoxin - kainite (Rimbau et al., 2001; McCarty et al., 2009). It significantly reduces microglia and astrocyte activation and produces pathology of Parkinson`s Disease.

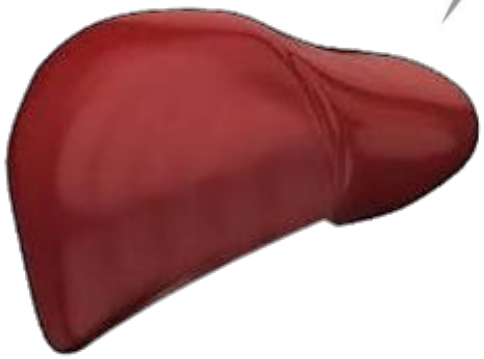
- Studies reveal that Phyocyanin is a potent platelet aggregation inhibitor with a potential to hamper arterial thromboembolism in conjunction with its neuroprotective ability (Hsiao et al., 2005).

# PHYCOCYANIN as Nephro-Protective



- Oxalate causes its deleterious effects to kidneys, liver and the hematological system by inducing oxidative stress, which further leads to membrane integrity loss, renal cell damage and, finally, calcium oxalate crystal deposition.
- Lipid peroxidation (LPO) produce a great variety of stable, diffusible saturated and unsaturated aldehydes like malondialdehyde (MDA) that are extremely active and can diffuse within or even escape from the cell and attack targets far from the site of the original free radical initiated event, resulting in cell damage and therefore act as 'cytotoxic second messengers'.
- Phycocyanin protects the integrity of the renal cell by stabilizing the free radical mediated LPO and protect against oxalate induced nephro injury through reversing the effects of oxalate on oxidative stress parameters by interacting with hydroxyl radical and by rebalancing the GSH content, catalase and G6PD activity in oxalate treated animals (Farooq et al., 2004; 2006).
- Phycocyanin protects against diabetic nephropathy by inhibiting oxidative stress (Zheng et al., 2012).

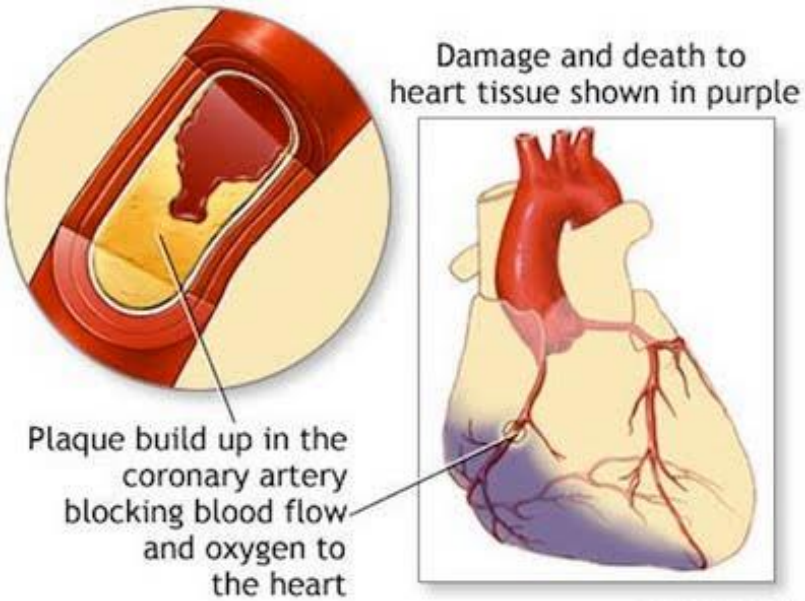
# Phycocyanin as Hepato-Protective



- Oxidative damage is implicated in the pathogenesis of various liver injuries.
- Inflammatory lesions to Fatty liver/Liver Cirrhosis also damage liver cell membranes.
- Phycocyanin is a potent Radical scavenger & Selective COX-2 inhibitor.
- Phycocyanin protects human hepatocyte cells (L02) by significantly preventing the H2O2-induced overproduction of intracellular ROS and MDA, as well as it replenish the SOD activity and GSH level, which got depleted due to oxidation (Ou et al., 2011).
- Phycocyanin inhibits microsomal lipid peroxidation induced by Fe+2 – ascorbic acid or the free radical initiator 2, 2' azobis (2-amidinopropane) hydrochloride (AAPH) (Bermejo-Bescos et al 2008).
- Phycocyanin can significantly reduce R-(+)-pulegone and CCl4 induced liver injury by reducing lipid peroxidation in rats (Vadiraja et al., 1998; Reddy et al., 2000).
- Phycocyanin overcomes multiple drug resistance in hepatocellular carcinoma cells (HepG2) by down regulation of ROS and COX-2 by decreasing NF-κB and AP-1 levels, which are the positive regulators of MDR1 expression (Nishanth et al., 2010).

