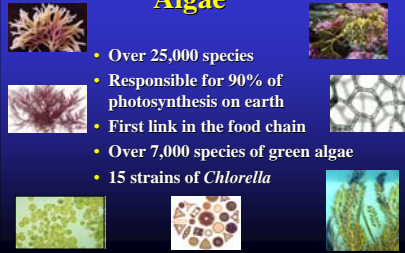


## Detoxification of Chemicals and Heavy Metals with *Chlorella*

Randall E. Merchant, Ph.D.  
 Professor of Anatomy and Neurosurgery  
 Virginia Commonwealth University Medical Center  
 Richmond, Virginia, USA

The following potential conflict of interest relationship is germane to my presentation.  
 Consultant: Sun Chlorella Corporation

## Algae



- Over 25,000 species
- Responsible for 90% of photosynthesis on earth
- First link in the food chain
- Over 7,000 species of green algae
- 15 strains of *Chlorella*

## *Chlorella pyrenoidosa*

- A unicellular green alga that grows in fresh water with the highest content of chlorophyll of any known plant.
- Contains high concentrations of certain vitamins, minerals, dietary fiber, nucleic acids, amino acids, and enzymes.
- Strong cell wall



## Active Cultures of *Chlorella*



## *Chlorella* Production

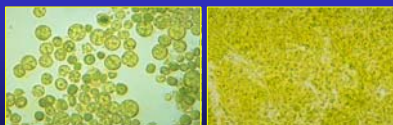
- Day 1 → 4 Cells
- Day 5 → One Thousand Cells
- Day 10 → One Million Cells
- Day 15 → One Billion Cells



## Large-Scale Production of *Chlorella*



## Digestibility



Chlorella in Its Natural State

Pulverized Cell Wall

## *Chlorella*

- Formed of 60% protein, 20% carbohydrates, & 11% unsaturated fat
- Contains 28.9 g/kg chlorophyll and its proteins contain all the essential amino acids
- Vitamins:  $\beta$ -carotene, Vitamins C, E, K, B1, B2, B6, B12, niacin, folic acid, biotin, choline, liponic acid, inositol, pantothenic acid, lutein
- Minerals: phosphorus, calcium, iron, zinc, magnesium, & copper



## Chlorella is a Whole Food

- Macronutrients, micronutrients, minerals, & other components.
- More than the sum of its parts.
- Components work in synergy to exert their nutritional benefit.



## The Results of Our Clinical Trials of Chlorella

- Reduces high blood pressure
- Lowers serum cholesterol
- Accelerates wound healing
- Enhances immune functions
- Relieves symptoms
- Improves quality of life
- Normalizes body functions

## Keeping the Body in Balance

• Good Health

- Genetics
- Aging
- Disease
- Stress
- Lifestyle
- Diet

## A Chemical World



- More than half of the world's population lives in countries with unhealthy levels of air pollution.
- Each year, millions of pounds of chemicals, metals, and carcinogens are released into the air.

## Chemical Toxins in Our Air, Water, & Food

- Polybrominated Diphenyl Ethers (PBDEs)
- Phthalates
- Toxic Pesticides
- Perfluorooctanes (PFOs)
- Polychlorinated Biphenyls (PCBs)
- Dioxins
- Bisphenols
- Metals (Pb, Hg, Cd, As, Al, Cr)

## Bio-Accumulation

Synthetic chemicals are present in the blood and fat cells of every living person.



- Chemicals are stored in the body and accumulate
- Stored primarily in body fat
- Danger of rapid weight loss

## Breast Milk

- Breast milk concentrates over 350 different chemicals including dioxins and flame retardants
- Babies are much more vulnerable to chemicals



## Toxic Pesticides



## Toxic Pesticides

Linked to asthma, neurological, developmental & immunological problems



## TOXIC PRODUCE

The 12 MOST Contaminated Fruits & Vegetables

- Apples
- Bell Peppers
- Celery
- Cherries
- Grapes (Imported)
- Nectarines
- Peaches
- Pears
- Potatoes
- Red Raspberries
- Spinach
- Strawberries



## Chlorophyll

- An anti-oxidant
- A natural antiseptic
- Binds to environmental chemicals
- Prevents chemicals from binding to DNA
- Prevents gene damage



## Chlorella's Cell Wall

- Improves bowel regularity
- Contains the glucans to stimulate natural defenses
- High in cellulose microfibrils and sporopollenin
- Ability to bind and remove toxic chemicals and heavy metals

## Chlorella & Heavy Metals

Chlorella can detoxify heavy metals:

- Lead
- Mercury
- Cadmium
- Arsenic
- Aluminum
- Uranium



## Cadmium (Cd)

- Chemically similar to zinc
- Used in batteries and coatings
- Found in air and water
- Cigarette smoke
- Biopersistent
- Long-term exposure associated with renal dysfunction, obstructive lung disease, lung cancer, hypertension
- Itai-Itai Disease – pain, weak bones, kidney failure

## Chlorella & Cadmium

Two groups of rats:

