

Commercial Success

Dunaliella

Israel and Japan

Collaboration

Namibia - Sanumarc

June 4, 2010

Ami Ben-Amotz

NBT & Seambiotic

Israel

ami@benamotz.com

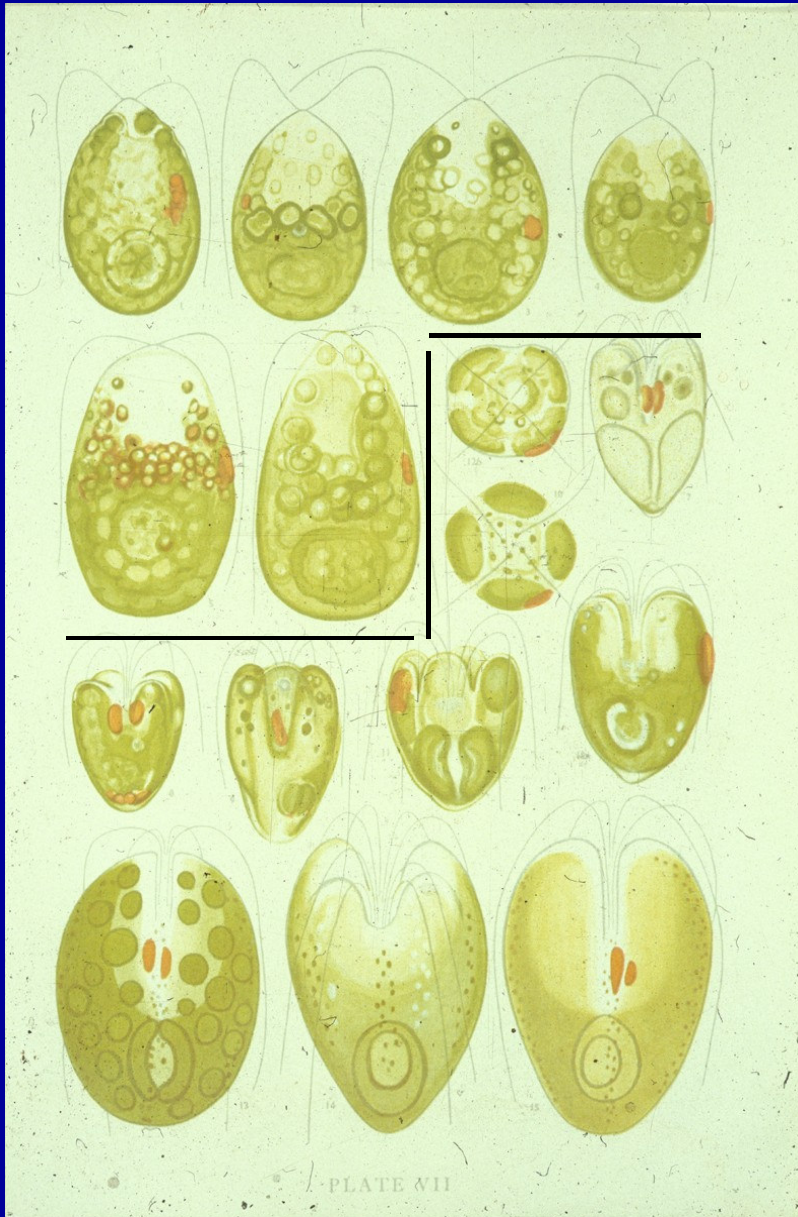
Dunaliella

Introduction

&

Background

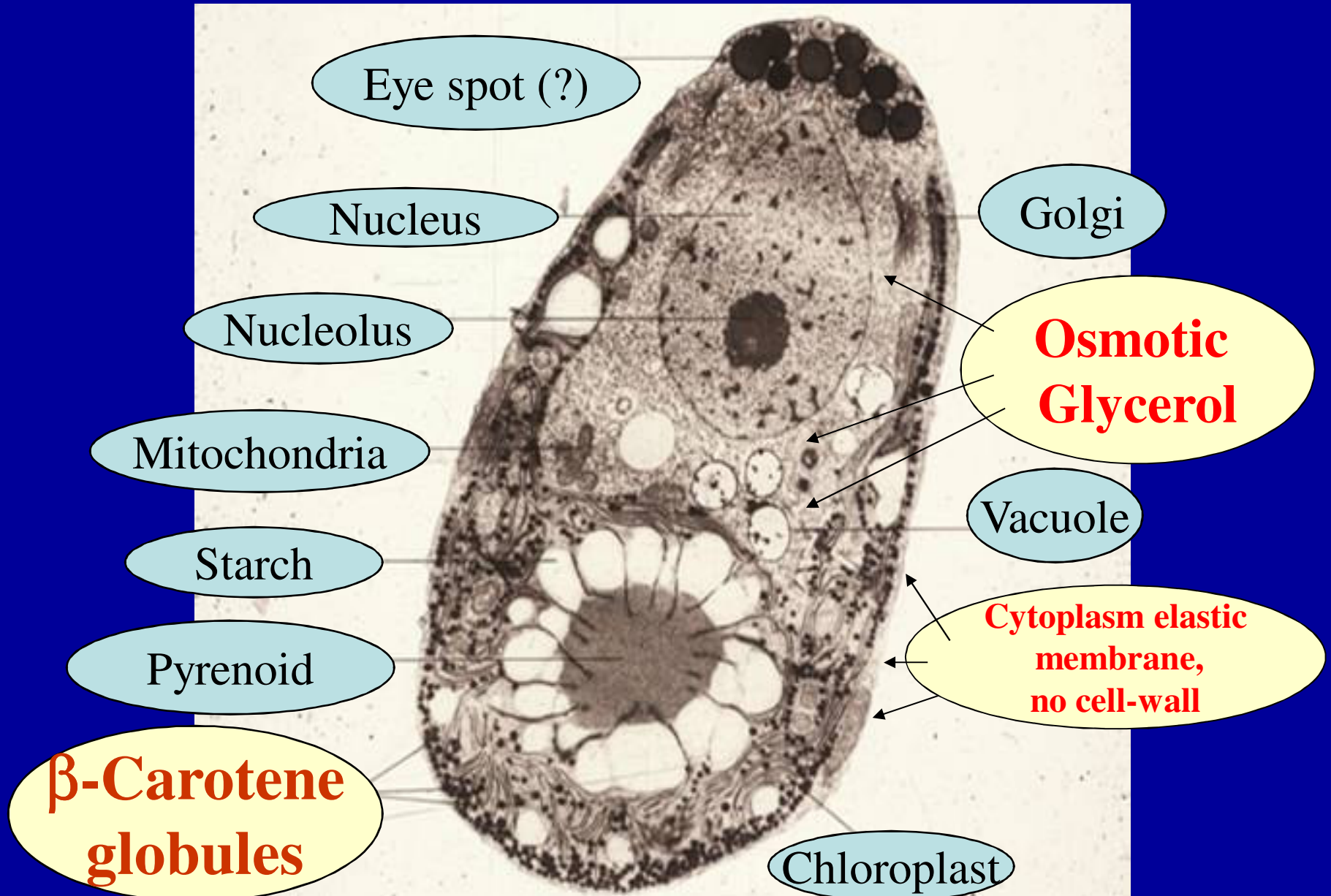
Dunaliella, Chlorophyta, Volvocales



Marine unicellular alga



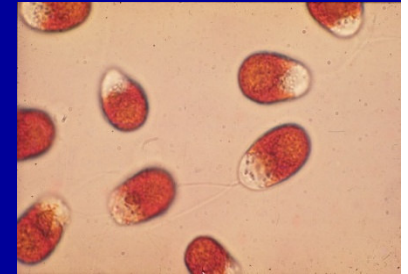
Dunaliella



Natural Bloom of *Dunaliella* Extreme Halotolerant Alga

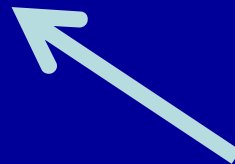


**Surviving in
saturated
salt (>32%)**



**Accumulating
osmotic
cellular glycerol
(>60%)**

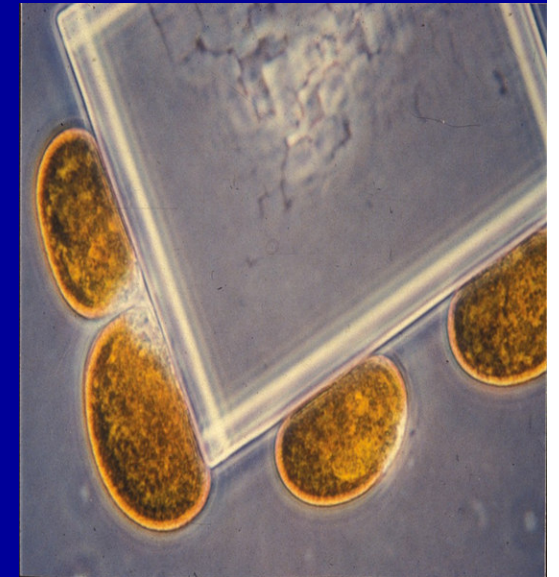
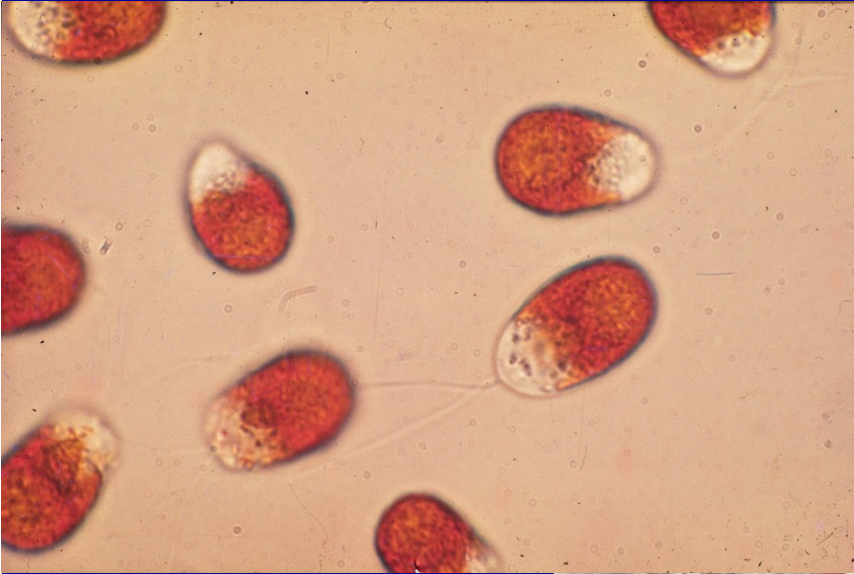
to the Great Salt Lake



From Sea Water



Halotolerant Algae



**Surviving in
saturated
salt (>32%)**



Osmotic Adaptation

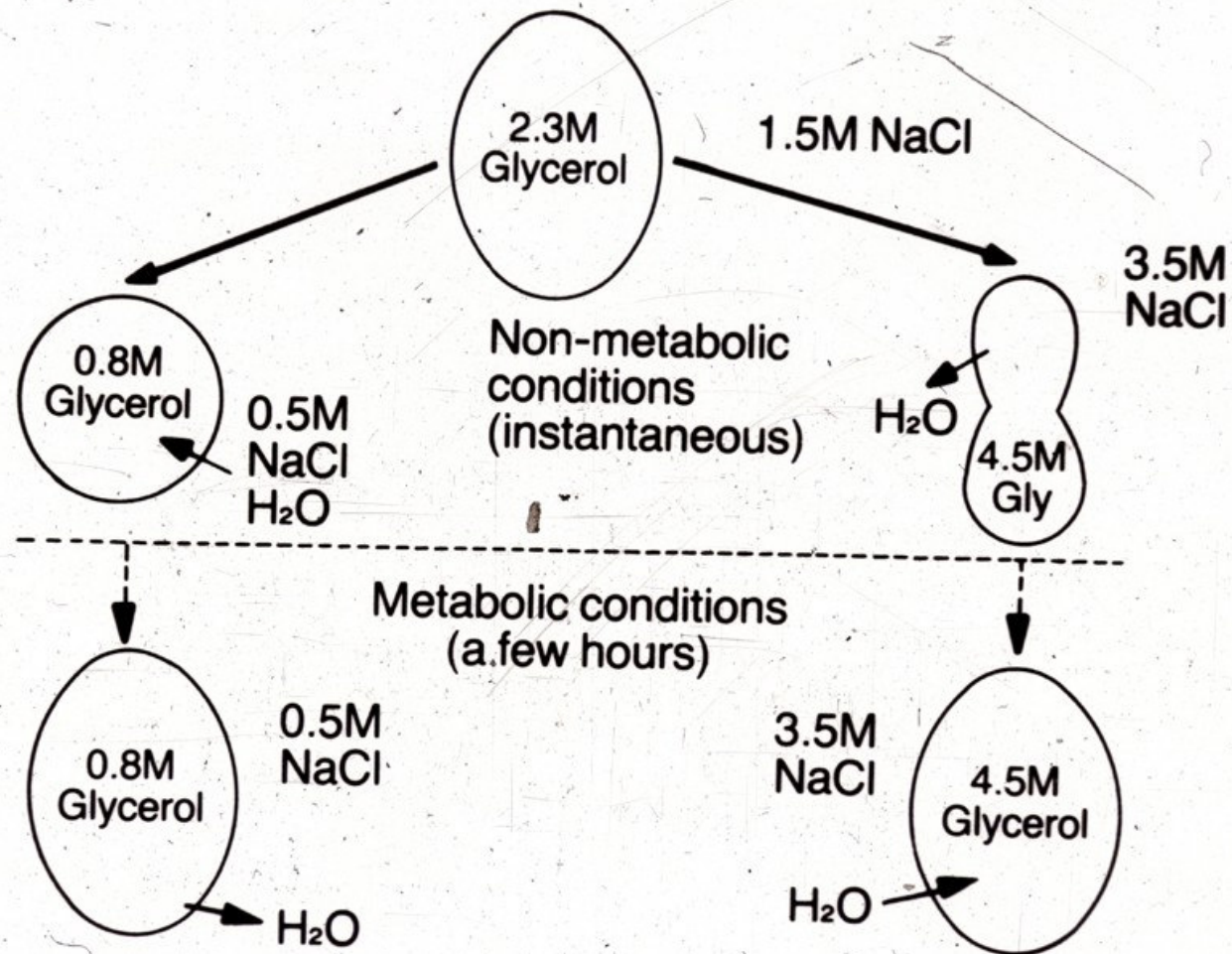
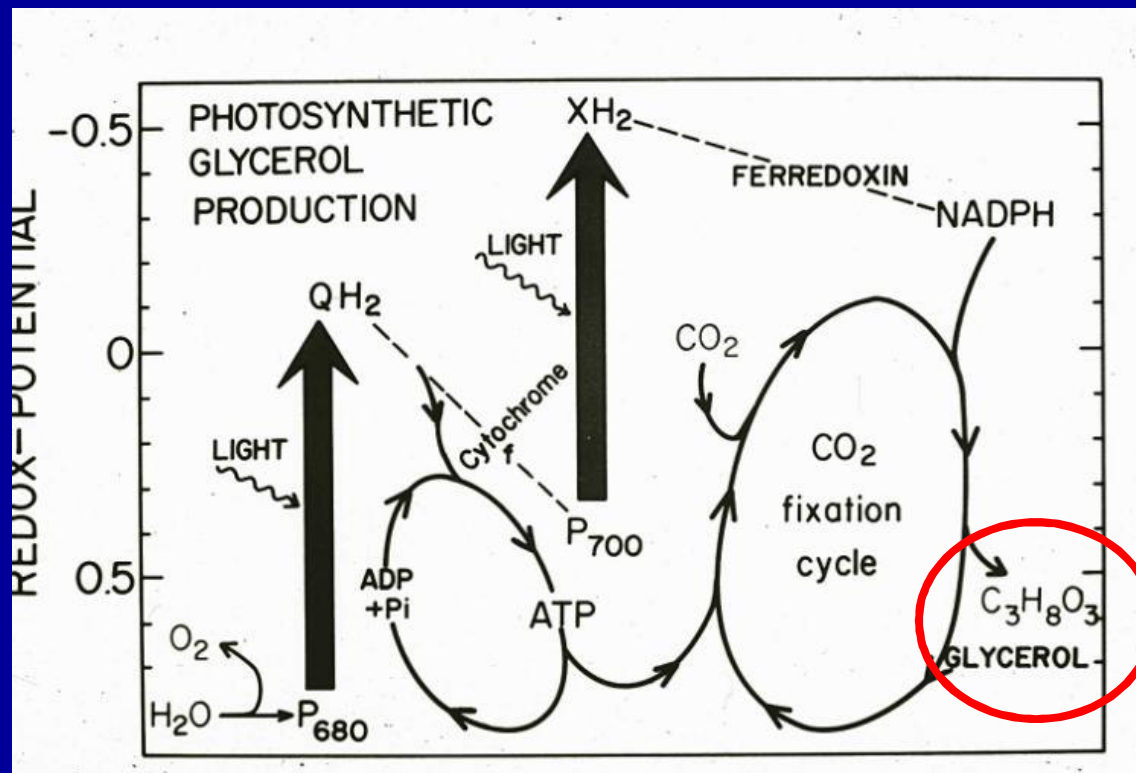