# Phycocyanin as Cardio-Protective

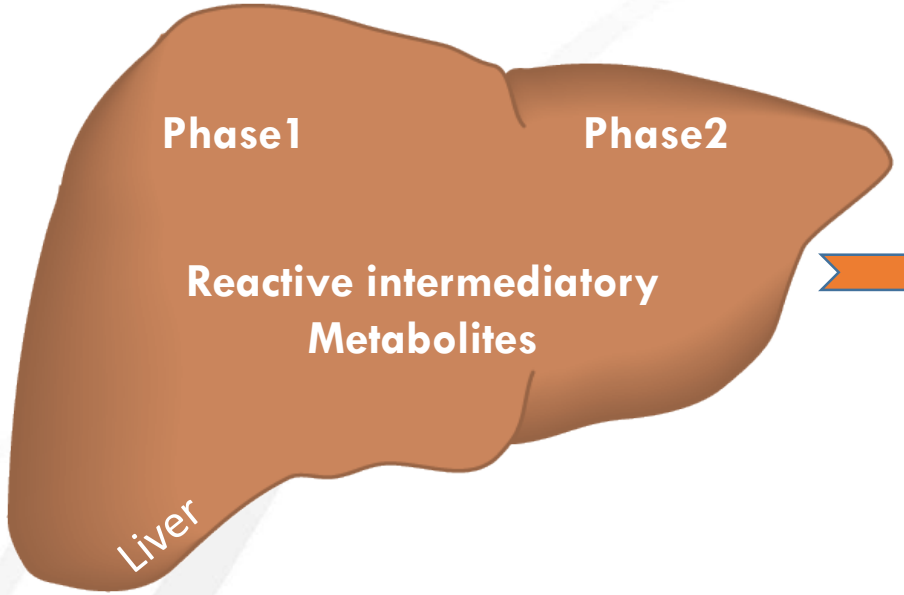
- Phycocyanin is a cytotoxic photosensitizer that exhibits specific binding to plaque and is activated at a wavelength minimally absorbed by blood. These properties suggest potential therapeutic use for plaque localization and regression (Morcos et al., 1988).
- Study reports the crucial role of the antioxidant nature of C-phycocyanin in its cardioprotection against doxorubicin-induced oxidative stress and apoptosis. Furthermore, C-phycocyanin does not compromise the antitumor effect of DOX (Khan et al., 2005).
- Cardioprotective effect of PC against ischemia-reperfusion (I/R)-induced myocardial injury in an isolated perfused Langendorff heart model was studied & it was observed that Phycocyanin attenuated I/R-induced cardiac dysfunction through its antioxidant and antiapoptotic actions and modulation of p38 MAPK and ERK1/2 pathways (Khan et al., 2006).
- Chronic consumption of Se-rich Spirulina phycocyanin powerfully prevents the development of atherosclerosis. The underlying mechanism is related mainly to inhibiting pro-oxidant factors and at a lesser extent improving the serum lipid profile (Riss et al., 2007).



# Detoxification- Removal of harmful toxins from the body

Toxins in Body
(Fat soluble)

- Metabolic End products
- Bacterial endotoxins
- Micro-organsisms
- Food additives
- Pollutants
- Medications
- Smoke
- Alcohol




Disposal of
Water soluble toxins
from body

- Accumulation of Toxins in body can cause:
  - Oxidative Stress
  - Secondary Tissue damage
  - Toxicity
  - Initiation of carcinogenic processes leading to cancer

- Phycocyanin supports Detoxification process of body by providing its antioxidant support and amino acids required.

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HASH BIOTECH LABS

# Hash Biotech Labs: An Overview

- Hash BioTech Labs is premiere Research and Development establishment in the field of Phycology – Study of microalgae.
- Founded in 2007, by an alumnus of Oxford University; with a honourable objective & passion to develop technology driven solutions to address modern world challenges and then turning them into something tangible that touches core of people's lives and makes them more active and brighter.
- Hash BioTech is actively engaged with the development of micro-biological molecules and compounds.
- Its existing research portfolio consists of superior and optimised varieties of micro algal strains, that are essential for progressive industries to continue their evolution towards the 'next generation' solutions to energy, pharmaceutical, nutraceutical, medical diagnostics, food & beverages, cosmetics and pigments industry.

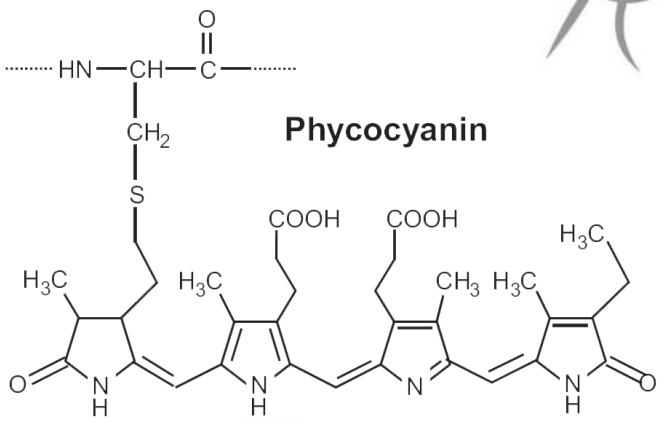
# Our Achievements in R&D

- Establishment of Hash Biotech`s Culture Collection of Micro Algae Strains - with in-house isolated strains gathered by carrying out extensive survey of 1000s of diverse algal habitats.
- Development of technology for most cost effective growth medium for the outdoor cultivation of *Spirulina platensis* in open raceway ponds.
- Development of the procedures for training & optimizing micro algal strains. To adapt the strains to region specific climatic conditions.
- Design and development of most cost effective Drying & Harvesting System of micro algae.
- Improvement of the *Spirulina* strain for higher Phycobiliprotein content and development of procedures for their Extraction & purification.