Cadmium in food without *Chlorella* for 10 days



Retarded Growth

Cadmium in food with *Chlorella* for 10 days



Normal Growth

## Cadmium in Humans

- Patients with Stage III-V Itai-Itai Disease
- Took 7.5 grams of *Chlorella* per day
- Urine Cadmium:

30 Days



60 Days



Ichimura & Hagino, Jpn J Hygiene 30:77-8, 1975

## Dioxins

- Result from industrial activities and fires
- Enter food chain - plants and animal fats
- May cause cancer and birth defects



## Chlorella & Dioxins

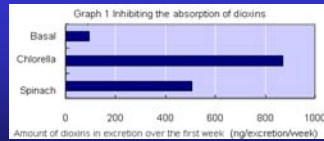
Effect of *Chlorella pyrenoidosa* on Fecal Excretion and Liver Accumulation of Polychlorinated Dibenzo-*p*-Dioxin in Mice.

H. Takekoshi, G. Suzuki, H. Chubachi, and M. Nakano

Saiseikai Nara Hospital, Nara, Japan

Chemosphere 59:297-304, 2005

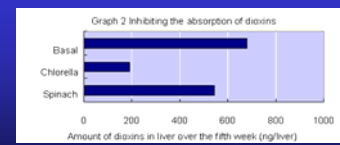
## Chlorella & Dioxins



The 10% *Chlorella pyrenoidosa* diet group excreted dioxins approximately 9.2 times than mice fed the basal diet. The Spinach diet group excreted dioxins approximately 5.3 times than mice fed the basal diet.

H. Takekoshi, et al., *Chemosphere* 59:297-304, 2005

## Chlorella & Dioxins



Liver accumulation in mice fed the 10% *Chlorella pyrenoidosa* diet was significantly less by 72% than that observed among mice fed either the basal diet and the Spinach diet by 65%.

H. Takekoshi, et al., *Chemosphere* 59:297-304, 2005

## Chlorella & Dioxins

*Chlorella* (*Chlorella pyrenoidosa*) supplementation decreases dioxin and increases immunoglobulin A concentration in breast milk.

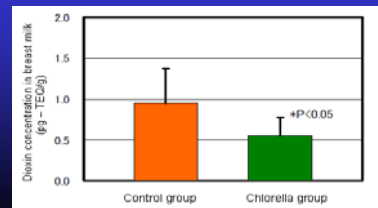
S. Nakano, H. Takekoshi, and M. Nakano

*The Journal of Medicinal Food*, 10:134-142, 2007.

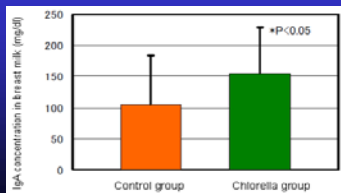
## Study Design

- 35 volunteers pregnant 3-4 months
  - 17 normal diet for remainder of pregnancy
  - 18 normal diet plus ingested 7.5 g *Chlorella*/day
- Breast milk samples taken from mothers after babies born
- Analysis for 28 dioxin isomers and IgA in breast milk

## Effect of *Chlorella* Ingestion on Dioxin Concentration in Breast Milk



## Effect of *Chlorella* Ingestion on IgA Concentration in Breast Milk



## Anti-Carcinogenic Effect

Suppression of Glutathione S-Transferase Placental Form-Positive Foci Development in Rat Hepatocarcinogenesis by *Chlorella pyrenoidosa*.

H. Takekoshi, T. Mizoguchi, Y. Komasa, H. Chubachi, Y. Inoue, H. Imanishi, and M. Nakano

*Oncology Reports* 14:409-414, 2005

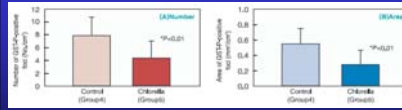
## Anti-Carcinogenic Effect

- Heterocyclic amines ubiquitously present in food and other sources and are produced by cooking meat or fish
- Estimated daily exposure 0.2-2.6  $\mu\text{g}/\text{day}$
- Studies have shown that heterocyclic amines involved with the induction and development of some human cancers

## Anti-Carcinogenic Effect

- Examined chemopreventive effect by administering Chlorella powder as 10% of the diet to rats with hepatic cancer induced by the carcinogenic heterocyclic amine, diethylnitrosamine (DEN).
- Measured the number and size of tumors which developed in liver after eight weeks.

## Anti-Carcinogenic Effect



Adding Chlorella to the diet inhibited by 67.6% of number and by 74.2% of area of hepatic tumors induced by DEN.

H. Takekoshi, et al., *Oncology Reports* 14:409-414, 2005

## Conclusions

- ✓ Chlorella is a “functional food” in that it provides the body with stunning amount and variety of nutrients that together exert healthful benefits.
- ✓ Chlorella helps protect the body by preventing the absorption of potentially harmful chemical toxins and metals.
- ✓ Chlorella helps protect by helping to rid the body of potentially harmful chemical toxins and metals.