Fig. 4. Schematic representation of the volume changes of Dunaliella in response to hypertonic or hypotonic conditions.

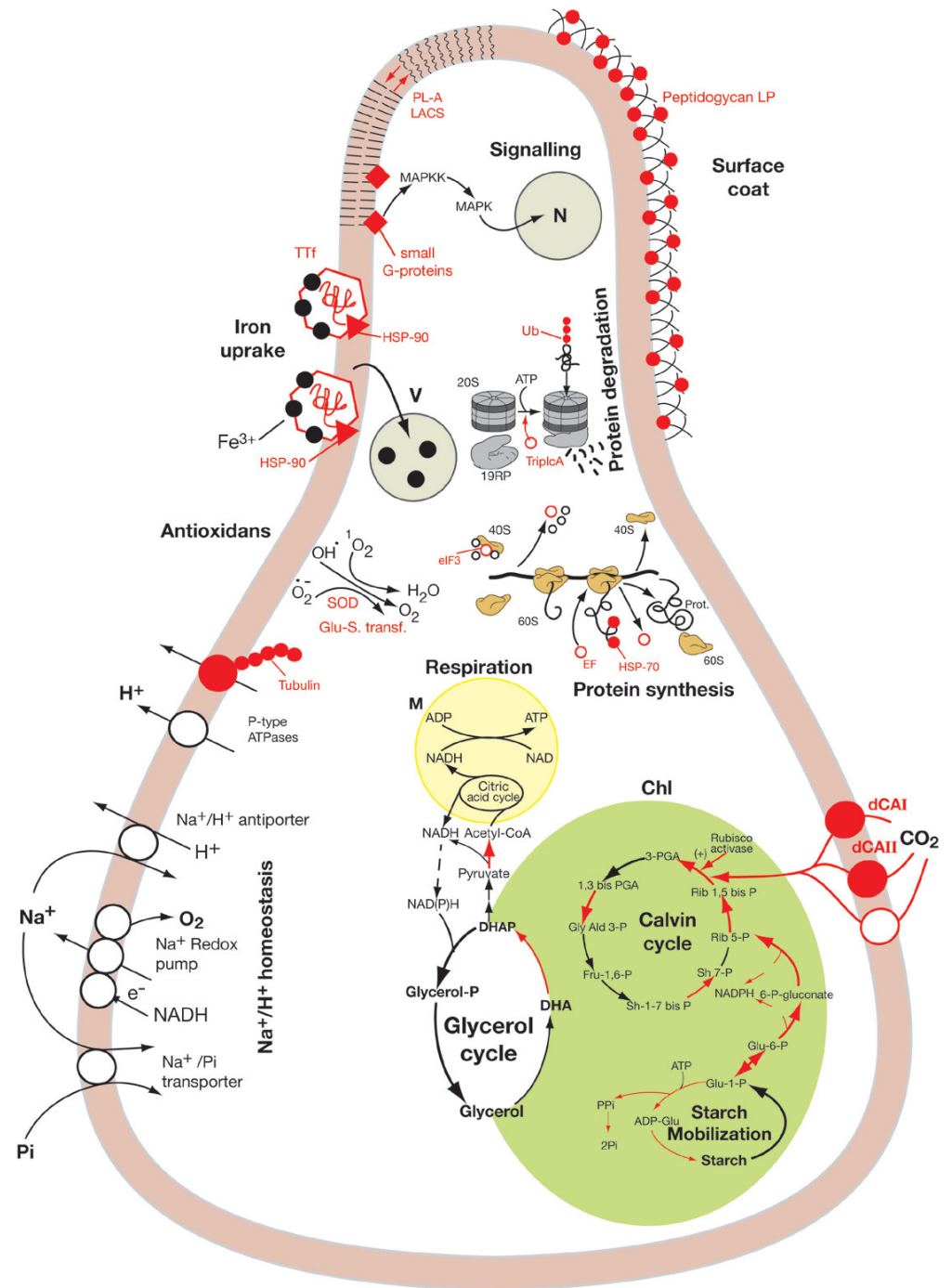
Photosynthesis in *Dunaliella*

Sugar & Glycerol Biosynthesis



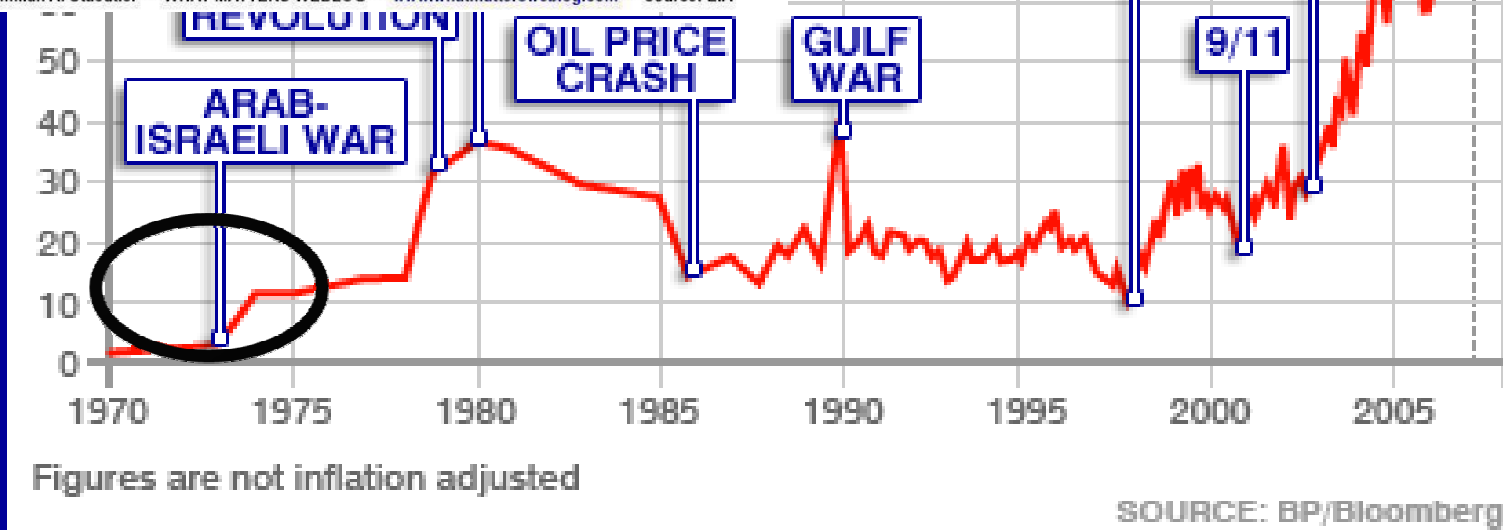
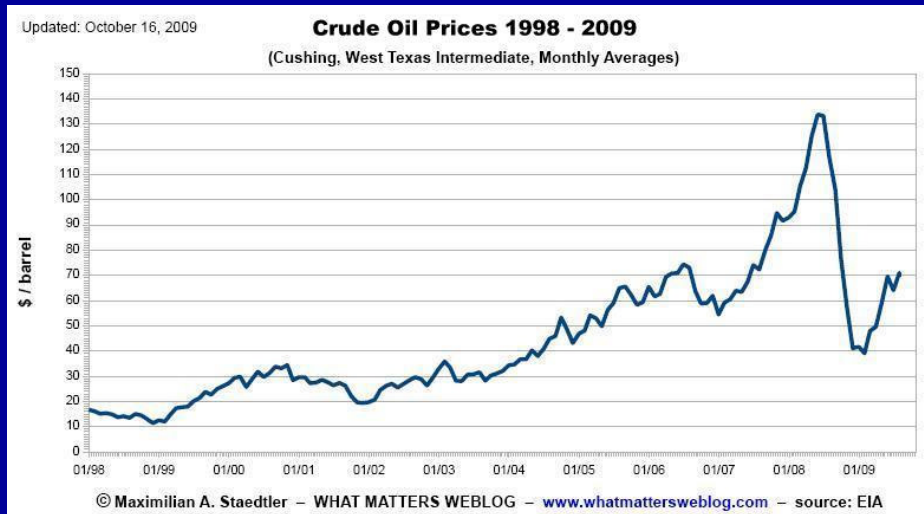
Halotolerance in *Dunaliella*

Katz et al., 2009



Oil Price and Wars

Feasible algae for Energy at above \$100/barrel (1975)