# Our Achievements in R&D

- Isolation and cultivation of nitrogen fixing and phosphate solubilising improved strains of cyano bacteria for utilization as bio-fertilizer.
- Isolation, purification and cultivation of oil producing micro algae along with determination of lipid contents of various micro algal strains.
- Development of technology to extract Astaxanthin from microalgae *Haematococcus pluvialis*. It is a red carotenoid pigment, having structure similar to beta-carotene & is a strong anti-oxidant molecule.
- Development of process for the conversion of algal oil and Jatropha oil into biodiesel.
- Development of Hybrid Jatropha seed with higher oil content and reversing the male female ratio in Jatropha seed doubling the yield per plant.

# Our Achievements in R&D




- C-Phycocyanin belongs to a family of phycobiliprotein that are well suited as a fluorescent reagent without any toxic effect for immunological analysis because they have a broad excitation spectrum and large stokes shift; and fluoresce with a high quantum yield. C-Phycocyanin has $\lambda_{ex}$ 609 nm and $\lambda_{em}$ 643 nm and has been isolated with purity index >4.5. There are reports about the role of C-Phycocyanin in staining RBCs, WBCs, platelets, lymphocytes, nucleated cells and Genomic DNA. Researchers have also concluded that the partially purified C-PC could be used as a substitute of ethidium bromide and may be applied for immunological analysis and DNA staining.

- Phycoerythrin is another Phycobiliprotein from cyanobacterial family and has been shown to be particularly useful due to its large absorption coefficient and great fluorescence properties just as the high quantum yield and high stokes shift. Phycoerythrin has $\lambda_{ex}$ 542 nm and $\lambda_{em}$ 575 nm and has been isolated with purity index >4.6. It is widely used as a fluorescent biomarker and as an analytical reagent. It can be easily cross linked with antibodies and other proteins by using conventional molecular tagging techniques without losing its fluorescent properties.

# TIMELINE OF HIGH PHYCOCYANIN SPIRULINA


**2007**

- Isolation of *Spirulina* strain from nature

**2008**

- Optimizing strain to live in specified acclimatised conditions

**2009**

- Optimisation of strain for higher Phycocyanin content

**2009-2011**

- Lab scale purification and extraction of Phycocyanin

**2011-2012**

- Optimising Mass Production

**2012-2013**

- Commencement of Mass Production

## LAUNCH OF HIGH PHYCOCYANIN SPIRULINA


## Production Facility at
## Dasuya, Hoshiyarpur, Punjab, India

## HASH BIOTECH FARMS

# ALGAL PRODUCTION FACILITY



# HASH BIOTECH LABS: THE TEAM

The research team at Hash Biotech Labs is lead by a dedicated group of scientists that have a substantial history of successful research work and numerous innovations & scientific discoveries to their credit. Team of Hash Biotech Labs have dedicatedly developed and mastered various Protocols and Procedures to cultivate quality *Spirulina* outdoors in a record time.

# In House Seed Culturing

## Raceway Ponds

IIMSAM

Hash BioTech Labs

## Raceway Ponds

## Spray Drying Facility

IIMSAM

Hash BioTech Labs

## QA/QC

# Hash Biotech Labs

## Affiliation & Certification

IIMSAM

UNITED NATIONS

WE BELIEVE

**INTERGOVERNMENTAL INSTITUTION FOR THE**
**USE OF MICRO-ALGAE SPIRULINA AGAINST MALNUTRITION**
(INTERGOVERNMENTAL OBSERVER
TO THE UNITED NATIONS ECONOMIC AND SOCIAL COUNCIL)

WHO GMP

Department of Scientific & Industrial Research
Government of India

# PROPOSAL - A

## ESTABLISHING IIMSAM SPIRULINA CULTIVATION CENTRE IN YOUR COUNTRY

## CAPACITY OF THE PROJECT

- Hash BioTech Labs, in association with IIMSAM, shall be establishing Spirulina Cultivation Centre in the given country with the capacity of 50 Metric Tons per year (Subject to the climate conditions, following best cultivation practices and standards laid out by Hash Biotech Labs).

- 50 MT of Spirulina shall be enough to provide nutrition dose to nearly **100,000** undernourished children/underprivileged individuals per month.

- The full capacity of the plant can only be achieved after 8 to10 months of the commissioning of the plant keeping in view of the climatic conditions.

- Full 50 MT of the production can be guaranteed per annum by the Hash BioTech Labs, if turnkey contract for running Spirulina Cultivation Centre for at least term of 5 years be allotted to Hash Bio Tech Labs exclusively. The additional cost for running Spirulina Cultivation Centre can be discussed. In this case, Hash Biotech Labs guarantees to provide/produce 50 MT Spirulina every year.

## CIVIL CONSTRUCTIONAL WORK

- Construction of the following areas, as per GMP standards, as per the approved drawings and need based requirements:
- Processing Hall measuring approx. 2500 sq ft (232 sq mtrs) for Spray Drying, washing, control panels etc.
- Warehousing facility covering approx 2000 sq ft (185 sq mtrs) area for pre process and post processed material.
- Laboratory space covering approx. 2000 sq ft (185 sq mtrs) area including R & D facilities, construction of inoculation tanks, processing area in process QA/QC labs, establishing microbiology culture lab, in door inoculums culture ponds
- Harvesting area covering approx. 1500 sq ft (139 sq mtrs) area
- Administrative Block covering approx 1000 sq ft (93 sq mtrs) area for administration and meetings.

# BIOLOGICAL

**Selection, Characterization and Optimization of best suitable *Spirulina* strain**

Research and Development team of Hash Biotech Labs will collect, screen & select most potential strain based on growth kinetics, biomass and macromolecular contents.

**Designing & Development of best growth medium**

Growth medium capable of supporting faster growth and highest biomass production in potent marine strain would be designed and developed for routine cultivation indoors or outdoors.

**Biochemical Analysis and Estimation**

Biochemical analysis of selected strain would be made to identify various composition parameters/contents including proteins, Phycocyanin, carbohydrates lipids, minerals vitamins etc.

**Improvement of Strain**

Selected strain will be improved by training to adopt environmental stresses like pH, temperature, nutrients, light intensity, turbulence, $CO_2$ salinity under laboratory conditions and most importantly for Phycocyanin.

IIMSAM Hash BioTech Labs

# BIOLOGICAL

**Scaling up of Improved strain**

Scaling up of improved strain would be made from 100ml culture to 1000L or more. If required culture could be grown in photo-bioreactor. This culture would be treated as mother culture under semi natural and natural conditions for identification of optimum growth conditions.

**Cultivation of mother culture under Semi natural and Natural conditions**

The mother culture thus produced would be grown under semi natural and natural conditions to optimize better growth parameters.

**Transfer of trained Spirulina strain in small outdoor covered raceways ponds**

Well adopted mother culture will be transferred to one of the race way ponds and after optimization of biomass production, subsequent raceways will be inoculated.

IIMSAM Hash BioTech Labs

# SCOPE OF THE WORK

## ERECTION OF CULTIVATION PONDS

In 50,000 Sq Mts ( Fifty Thousand) ponds for the cultivation of Spirulina as per the specification laid out by R&D team of Hash Biotech Labs shall be erected on the site keeping in view of the installed capacity of production.

## CONSTRUCTION OF THE UNDERGROUND WATER TANKS

Two underground water tanks with adequate capacity to hold required water shall be constructed as per the requirements maintaining and following the set quality standards of constructions along with the Pump houses.

## ESTABLISHING OF LABORTORY FACILITY

Complete laboratory set up will be provided for the quality control and quality assurance of the product and keeping the stringent measures for the quality and nutrient ingredients as per the global standards of the project. The equipments will be provided with latest available technology and specialized standards of the Algology

Equipment for R & D, QC/QA labs, Equipment for the microbiology labs. Providing of lab chemicals. Indoor production chemicals, outdoor production chemicals and other consumables for the lab and production till the commencement of commercial production.

## INSTALLATIONS OF THE PLANT, MACHINERY AND OTHER EQUIPMENTS

All the required machinery and equipment's to run the plant smoothly and accessories for optimizing the capacity of the project shall be installed with the best available quality and standards including continuous Dryer equipment also designed by Hash Bio tech which maintain the nutrient values of the product and maintain and preserve shelf life of the product, packaging machinery. The company will provide the agitators also for the mass production.

## ESTABLISHING QUALITY CONTROL PARAMETERS

A code of quality and the continuous assurance of the quality will be set up and maintained to give the efficient quality productions. The best practices will be implanted for the best utilization of the installed capacity.

## ESTABLISHING THE HARVESTING AND SEPERATION TECHNOLOGY

We shall provide the best available technique for the harvesting and separation operations in production designed by Hash Biotech which help in continuous production and help in minimizing of wastage and achieving optimum productivity.

## TRAINING TO THE MANPOWER AT ALL LEVELS OF PROJECT

Our specialized team of professionals and scientists shall give the proper training on the project to all the personnel working in the Laboratory, machinery , dryers, harvesting stations , cultivation activities , use of the agilaters, nutraceuticals and also in the administration segment of the project.

# PRE REQUISITES FOR ESTABLISHING IIMSAM SPIRULINA CULTIVATION CENTRE IN YOUR COUNTRY

**LAND FOR THE PROJECT**

Minimum 30 acres ( 120,000 Sq Mts) of land for the project adjoining to the highway for ease in access for the transportation. Most importantly, there has to be provision of drainage.

**ZERO LEVEL**

The land should be properly developed and leveled preferably with roads.

**PROVIDING THE POWER CONNECTION**

The site should be well connected with the required power load connection ( minimum 400 KW). There should be proper street lights along side the inner roads and on places where ever necessary.