The 1st Energy Crisis 1973-5

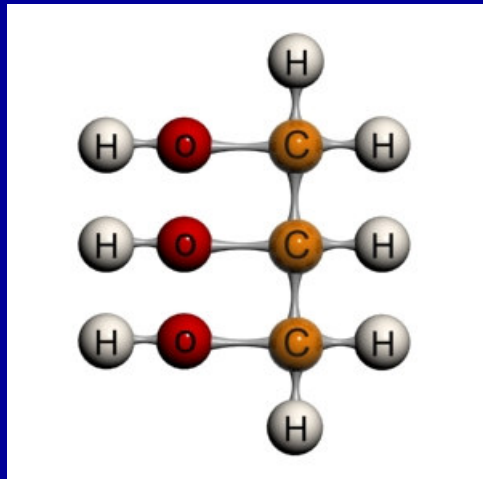
Algae for Energy

Large scale production of

Glycerol

by

Dunaliella



1st Energy Crisis 1975, Glycerol Algal Farm, 500 hectares in Sinai



Algae & Oil Price 1975

oil price dropped down

Dunaliella Project was stopped

Until then

Search for High Value Algal Products



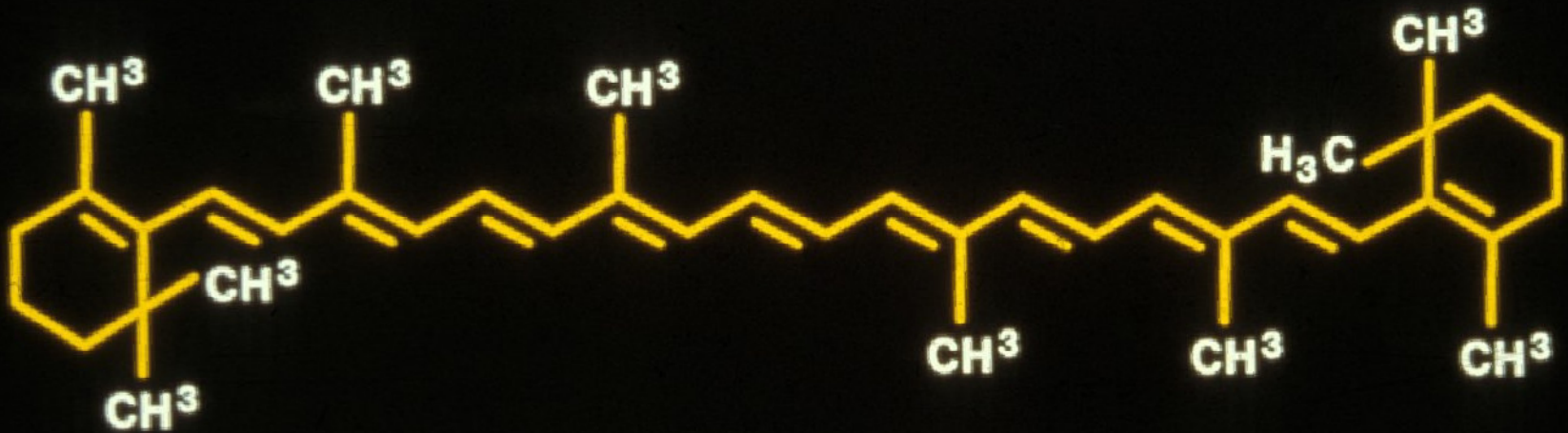
Dunaliella

High Value

Products

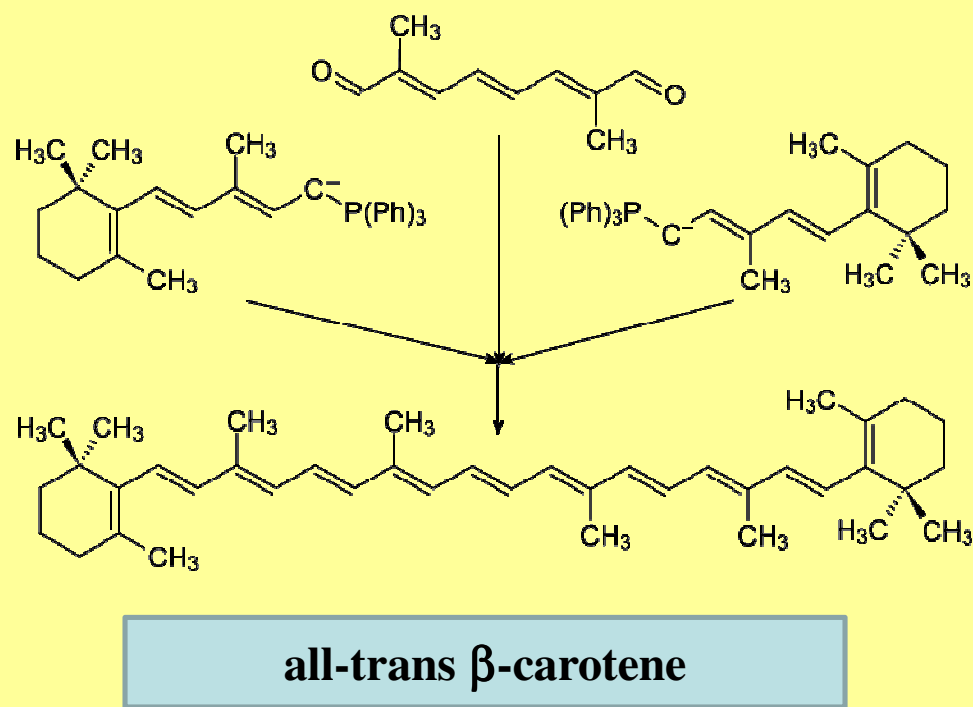
all-trans β -Carotene

Beta-Carotene



C₄₀H₅₆, Molecular Weight 536.85, C 89.49%, H 10.51%

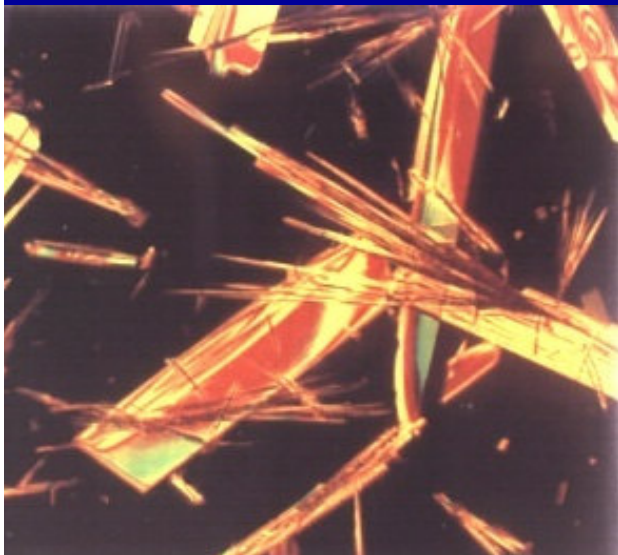
Chemical Scheme of Carotenoids Synthesis all-trans β -Carotene, BASF & Roche ~1950



Synthetic all-trans- β -Carotene



Low fat solubility



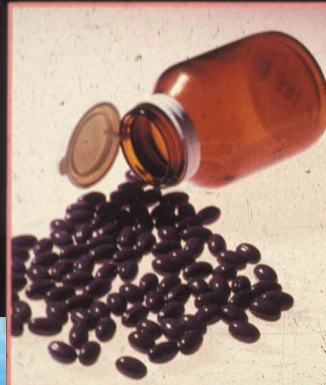
Beta-Carotene from ROCHE in the production of high-standard foods.

Ask ROCHE for advice, know-how and top-quality products.

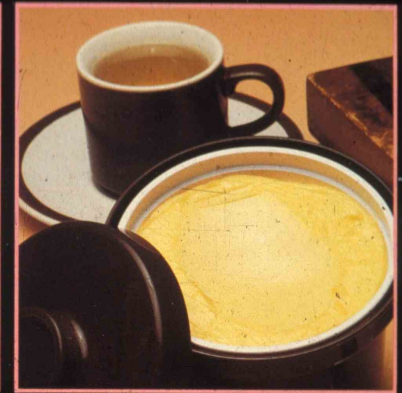
Crystals & Oil emulsion

Colored Food

Synthetic all-trans- β -Carotene



Beta carotene — also known as pro vitamin A — is sold in soft gelatin capsules to the health food industry.

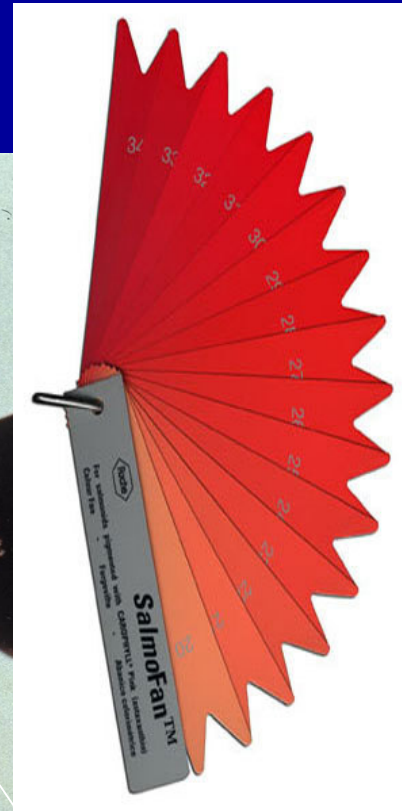
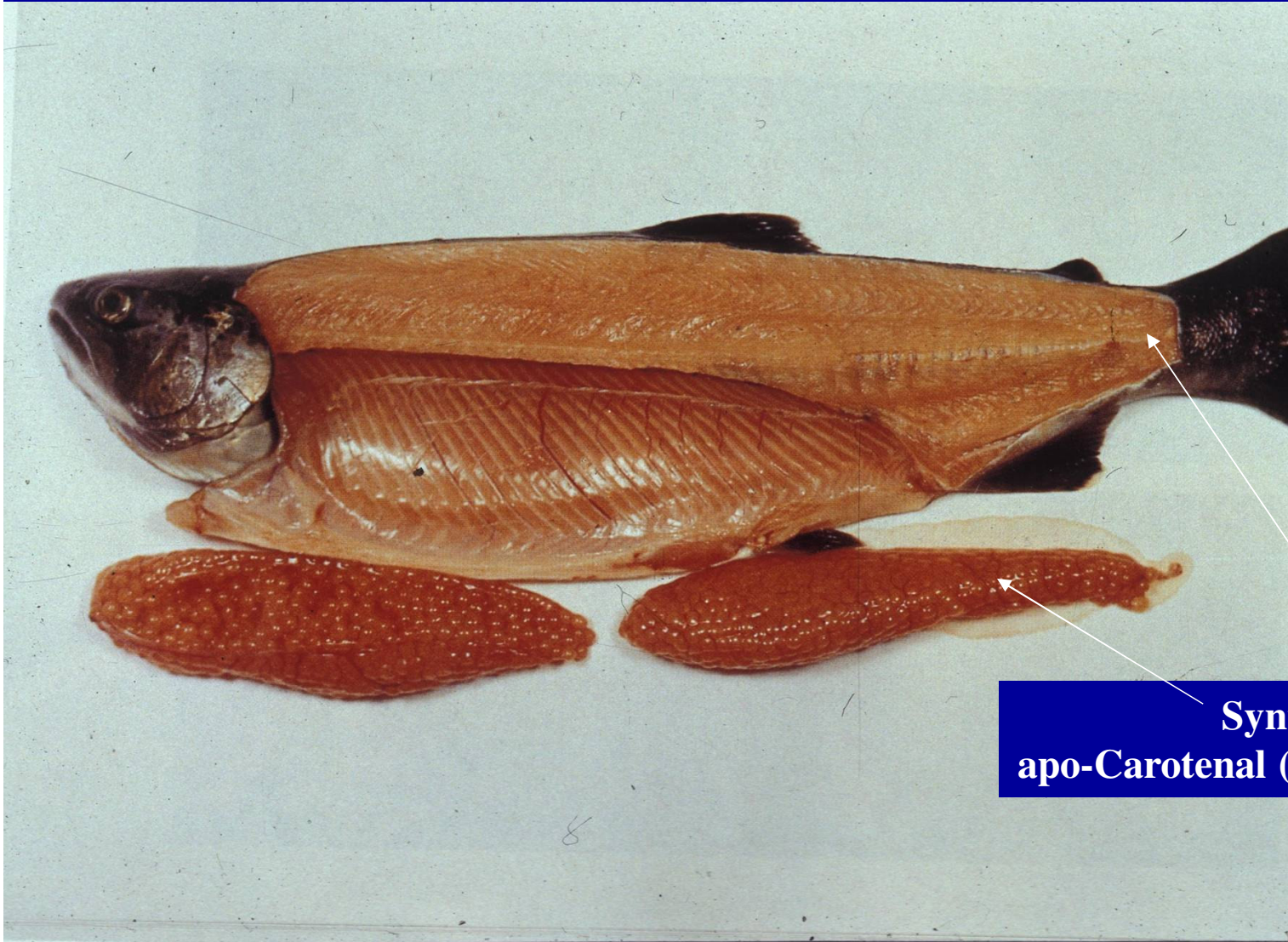


Beta carotene is commonly used as a colorant and to provide vitamin A fortification to margarine.

A wide range of foodstuffs can incorporate beta carotene.



Colored Fish



Synthetic
apo-Carotenal (“Carotene Pink”)

Colored Eggs



**Synthetic
apo-Carotenal**

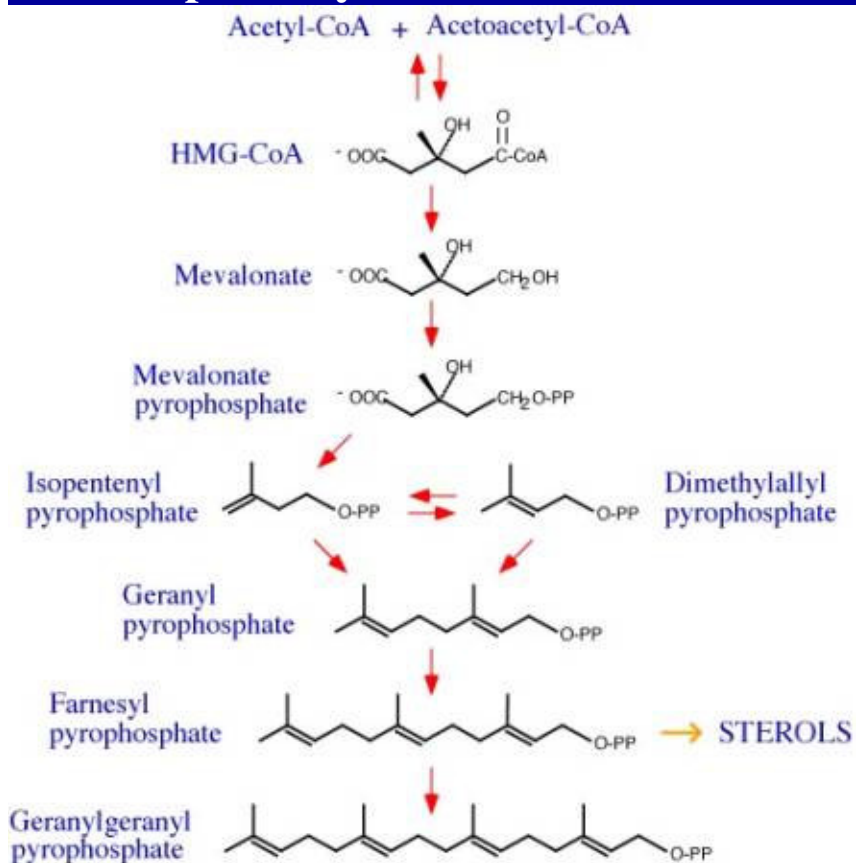


Natural Carotenoids

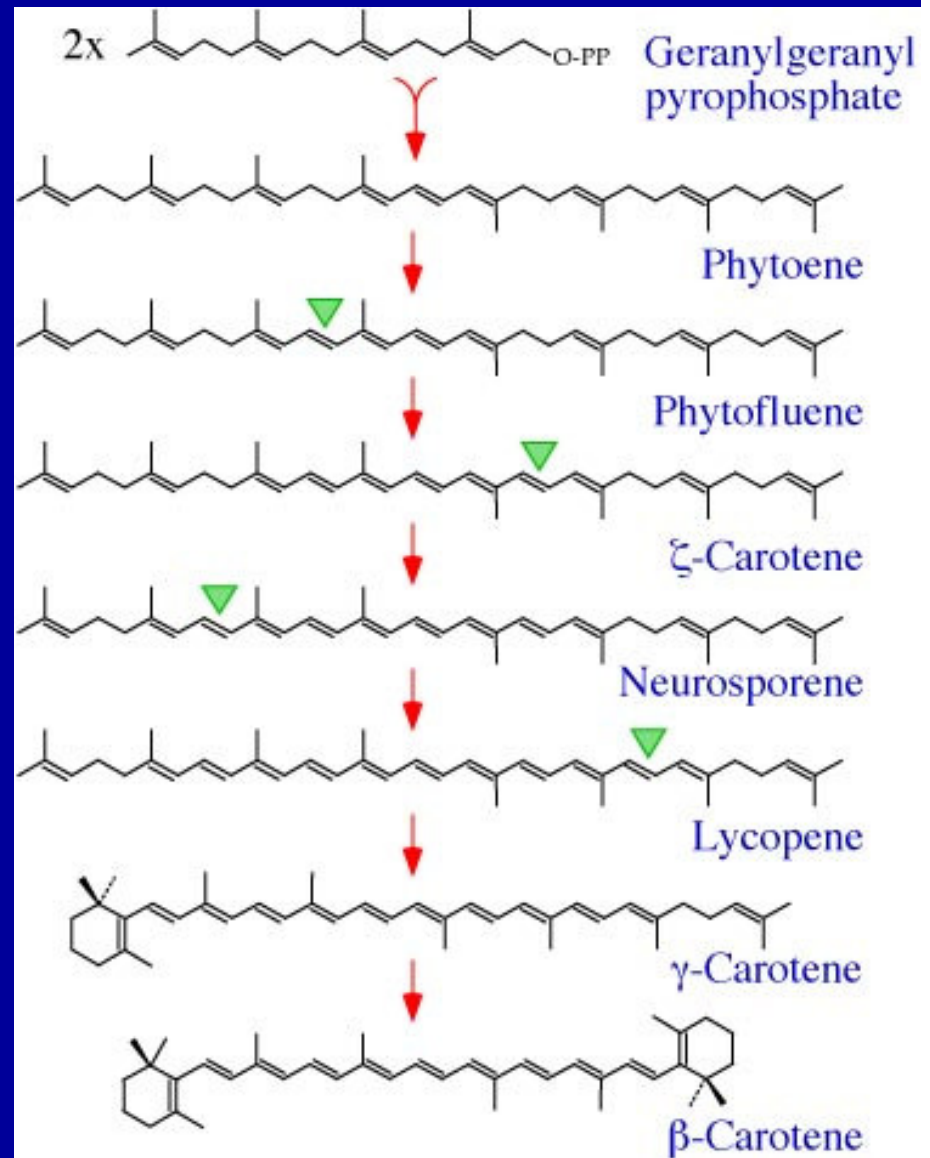
BIO-Synthesis of Carotenoids



Polar pathway



Lipophilic pathway



Dunaliella Research (nutrient optimization studies of 2x2 & 3x3) The Weizmann Institute