**COMMUNICATION NETWORK FACILITIES**

The provision of telephone facility and the access to internet should be available at the site.

**WATER SOURCES**

Water is the main requirement for the whole process. The site should be provided with the installation of two tube wells with 8" dia with the capacity or 50,000 Lts /per hr each. Or other source of water

**RESIDENTIAL ACCOMODATION FOR THE STAFF**

We require the residential accommodation for the staff and executives who are to live there for the purpose of erection and commissioning of the project with moderate facilities and living conditions. Senior IIMSAM official shall be provided appropriate accommodation as per the protocol.

**PROVIDING OF WORK VISA FOR THE STAFF**

The staff for erection, consultation, execution and commissioning needs the multiple work visa so that they could access to the site without any problem and hassles. Senior IIMSAM shall be provided appropriate Visa for the period of minimum five years.

**GOVERNMENT APPROVALS**

We shall be provided with all the required government approvals wherever needed for the project and products and its certifications.

**SECURITY**

Since, this mission shall be mission of food security so, appropriate security cover need to be provided. Also, senior IIMSAM officials need to be proper cover as per the protocol during their visits.

# TIME LINES FOR ESTABLISHING IIMSAM SPIRULINA CULTIVATION CENTRE IN YOUR COUNTRY

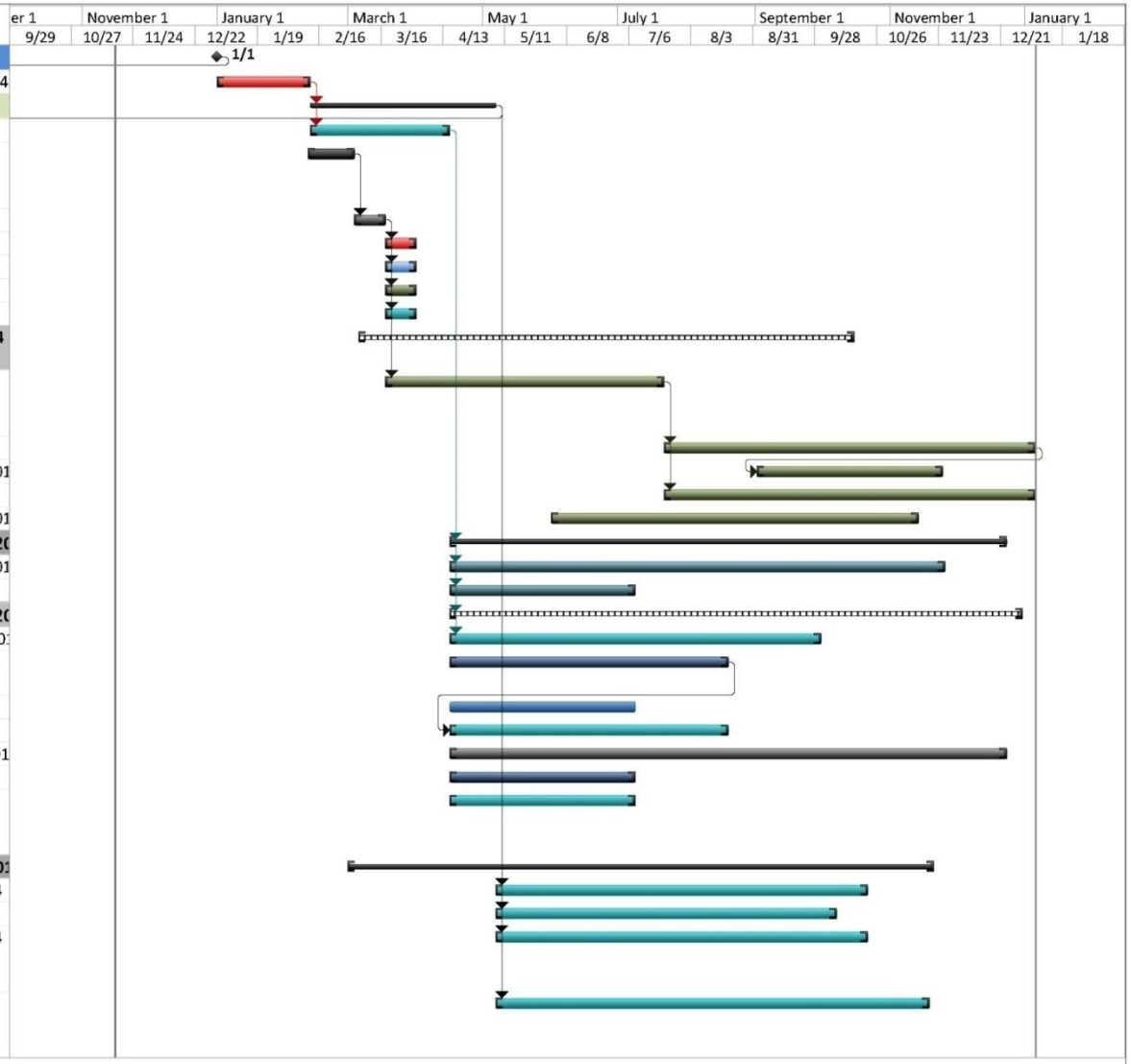
## PROJECT TIMELINE

The whole project will be completed and commissioned within period of 10 months from the date of award of the contract and providing with the essentials pre requisites to commence the operations.

The period can be extended in case of any problem arising out due to natural reasons, political reasons, act of God etc due to which there are the hurdle in smooth functioning of the project.

# PROJECT TIMELINE

| Task Name | Duration | Start | Finish |
|---|---|---|---|
| **Project initiation** | **0 days** | **January 1, 201** | **January 1, 2014** |
| Manpower and Resource Deployment | 30 days | January 1, 201 | February 11, 2014 |
| **Project Planning** | 60 days | February 12, 2 | May 6, 2014 |
| Site master plan preparation | 45 days | February 12, 2 | April 15, 2014 |
| Survey of location as per the technical requirement for the optimum production of Spirulina | 15 days | February 11, 2014 | March 3, 2014 |
| Site assessment | 10 days | March 4, 2014 | March 17, 2014 |
| Soil testing | 10 days | March 18, 201 | March 31, 2014 |
| Water testing and availability | 10 days | March 18, 201 | March 31, 2014 |
| Vegetation/ flora/fauna study | 10 days | March 18, 201 | March 31, 2014 |
| Habitat | 10 days | March 18, 201 | March 31, 2014 |
| **Development of strain/Media for mass cultivation** | **160 days** | **March 6, 2014** | **October 15, 2014** |
| Selection, characterization and optimization of best spirulina strain | 90 days | March 18, 2014 | July 21, 2014 |
| Development of best growth medium | 120 days | July 22, 2014 | January 5, 2015 |
| Scaling up of improved strain | 60 days | September 2, 2 | November 24, 201 |
| Indoor inoculum culture development | 120 days | July 22, 2014 | January 5, 2015 |
| outdoor Mass Cultivation | 120 days | June 1, 2014 | November 13, 201 |
| **Land development** | **180 days** | **April 16, 2014** | **December 23, 2(** |
| Leveling of land and boundary | 160 days | April 16, 2014 | November 25, 201 |
| Construction of water storage tank | 60 days | April 16, 2014 | July 8, 2014 |
| **Civil construction** | **185 days** | **April 16, 2014** | **December 30, 2(** |
| Construction of Administrative block | 120 days | April 16, 2014 | September 30, 20 |
| Construction of lab (I) R & D for strain development | 90 days | April 16, 2014 | August 19, 2014 |
| Microbiology culture lab | 60 days | April 16, 2014 | July 8, 2014 |
| Indoor inoculum culture ponds | 90 days | April 16, 2014 | August 19, 2014 |
| Outdoor mass production ponds | 180 days | April 16, 2014 | December 23, 201 |
| Storage area for raw material | 60 days | April 16, 2014 | July 8, 2014 |
| Storage area for finished goods as per the technical requirement of the product stability | 60 days | April 16, 2014 | July 8, 2014 |
| **Equipment/Machineries** | **190 days** | **March 1, 2014** | **November 20, 201** |
| Equipment for R & D/ QA/QC labs | 120 days | May 7, 2014 | October 21, 2014 |
| Equipment for microbiology labs | 110 days | May 7, 2014 | October 7, 2014 |
| Hash Biotech designed harvesting, separation and filtration units for continuous production | 120 days | May 7, 2014 | October 21, 2014 |
| Hash Biotech designed continuous drying equipment's which also preserve nutrients & shelf life of the products | 140 days | May 7, 2014 | November 18, 2014 |

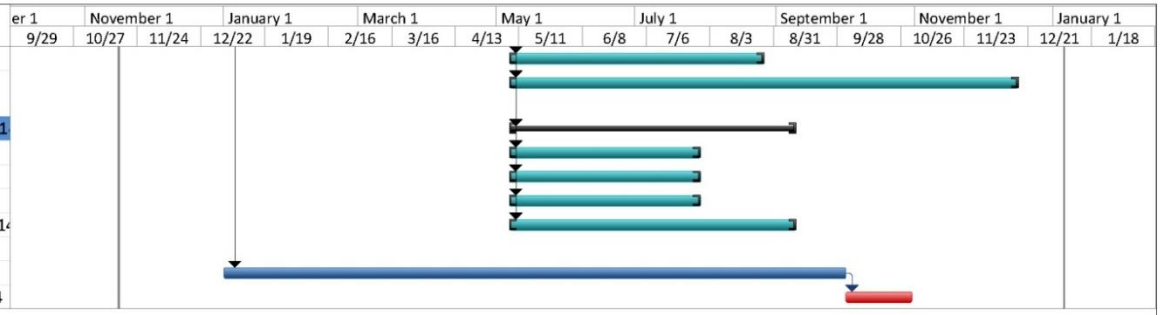



Project: Hash BioTech Labs 50MT
Date: November 16, 2013

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Task | Project Summary | Inactive Milestone | Manual Summary Rollup | Deadline |
| Split | External Tasks | Inactive Summary | Manual Summary | Progress |
| Milestone | External Milestone | Manual Task | Start-only |
| Summary | Inactive Task | Duration-only | Finish-only |