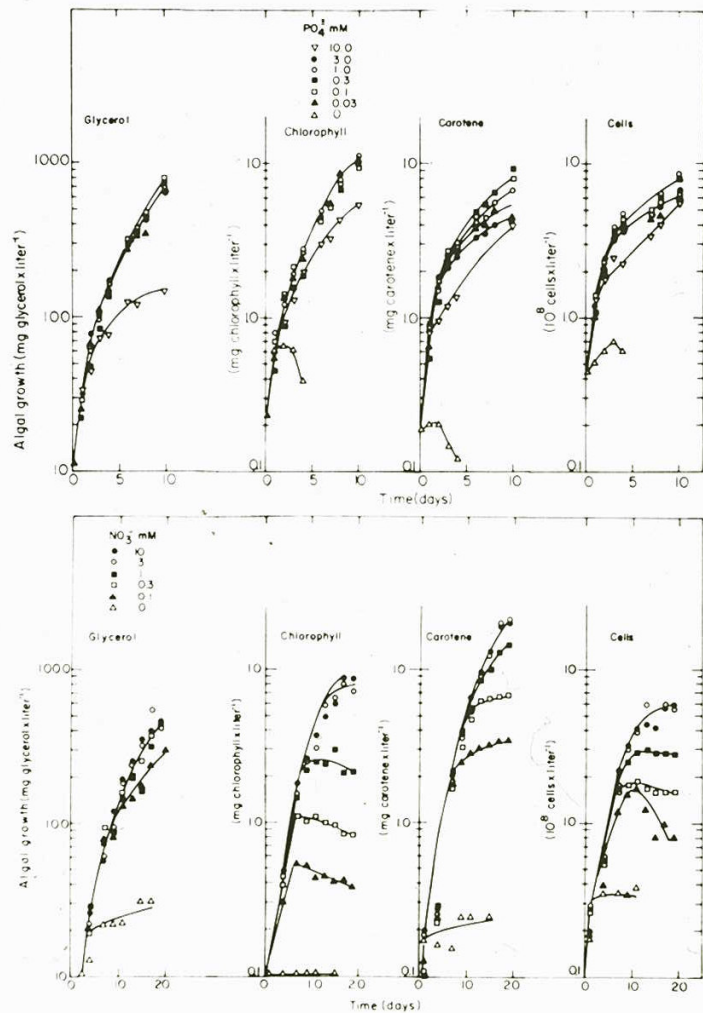


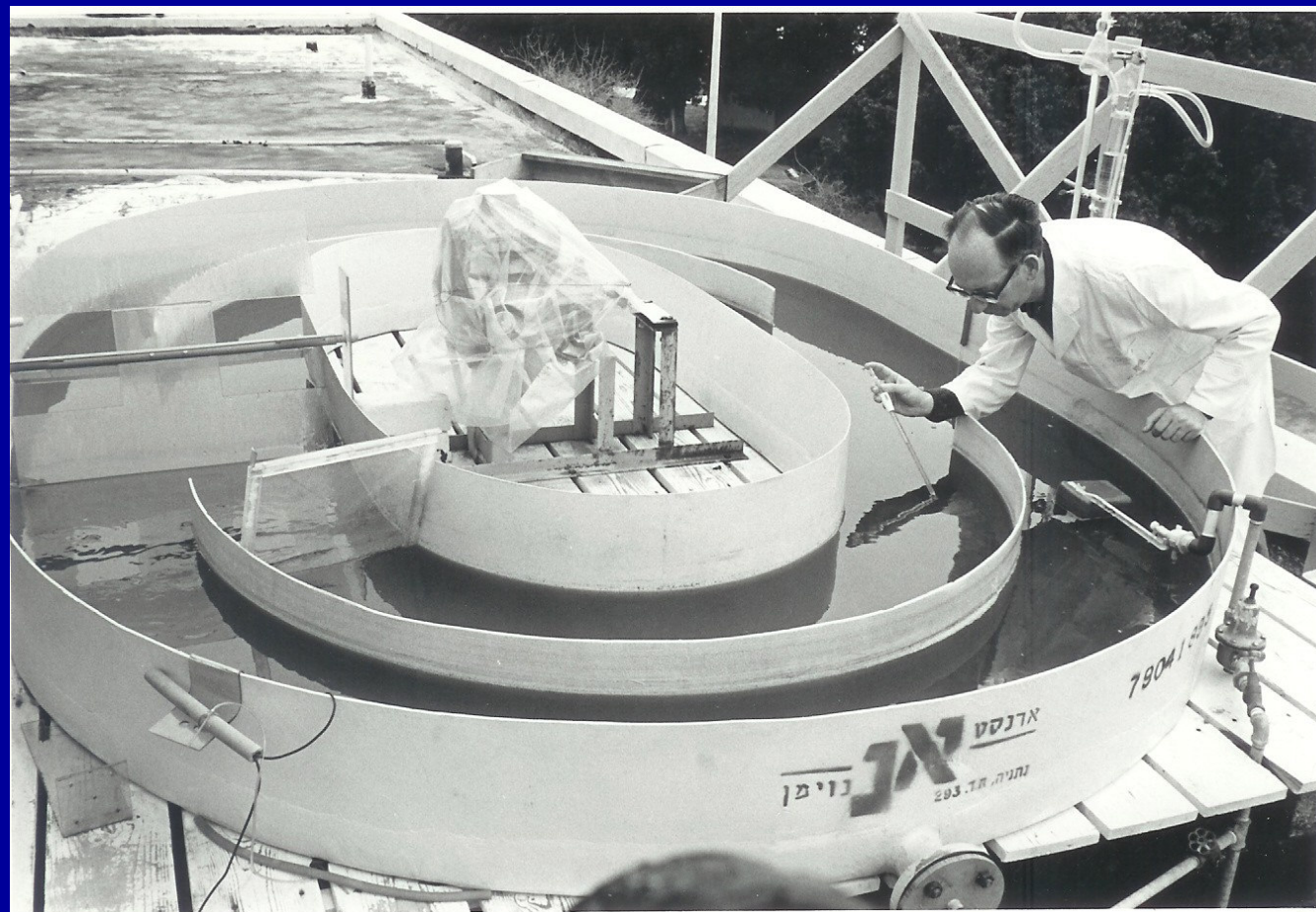
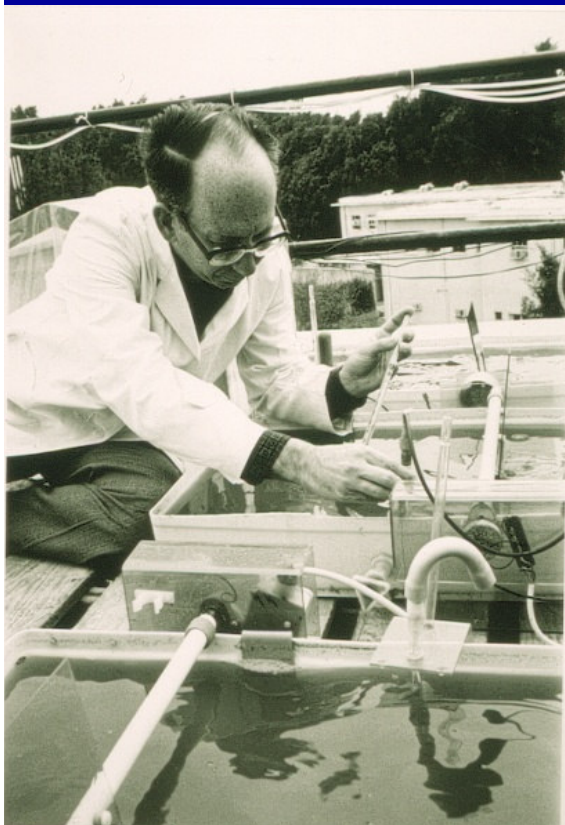
FIG. 3. Effect of phosphate concentration (upper) and nitrate concentration (lower) on the growth of *D. bardawil* and its content of glycerol, chlorophyll and carotene. Algae were preconditioned indoors on a nitrate or phosphate free medium containing 3 M NaCl until growth was retarded, then transferred to media with the indicated nitrate or phosphate concentrations.



The Weizmann Institute Indoors & outdoor studies



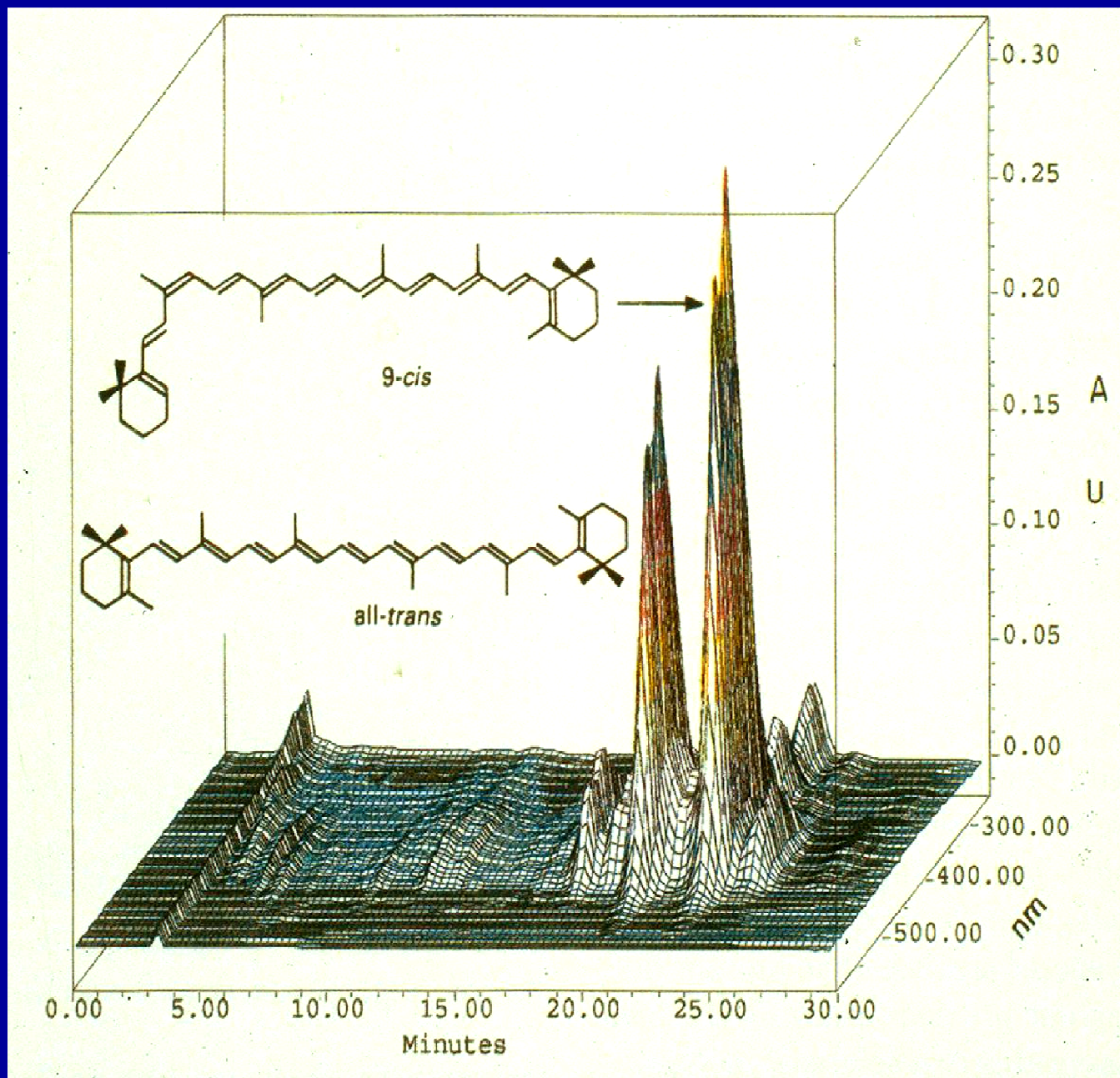
The Weizmann Institute *Dunaliella* Research,
(1975-1991, the Late Prof. M. Avron)



The Weizmann Institute *Dunaliella* Research (outdoor biotechnology)



Natural Carotenoid Isomers (HPLC Analysis)