# PROJECT TIMELINE

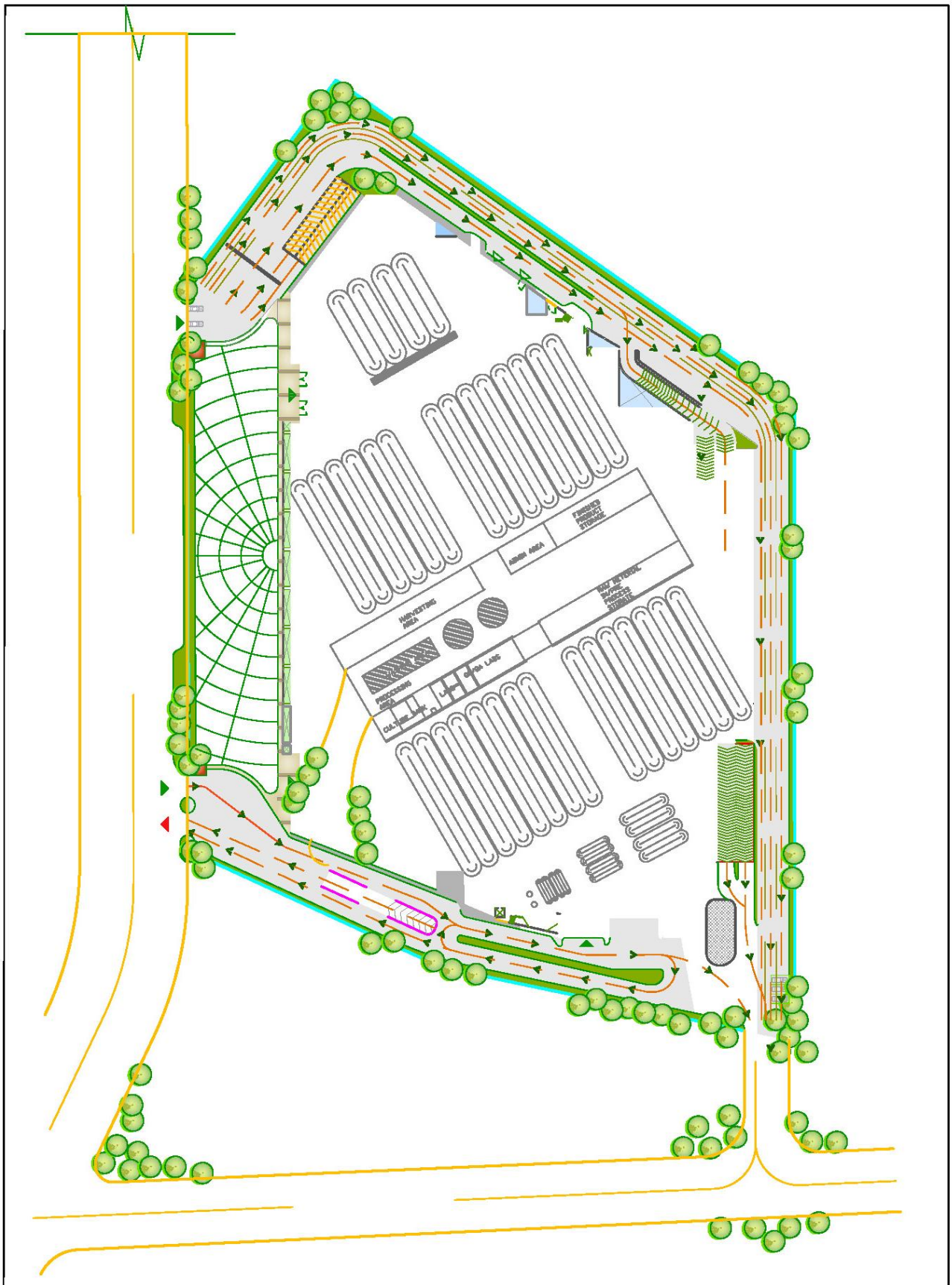
| Task Name | Duration | Start | Finish |
|---|---|---|---|
| Packaging machineries | 80 days | May 7, 2014 | August 26, 2014 |
| Miscellaneous equipment's for production of lab and furniture | 160 days | May 7, 2014 | December 16, 2014 |
| **Raw material and consumable** | **90 days** | **May 7, 2014** | **September 9, 201** |
| Lab chemicals | 60 days | May 7, 2014 | July 29, 2014 |
| Indoor production chemicals | 60 days | May 7, 2014 | July 29, 2014 |
| Outdoor production chemicals | 60 days | May 7, 2014 | July 29, 2014 |
| Consumable for labs and Production Unit | 90 days | May 7, 2014 | September 9, 201 |
| | | | |
| Commissioning of project | 196 days | January 1, 201 | October 1, 2014 |
| Project Handover | 21 days | October 2, 201 | October 30, 2014 |