Biosynthesis of β -Carotene Isomers

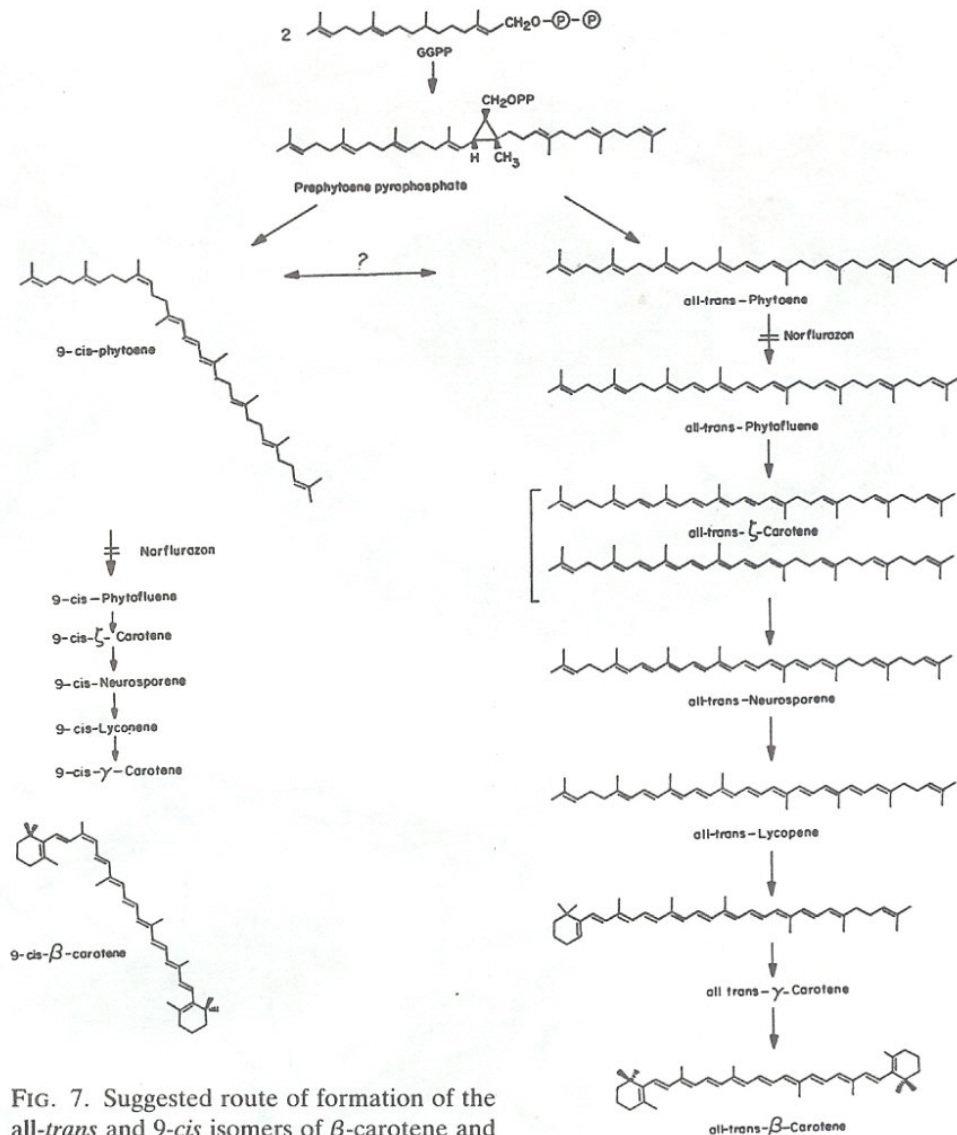
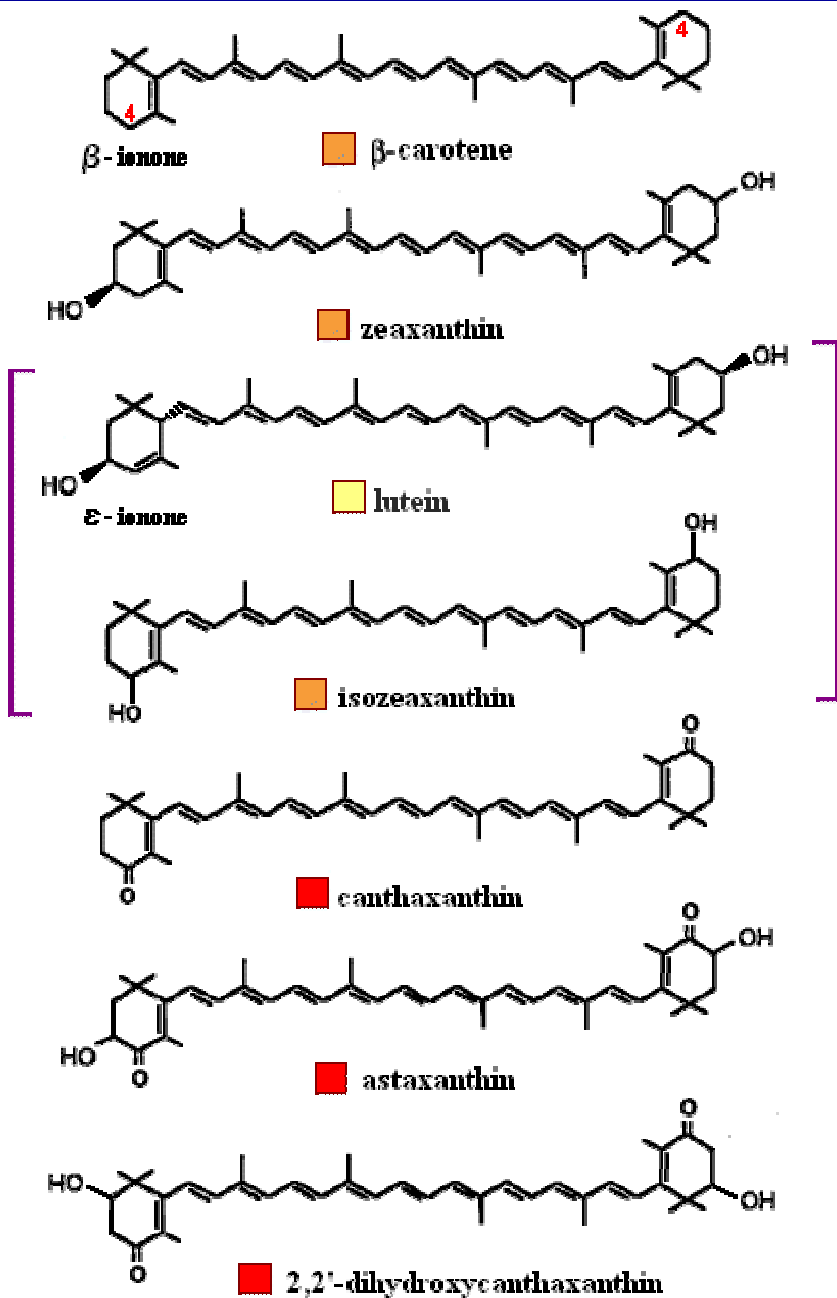


FIG. 7. Suggested route of formation of the all-trans and 9-cis isomers of β -carotene and phytoene.

Carotenoids and Isomerization

Sacrificial radical scavenging

Anti-oxidant (quench singlet oxygen)



2748 *J. Am. Chem. Soc.*, Vol. 117, No. 10, 1995

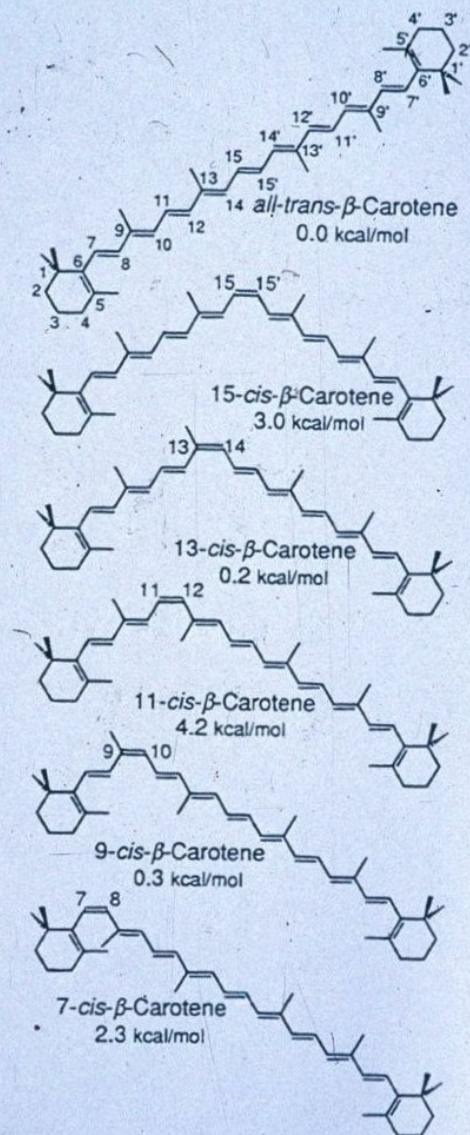
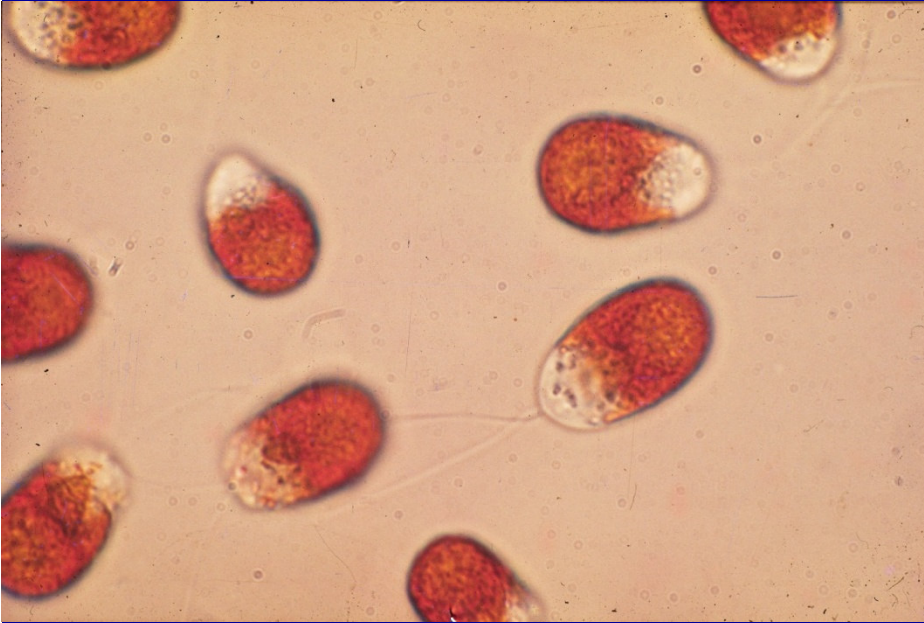


Figure 1. The mono-cis isomers of *all-trans-β-carotene* are shown along with their steric energies relative to *all-trans-β-carotene*, as calculated by the molecular mechanics program, MM-ERW.

The β -carotene in *Dunaliella* (and in fruits & vegetables) is composed of various stereoisomers of possible nutrition/medical interest



Dunaliella

Large Scale

Biotechnology

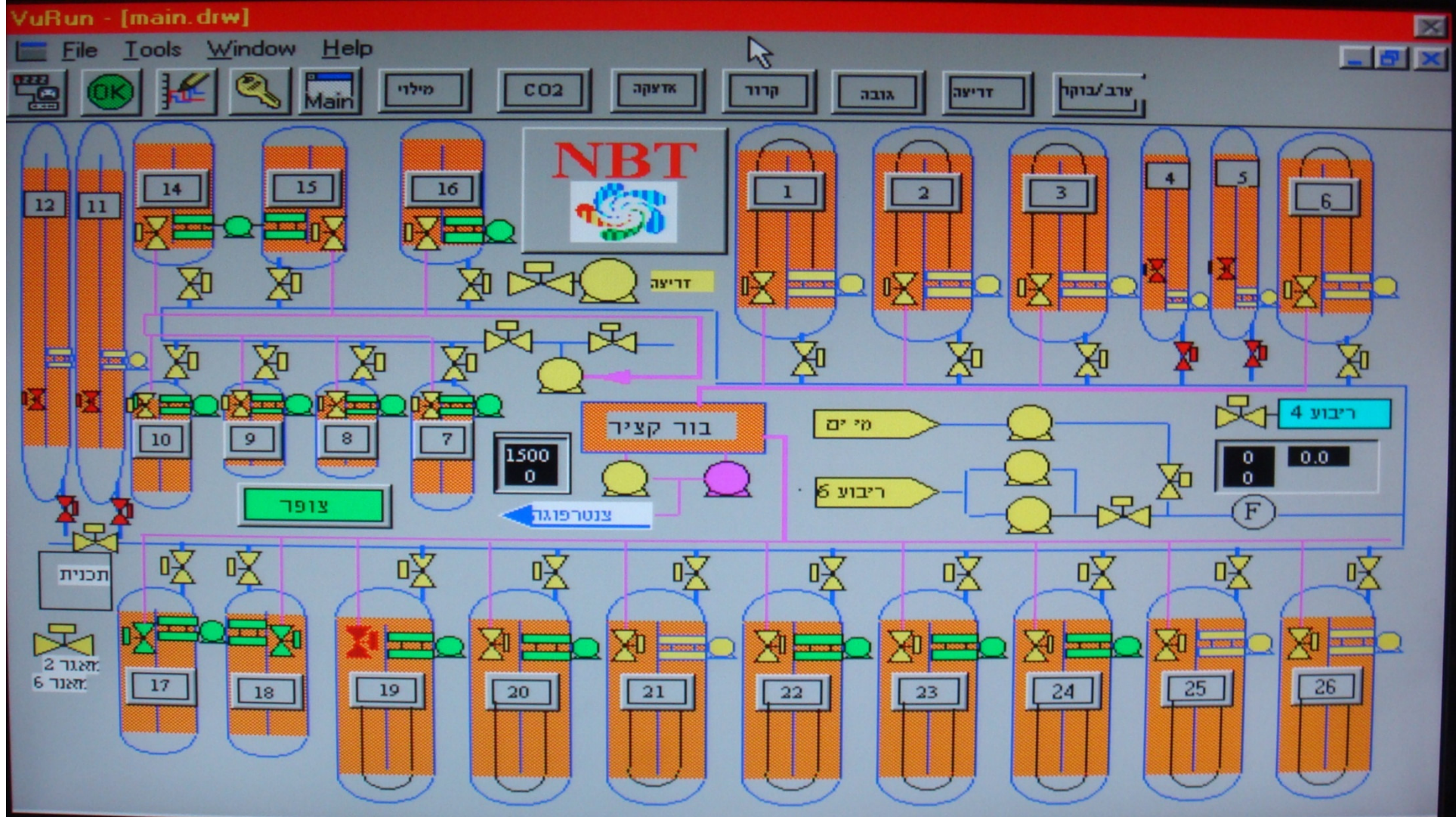
Cultivation & Processing

Dunaliella Biotechnology

Intensive Plant, NBT. Ltd., Eilat, Israel



PC Phycology Control



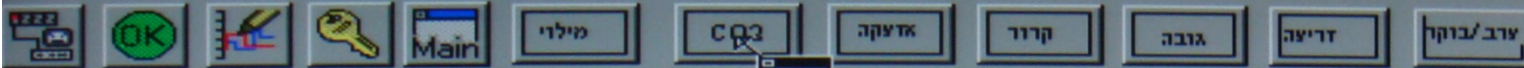
Dunaliella Ponds



All Site PC pH Control

VuRun - [C:\Vunig30\NBT\CO2.DRW]