Project: Hash BioTech Labs 50MT
Date: November 16, 2013

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Task | Project Summary | Inactive Milestone | Manual Summary Rollup | Deadline |
| Split | External Tasks | Inactive Summary | Manual Summary | Progress |
| Milestone | External Milestone | Manual Task | Start-only | |
| Summary | Inactive Task | Duration-only | Finish-only | |

# MODEL PROJECT LAYOUT




| | | | | |
|---|---|---|---|---|
| PROJECT :- SPIRULINA CULTIVATION CENTRE | This drawing is the sole property of HASH BIOTECH LABS PRIVATE LIMITED, CHANDIGARH, INDIA and must not be sent or copied or reproduced without their written permission nor used for any purpose other then for which it is used. | INTERGOVERNMENTAL INSTITUTION FOR THE USE OF MICRO ALGAE SPIRULINA AGAINST MALNUTRITION<br>IIMSAM | MODEL SPIRULINA CULTIVATION FARM<br>PROJECT REF :- IIMSAM<br>DRAWING NOT TO SCALE (FOR EXPRESSION ONLY)<br>PREPARED BY HASH BIOTECH LABS<br>Sheet: —<br>Date NOV 2013 | HASH BIOTECH LABS PRIVATE LIMITED<br>SCO : 465 - 466 SECTOR - 35 C CHANDIGARH - 160035 INDIA<br>Telephone: +91 172 - 4958888 mail : info@hashbiotech.com<br>www.HashBiotech.com |

# PROPOSAL - B

IIMSAM – HASH BIOTECH LABS HUMANITARIAN LIFESAVER

# SPIRULINA

IIMSAM – HASH BIOTECH LABS HUMANITARIAN LIFESAVER SPIRULINA EXTRACT

# PHYCOCYANIN

# DISTRIBUTION

# DELIVERABLES, SCOPE OF WORK & PRE REQUISITES

- Hash Biotech Labs, in association with IIMSAM, shall supply following two Products:

**IIMSAM – HASH BIOTECH LABS HUMANITARIAN LIFESAVER**

# SPIRULINA

**IIMSAM – HASH BIOTECH LABS HUMANITARIAN LIFESAVER SPIRULINA EXTRACT –**

# PHYCOCYANIN

- Hash Biotech Labs will be providing Spirulina and Phycocyanin doses for a minimum period of 12 months, to registered malnourished individuals.

- Hash Biotech labs/IIMSAM shall be provided with the complete data bases of individuals, who have been registered for consumption of IIMSAM Humanitarian Spirulina, for their Blood Haemoglobin, Names, Sex, Age, Height and Weight on monthly basis.

# DOSAGE & PACKING

- **IIMSAM – Hash Biotech Labs Humanitarian Lifesaver Spirulina**: 3-4 Tablets of 500 mg shall be given to the Individuals for the period of 12 months.

- **IIMSAM – Hash Biotech Labs Humanitarian Lifesaver Spirulina Extract – PHYCOCYANIN** - 2 Tablets of 200 mg per day shall be given to the Individuals in first Month and sixth month.

- **IIMSAM – Hash Biotech Labs Humanitarian Lifesaver Spirulina** is packed in HPDE Bottles of 100 tablets of 500mg each and further packed in Corrugated box of 100 bottles. Each Bottle is one month's dose.

- **IIMSAM – Hash Biotech Labs Humanitarian Lifesaver Spirulina Extract – PHYCOCYANIN is** packed in HPDE Bottles of 60 tablets of 200mg each and further packed in Corrugated box of 100 bottles. Each Bottle is one month's dose.


- The contents have an expiry of a minimum period of 3 years.

- An expert panel of Doctors, Pharmacists, Nurses etc..
- This panel shall be provided technical training in the form of online CMEs, Handouts and Brochures explaining the benefits of Spirulina by the technical experts from Hash Biotech Labs.
- The panel shall organize camps for registration of needy individuals, area wise, on a monthly basis.
- The individuals shall register them at these camps with their Names, Sex, Age, Height and Weight and provided with a unique registration number.
- Four Tablets of IIMSAM Humanitarian Spirulina shall be provided to all the needy individuals.
- The registered individuals shall revisit the camp every month on a pre-decided schedule for next month`s dose of IIMSAM humanitarian Spirulina.

# PROPOSED TIME LINES

# PROJECT TIMELINE

- Hash Biotech Labs, in association with IIMSAM, shall be providing supply of the Humanitarian Aid on monthly/quarterly bases.

- Duration of project shall be initially for a minimum period of 12 months.

**THE WHOLE PROJECT WILL BE INITIATED AND COMMISSIONED WITHIN PERIOD OF 2-3 MONTHS FROM THE DATE OF AWARD OF THE CONTRACT AND PROVIDING WITH THE ESSENTIALS PRE REQUISITES TO COMMENCE THE OPERATIONS.**

- The period can be extended or delayed in case of any problem arising out due to natural reasons, political reasons, act of God etc due to which there are the hurdle in smooth functioning of the project.

# COSTING

Costing for **PROPOSAL A & PROPOSAL B** is available on Request.

Please contact

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**"There are people in the world so hungry that God cannot appear to them except in the form of bread"**
**Mahatma Gandhi**


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