File Tools Window Help



שעת סיום 17 30

Scr

שעת התחלה 5 15

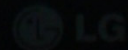
13 2

שעון בקר

| תקלה | max תקלה | בח HCl | פעולה מוד | הפעלת HCl | בח CO2 | פעולה מוד | הפעלת CO2 | תקלה | min תקלה | קריאת pH | בריכה |
|------|----------|--------|-----------|-----------|--------|-----------|-----------|------|----------|----------|-------|
| | 10.0 | | Man | 7.6 | | Auto | 8.1 | | 7.3 | 8.2 | 101 |
| | 10.0 | | Man | 7.9 | | Auto | 8.0 | | 7.3 | 8.5 | 102 |
| | 9.0 | | Man | 7.6 | | Auto | 8.0 | | 7.3 | 7.9 | 103 |
| | 0.0 | | Man | 10.0 | | Auto | 8.0 | | 0.0 | 2.8 | 104 |
| | 9.0 | | Man | 7.8 | | Auto | 8.3 | | 7.3 | 8.0 | 106 |
| | 10.0 | | Man | 7.8 | | Auto | 8.0 | | 7.3 | 7.7 | 107 |
| | 9.5 | | Man | 7.8 | | Auto | 8.0 | | 7.3 | 7.9 | 108 |
| | 9.0 | | Man | 7.8 | | Auto | 8.0 | | 7.3 | 7.9 | 109 |
| | 9.0 | | Man | 7.8 | | Auto | 8.0 | | 7.3 | 7.9 | 110 |
| | 0.0 | | Man | 8.0 | | Man | 8.0 | | 7.3 | 5.0 | אין |
| | 10.0 | | Man | 7.8 | | Auto | 8.0 | | 7.3 | 7.9 | 114 |
| | 9.0 | | Man | 7.8 | | Auto | 8.0 | | 7.0 | 7.9 | 115 |
| | 9.0 | | Man | 7.8 | | Auto | 8.0 | | 7.0 | 7.9 | 116 |
| | 9.5 | | Man | 7.8 | | Auto | 8.4 | | 7.3 | 8.2 | 117 |
| | 9.5 | | Man | 7.6 | | Auto | 8.4 | | 7.0 | 7.9 | 118 |
| | 9.0 | | Man | 7.6 | | Auto | 8.4 | | 7.3 | 8.4 | 119 |
| | 10.0 | | Man | 7.6 | | Auto | 8.4 | | 7.2 | 8.3 | 120 |
| | 10.5 | | Man | 7.6 | | Auto | 8.3 | | 7.0 | 8.2 | 121 |
| | 9.0 | | Auto | 8.9 | | Auto | 8.4 | | 7.3 | 8.1 | 122 |
| | 9.0 | | Man | 7.6 | | Auto | 8.4 | | 7.3 | 8.3 | 123 |
| | 9.0 | | Man | 7.6 | | Auto | 8.1 | | 7.3 | 6.8 | 124 |
| | 10.0 | | Auto | 8.9 | | Auto | 8.3 | | 7.3 | 4.5 | 125 |
| | 9.0 | | Man | 7.6 | | Auto | 8.3 | | 7.3 | 8.9 | 126 |

בח ראשי

צופר



Depth Control (by sonic wave)

VuRun - [C:\Wuniq30\NBT\high.DRW]

File Tools Window Help

OK Main מילוי CO2 אדוקה קרור גובה זריעה צרב/בוקר

Sci

| מ"ק = סנטימטר | גובה לחומצה | אגם תקלה | אגם גובה | זתם תקלה | זתם גובה | pV | בריכה סמ |
|---------------------|-------------|----------|----------|----------|----------|------|----------|
| הערה | | | | | | | |
| 31 פעולת השאיבה | 15.0 | | 22.0 | | 0.0 | 0.0 | 101 |
| 31 של המשוטה | 9.0 | | 35.0 | | 0.0 | 4.3 | 102 |
| 31 משפיעה על | 16.0 | | 26.0 | | 0.0 | 19.4 | 103 |
| 17 קריאת הגובה | 24.0 | | 36.0 | | 0.0 | 11.4 | 106 |
| 3 לכן כאשר עובדים | 15.0 | | 26.0 | | 0.0 | 11.4 | 107 |
| 1 לפי ידידת גובה יש | 13.0 | | 30.0 | | 0.0 | 19.6 | 108 |
| 1 לרדת ב-1 ס"מ | 13.0 | | 30.0 | | 0.0 | 21.0 | 109 |
| פחות | | | | | | | |
| 3 להפך אם עובדים | 8.7 | | 27.0 | | 0.0 | 18.0 | 110 |
| 7 לפי גובה עולה | 6.0 | | 37.0 | | 0.0 | 7.5 | 114 |
| 7 | 7.0 | | 25.0 | | 0.0 | 13.9 | 115 |
| 7 | 10.0 | | 22.0 | | 0.0 | 0.0 | 116 |
| 12.5 | 13.5 | | 40.0 | | 0.0 | 28.0 | 117 |
| 12.5 | 19.5 | | 36.0 | | 0.0 | 28.6 | 118 |
| 27 | 13.0 | | 22.0 | | 0.0 | 0.0 | 119 |
| 29 | 13.5 | | 40.0 | | 0.0 | 2.3 | 120 |
| 30 | 15.0 | | 30.0 | | 0.0 | 3.1 | 121 |
| 30 | 16.5 | | 40.0 | | 0.0 | 15.4 | 122 |
| 31 | 12.0 | | 22.0 | | 0.0 | 0.0 | 123 |
| 31 | 14.0 | | 22.0 | | 0.0 | 0.7 | 124 |
| 32 | 12.0 | | 40.0 | | 0.0 | 0.7 | 125 |
| 32 | 11.0 | | 40.0 | | 0.0 | 0.0 | 126 |

Volume and Salinity Control

VuRun - [C:\Wuniq30\NBT\FILL.DRW]

File Tools Window Help

OK Main מילוי CO2 אדוקה קרור גובה דריעה ערב/בוקר

הזר

שם מפעיל: אילן אל 1403

| קריאה | דרוש | יעד | מקור | מס' |
|-------|------|-----------|---------|-----|
| 18.3 | 18.0 | בריכה 124 | מי ים | 1 |
| 30.3 | 30.0 | בריכה 122 | מי ים | 2 |
| 15.0 | 15.0 | בריכה 120 | ריבוע 6 | 3 |
| 8.0 | 8.0 | בריכה 124 | ריבוע 6 | 4 |
| 6.0 | 6.0 | בריכה 117 | ריבוע 6 | 5 |
| 13.0 | 13.0 | בריכה 118 | ריבוע 6 | 6 |
| 11.0 | 11.0 | בריכה 103 | ריבוע 6 | 7 |
| 18.3 | 18.0 | בריכה 103 | מי ים | 8 |
| 4.2 | 4.0 | בריכה 116 | מי ים | 9 |
| 4.2 | 4.0 | בריכה 115 | מי ים | 10 |
| 0.0 | 0.0 | בריכה 117 | מי ים | 11 |
| 0.0 | 0.0 | בריכה 117 | מי ים | 12 |
| 0.0 | 0.0 | בריכה 101 | מי ים | 13 |
| 0.0 | 0.0 | בריכה 107 | ריבוע 6 | 14 |
| 0.0 | 0.0 | בריכה 107 | מי ים | 15 |
| 0.0 | 0.0 | בריכה 124 | מי ים | 16 |
| 0.0 | 0.0 | בריכה 118 | ריבוע 6 | 17 |
| 0.0 | 0.0 | בריכה 118 | מי ים | 18 |

הפעלה אוטומטית

הפעלה איפוס

שלב מס' 2

מדרחי

מצב בווד מי ים

הפעלה ידנית

הדרמות

קריאה 0.0

דרוש 0.0

מי ים לבריכות

ריבוע 6 לבריכות

מי ים לריבוע 4

שעון עצר

רצוי 20

נמדד 0

הפעל הפעל גמר איפוס

קציר 11 קציר 12

מים לבריכה 4 מים לבריכה 5

7913

מים לבריכה 11 מים לבריכה 12

DUNALIELLA Harvesting

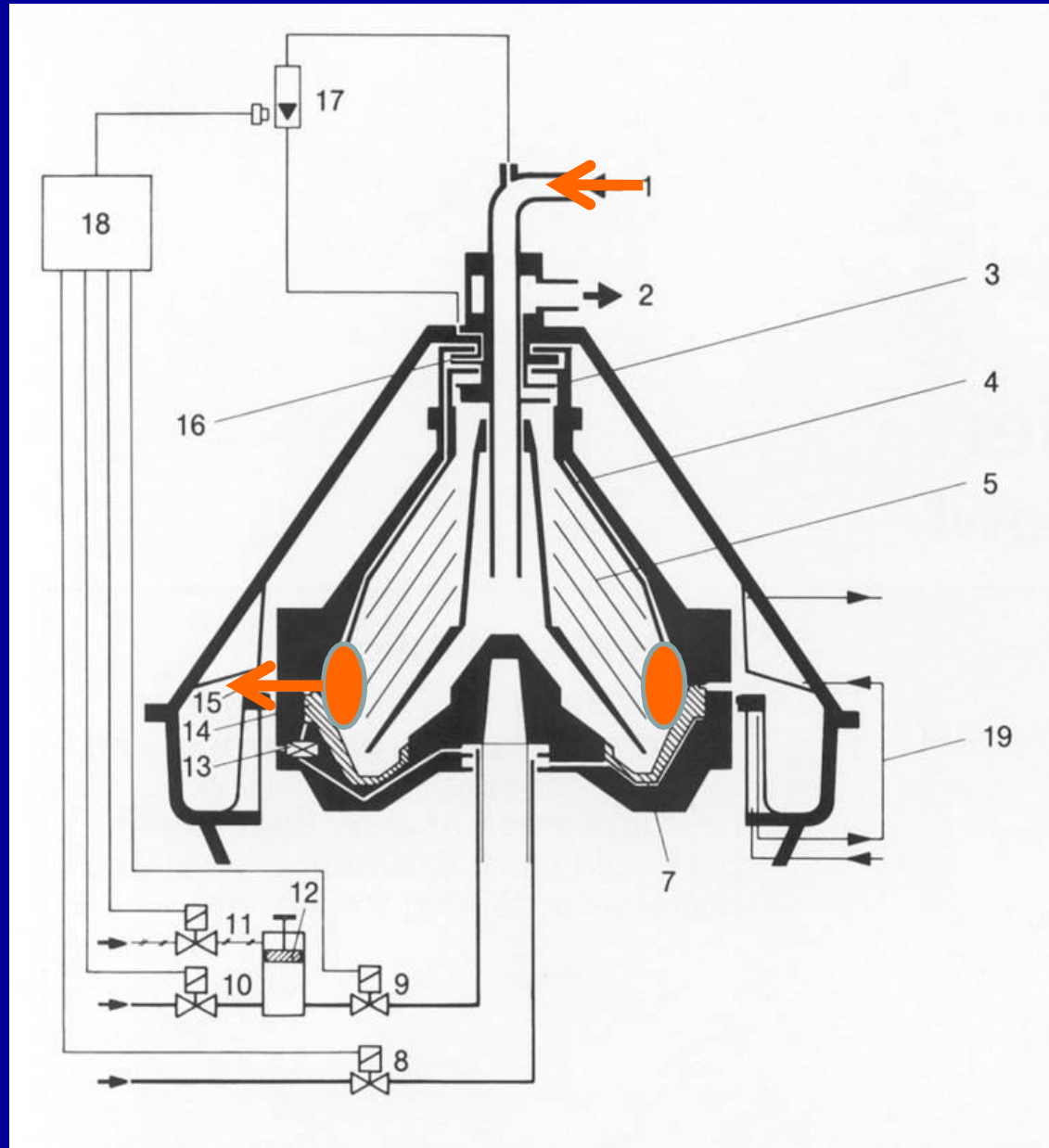
Westphalia Ltd., continuous “Clarifier Centrifuges”



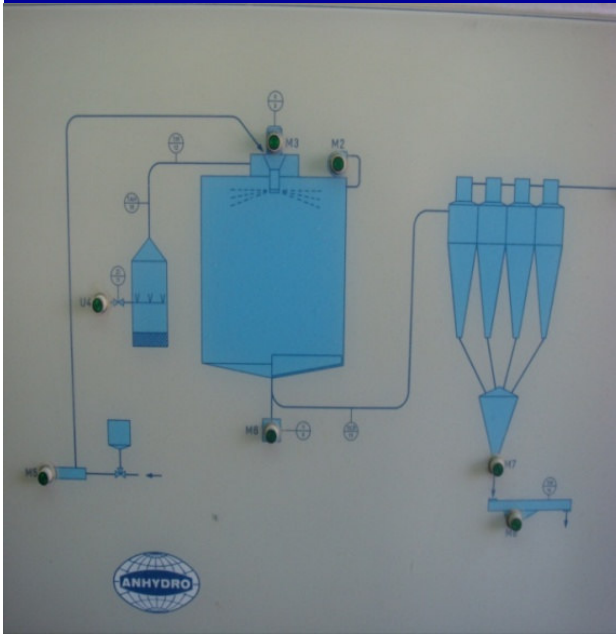
Dunaliella Paste



Clarifier Centrifuges



Common Spray Dryer



Dunaliella

Spray Dried High β -Carotene Algal Powder



β -Carotene *Dunaliella* Powder Vacuum Packing



Natural β -Carotene

Dunaliella

Feeding Studies

Chickens

1990-2000

Chicks Feed

No Vitamin A

+ Vitamin A

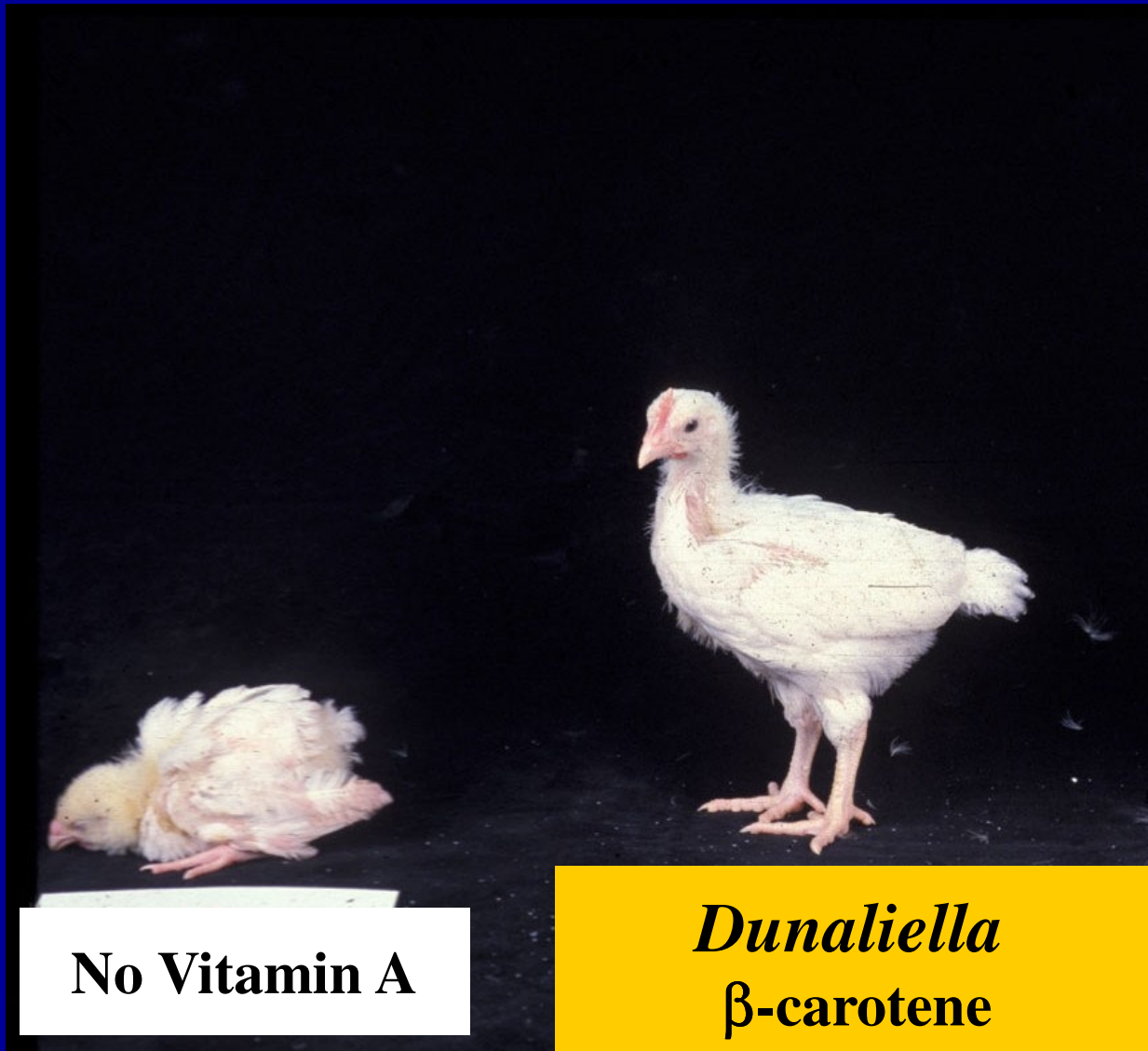
+ Synthetic β -carotene

+ *Dunaliella*



Chicken Feed

Vitamin A deficiency & *Dunaliella*



No Vitamin A

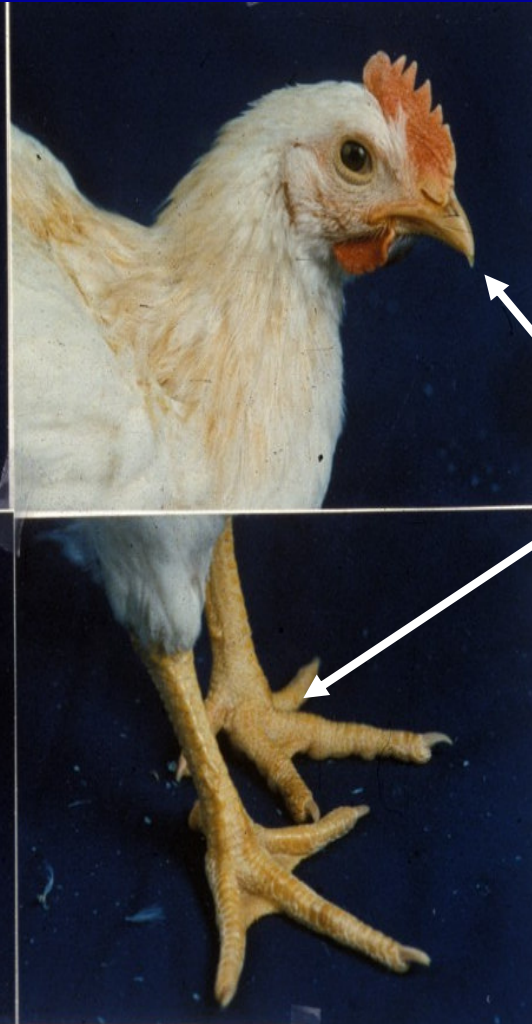
Dunaliella
β-carotene

Dunaliella Chicken Study

Control



Dunaliella



Chicken Feed, Egg Color



平成11年1月20日(水曜日) THE ALGAE VOL.219 (2)

通常の10倍(150 μ g)のベータカロチンを含む

大きな期待が膨らむ ドナリエラ卵の実力!!

ドナリエラ卵と一般卵のサルモネラ菌発生実験

ドナリエラ卵と一般卵のコレステロール量の比較

ドナリエラ卵の特徴

- 天然ベータカロチンが一般の卵と比べて10倍以上ある
- コレステロールが一般の卵より少ない
- 食中毒の原因となるサルモネラ菌の繁殖を抑える
- 卵の生臭さがほとんどない
- 味が非常に濃く、美味である
- 黄身の色が大変濃く、艶がある
- 黄身は半円状に盛り上がり、摘めるほどの弾力がある

日健総本社のドナリエラを飼料として利用すると、ニワトリも元気になり、その元気がニワトリから、このような素晴らしい卵が誕生するといわれています。

「昔々の濃い黄に比べ、イソラエルN・B-Tで培養された飼料用ドナリエラをニワトリに与え、そのニワトリから産まれた卵が、「ドナリエラ卵」です。当初、ジャスコ側から提示された卵の名前がありませんでしたが、「ドナリエラ卵」という名前がつけられたという経緯があります。世界中から注目を浴びているこのドナリエラ卵は、商品に携わることが出来るのは、我々の誇りです。そのために、自費と時間をかけて、比較

ます。そして、写真(左上)のようにサルモネラ菌の発生を抑えるという抗衛作用があること、また、コレステロールを抑えることが出来るのも魅力的です。

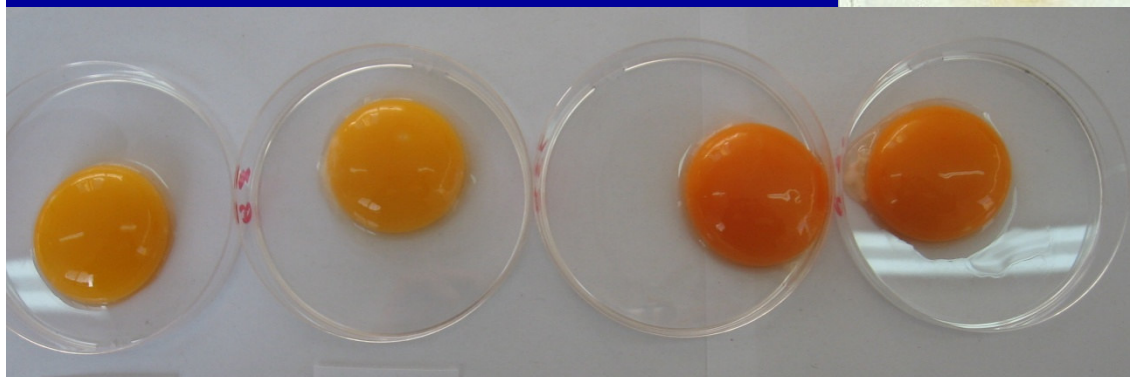
これらの新鮮な情報をホムバーティの場で活かせば、卵が盛り上がり、食味が弾むこととなるでしょう。

このような商品を開発・開発し、生み出すことが出来る日健総本社ですから、発売から20余年、現在同様、愛用していただいている「ロスウェル・コンコード」ドナリエラ、エバマンダをはじめとする40数種類の我々の商品群がいかに愛されたものであるかがお分かりいただけると思います。

今、国内外の様々な企業から我々の天然ヘチベータカロチン「ドナリエラ」に対する関心が高まり、アプロイティブがあります。世界中から注目を浴びているこのドナリエラ卵は、商品に携わることが出来るのは、我々の誇りです。そのために、自費と時間をかけて、比較

ジャスコ店頭で販売されたドナリエラ卵

「昔々の濃い黄に比べ、イソラエルN・B-Tで培養された飼料用ドナリエラをニワトリに与え、そのニワトリから産まれた卵が、「ドナリエラ卵」です。当初、ジャスコ側から提示された卵の名前がありませんでしたが、「ドナリエラ卵」という名前がつけられたという経緯があります。世界中から注目を浴びているこのドナリエラ卵は、商品に携わることが出来るのは、我々の誇りです。そのために、自費と時間をかけて、比較



Dunaliella

**Human Commercial
Products**

The Blessing Of Nature
自然の贈り物
 天然ベータカロチン含有食品
 NATURAL BETA CAROTENE
Dunaliella
 ハードカプセル

私たちが健康に生きるためには、健康な食物を毎日食べる必要があります。化学物質や環境ホルモンなど、現在の生活習慣病を引き起こすものは、化学合成品によるものが多いのではないのでしょうか。天然の良さは、様々な必要な成分が混ざっておりこれらが互いに働きあって、安全でかつ幾つかの作用が発揮されます。

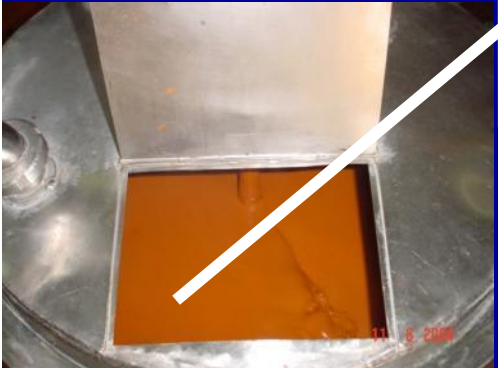
合成でたいしょうぶ？

Japan & Far East Market Price
 ~\$4,000/kg algal AFDA
 (β-Carotene Health Food)
 Total sale ~\$US 100 million/year

Final Product
Japan



Raw algae
Israel



Dunaliella Capsules

**300 mg dry powder/cap
20 mg β -carotene
9-cis/all-trans 1:1**



Commercial *Dunaliella*



Dunaliella Health Food Powder

Door to door marketing by 500,000 sale agents in the Far East



自然からの贈り物
天然カロチノイドをカプセルにつめ込んだ栄養食品

【ドナリエラハードカプセル】は、不規則な生活の乱、喫煙、飲酒、アルコール摂取の多い方、ストレスのたまりやすい方などに気軽に安心して天然カロチノイドが摂取できる優れた栄養食品です。

天然の良さを生かして...

私たちが健康に生き抜くためには、安全で健康な食物を毎日摂ることが必要です。その中でも特に、緑黄色野菜に含まれる天然カロチノイドは健康維持に欠かすことができません。ドナリエラハードカプセルは、天然カロチノイドがニンジンのおよそ900倍以上含まれる、まさにスーパー緑黄色野菜と呼ぶにふさわしい栄養食品です。

現代の食生活において、化学物質や環境ホルモンなど、生活習慣病を引き起こす要因はまさに化学製品によるものが多いと考えられています。

天然の良さは、人間の健康維持のために必要なさまざまな成分が含まれており、これらの互いの働きによって、安全かつ多くの身体に良い作用が発揮されることです。

天然カロチノイド含有食品
ドナリエラ Dunaliella
ハードカプセル

クロスタニンの
株式会社 日健総本社

Dunaliella β-Carotene Cosmetics



β -Carotene
Friend? 1980-90
or
Foe? 1990-2000

Vitamins, Market Boom 1980-1990

APRIL 6, 1992 \$2.50

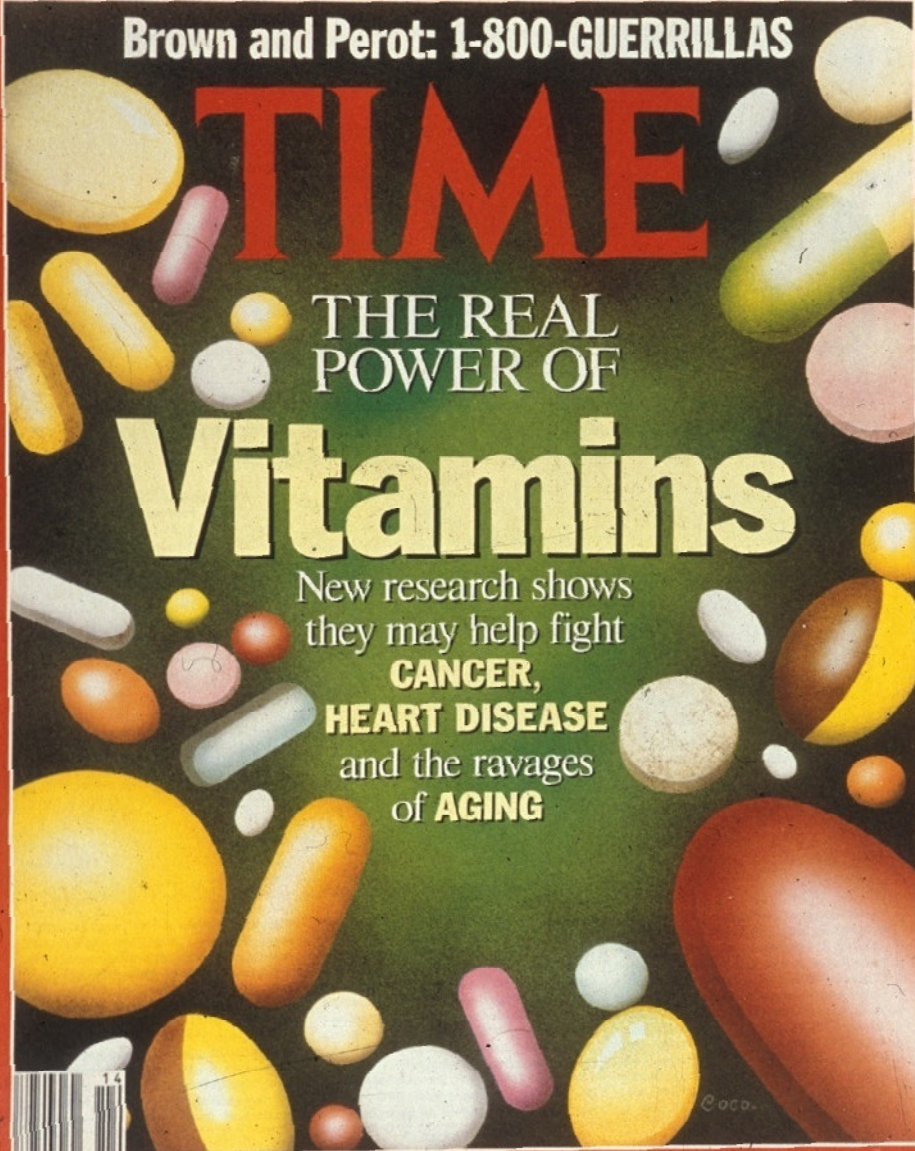
Brown and Perot: 1-800-GUERRILLAS

TIME

THE REAL
POWER OF

Vitamins

New research shows
they may help fight
CANCER,
HEART DISEASE
and the ravages
of **AGING**



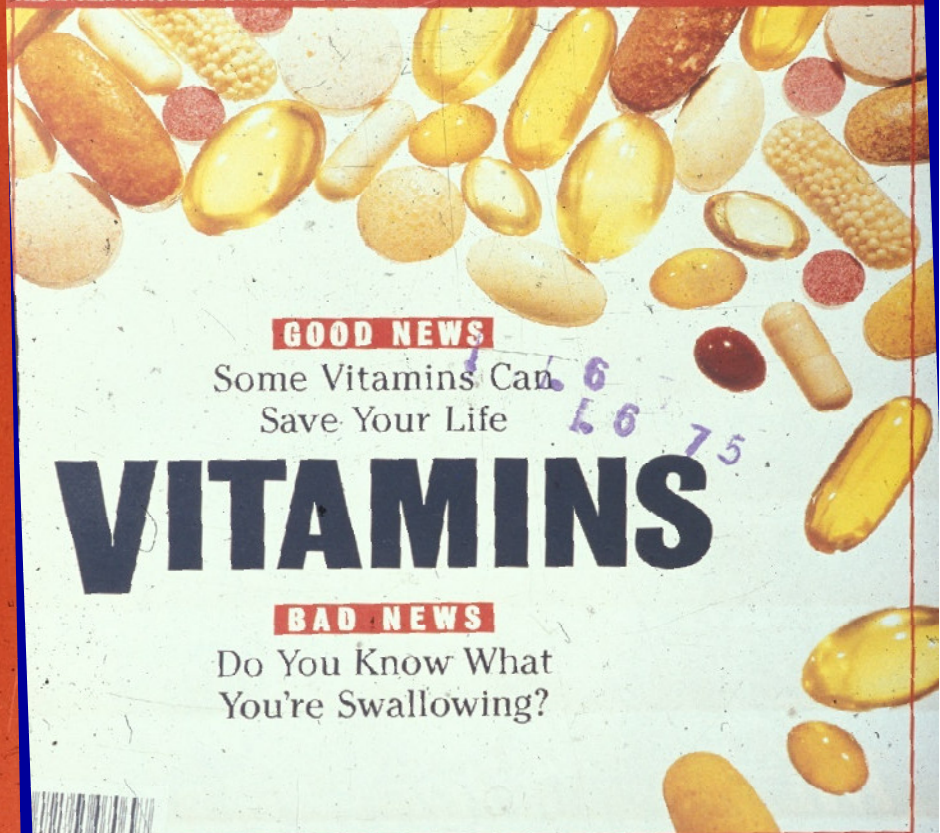
724404

WHAT'S WRONG WITH BILL CLINTON?

Newsweek

THE INTERNATIONAL NEWSMAGAZINE

June 7, 1995



GOOD NEWS

Some Vitamins Can
Save Your Life

VITAMINS

BAD NEWS

Do You Know What
You're Swallowing?

1805 0708
\$7.90

| | | | | | | | | | | | | | | | | | | |
|----|---------|------|--------|--------|--------|-------|---------|-------|-------|-------|-------|-------|-------|-------|----|-------|-----|-------|
| 23 | Adult | 30¢ | Canada | \$2.00 | France | 2.10 | Germany | 2.10 | Italy | 2.10 | Japan | 2.10 | Spain | 2.10 | UK | 2.10 | USA | 2.10 |
| | Child | 15¢ | Canada | \$1.00 | France | 1.05 | Germany | 1.05 | Italy | 1.05 | Japan | 1.05 | Spain | 1.05 | UK | 1.05 | USA | 1.05 |
| | Student | 1.50 | Canada | 15.00 | France | 15.00 | Germany | 15.00 | Italy | 15.00 | Japan | 15.00 | Spain | 15.00 | UK | 15.00 | USA | 15.00 |

“β-Carotene Prevents or Delays Cancer”, Roche 1986



Nutritionists have found that people with a daily intake of fruit and vegetables rich in Beta-Carotene have a lower risk of cancer.

Scientists have shown in the laboratory that Beta-Carotene is able to prevent or delay cancer.

Beta-Carotene is
a very promising
nutritional factor in
cancer prevention.

For scientific publications,
please contact ROCHE.

The Rise and Demise of β -Carotene

Omenn 1998

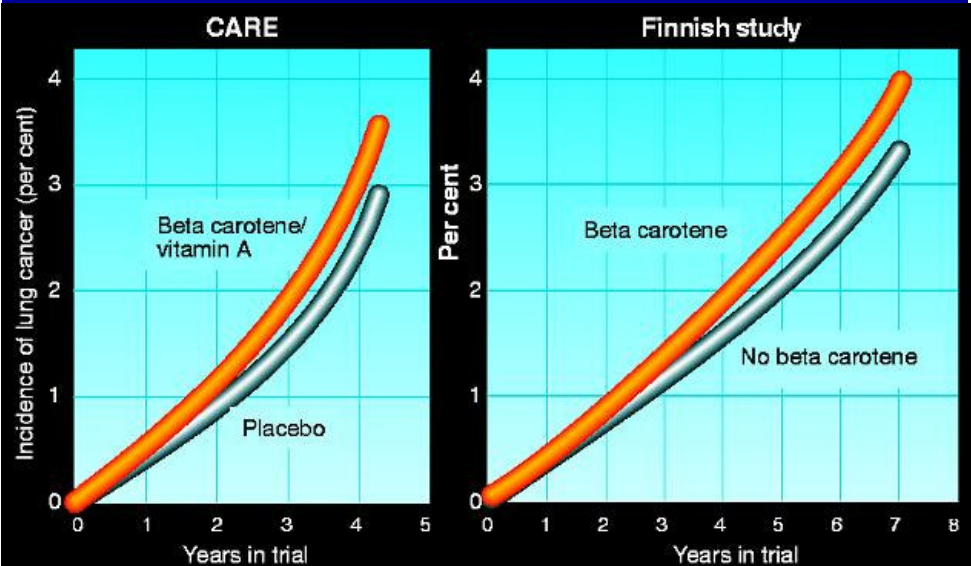
Annu. Rev. Public Health. 1998. 19:73-99
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CHEMOPREVENTION OF LUNG CANCER: The Rise and Demise of Beta-Carotene

Gilbert S. Omenn

Former address: School of Public Health & Community Medicine, University of Washington, Seattle, Washington 98195-7230 and Fred Hutchinson Cancer Research Center, Seattle, Washington 98109-1024; Current address: University of Michigan, Ann Arbor, Michigan 48109-0624; e-mail: gomenn@umich.edu

KEY WORDS: fruits/vegetables, carcinogenesis, vitamin-supplements, antioxidants, vitamin A



ABSTRACT

Beta-carotene and retinoids were the most promising agents against common cancers when the National Cancer Institute mounted a substantial program of population-based trials in the early 1980s. Both major lung cancer chemoprevention trials not only showed no benefit, but had significant increases in lung cancer incidence and in cardiovascular and total mortality. A new generation of laboratory research has been stimulated.

Rational public health recommendations at this time include: 1. Five-A-Day servings of fruits and vegetables, a doubling of current mean intake; 2. systematic investigation of the covariates of extremes of fruit and vegetable intake; 3. discouragement of beta-carotene supplement use, due to adverse effects in smokers and no evidence of benefit in non-smokers; 4. multilevel research to develop and evaluate candidate chemoprevention agents to prevent lung and other common cancers; and 5. continued priority for smoking prevention, smoking cessation, and avoidance of known carcinogens in the environment.

Could Synthetic β -Carotene Be the Real Problem?

Could Synthetic Beta-Carotene Be the Real Problem?

Copyright) 1996 by Jack Challem, The Nutrition Reporter
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This article is from the September 1996 issue of The Nutrition Reporter newsletter.

Smokers who took beta-carotene supplements in recent experiments may have faced a greater risk of lung cancer because they took the synthetic form of the nutrient, a new study suggests. The subtle differences between synthetic and natural beta-carotene do appear to influence how the body uses the nutrient.

Synthetic beta-carotene consists of just the "all-trans" isomer of the nutrient, whereas natural beta-carotene consists of two different isomers, "9-cis" and "all-trans." Isomers have the same molecular formula, but a different arrangement of atoms. They're a little like anagrams, in which the letters of one word can be rearranged to form another, such as "star" and "rats."

It turns out that the natural 9-cis isomer is a more potent antioxidant than the all-trans, according to Ami Ben-Amotz, Ph.D., and Yishai Levy, Ph.D., in the American Journal of Clinical Nutrition (May 1996;63:729-34). That means the natural form has something the synthetic does not.

In experiments at Israel's National Institute of Oceanography, the researchers gave young, healthy men supplements of either natural beta-carotene from Dunaliella algae or synthetic beta-carotene. Blood analyses showed the presence of the all-trans isomer of beta-carotene, but not the 9-cis form found in natural beta-carotene. However, the researchers looked for and found 9-cis metabolic byproducts, indicating the presence and activity of the natural isomer.

Ben-Amotz and Levy reported experiments showing that the natural 9-cis isomer was rapidly used up in quenching free radicals and preventing oxidative damage to cell fats. In contrast, much of the all-trans isomer was converted to vitamin A, which is a very weak antioxidant.

Ben-Amotz and Levy wrote that the differences between natural and synthetic beta-carotene "should provoke a shift in scientific attention to natural sources of carotenoids and their role in cancer prevention." They urged that researchers pay more attention to the different isomers of beta-carotene.

An earlier study, in Free Radical Biology & Medicine (1994;17:77-82) also showed that the natural 9-cis isomer is a more potent antioxidant than the all-trans form.

The information provided by Jack Challem and The Nutrition Reporter newsletter is strictly educational and not intended as medical advice. For diagnosis and treatment, consult your physician.

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for more information contact the nutrition_reporter@ortel.org
return to www.ortel.org/Challem (The Nutrition Reporter homepage)
you are at: www.ortel.org/Challem/Synth_beta.html

Vitamins Natural vs. Synthetic

Posted on: 09-11-2009 , by: admin, in:

Nutrition

Beta-Carotene: The Controversy

Alternative Medicine Review, Dec, 2000

by Lyn Patrick

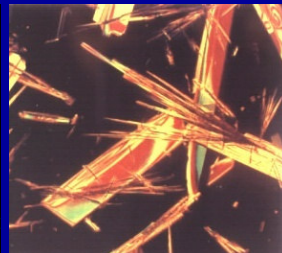
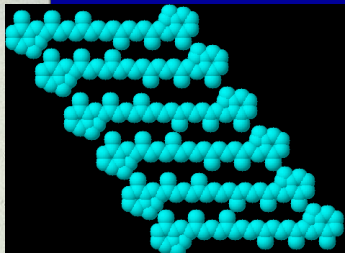
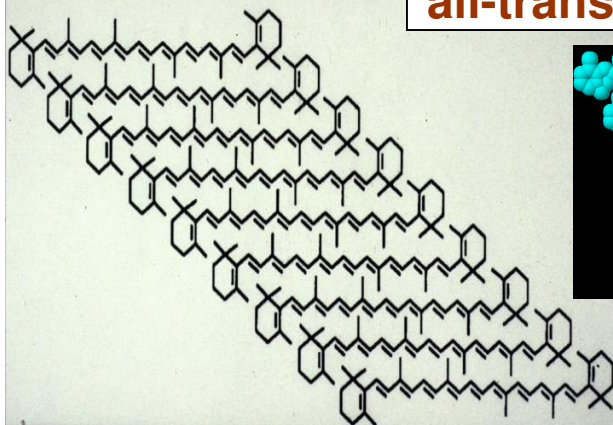
Carotenoids

Nutritional & Medical Effect

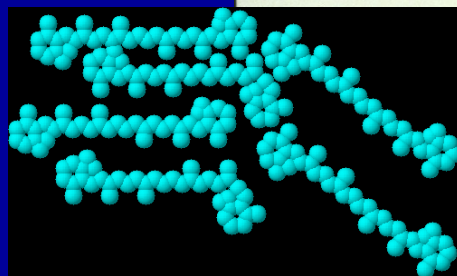
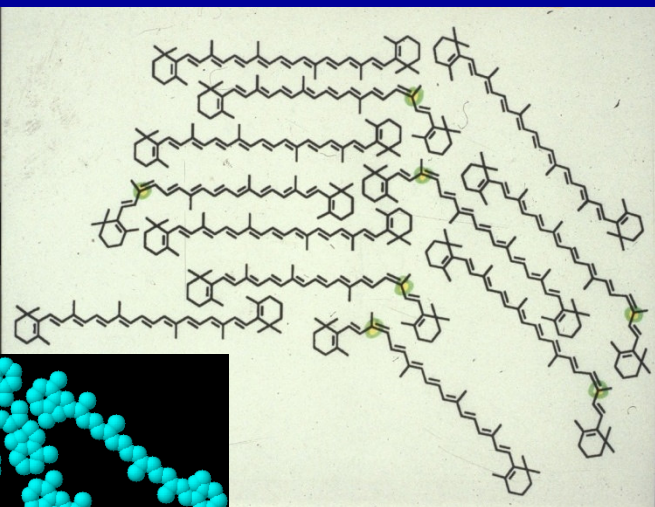
- 1. Antioxidants, cellular level?**
- 2. Pro-retinoic acids, molecular level?**
- 3. Structural?**
- 4. Other?**

β -Carotene, the Packaging Structural Model

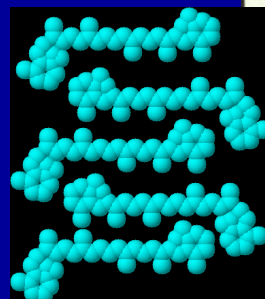
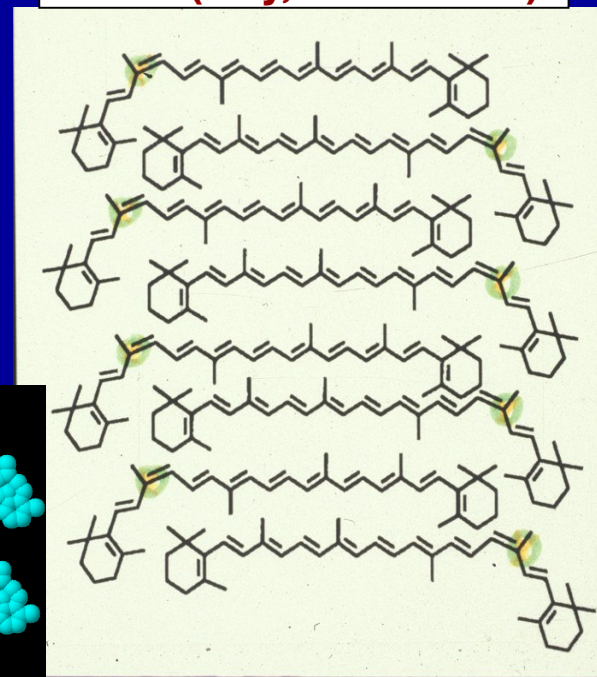
all-trans (crystals, not absorbed)



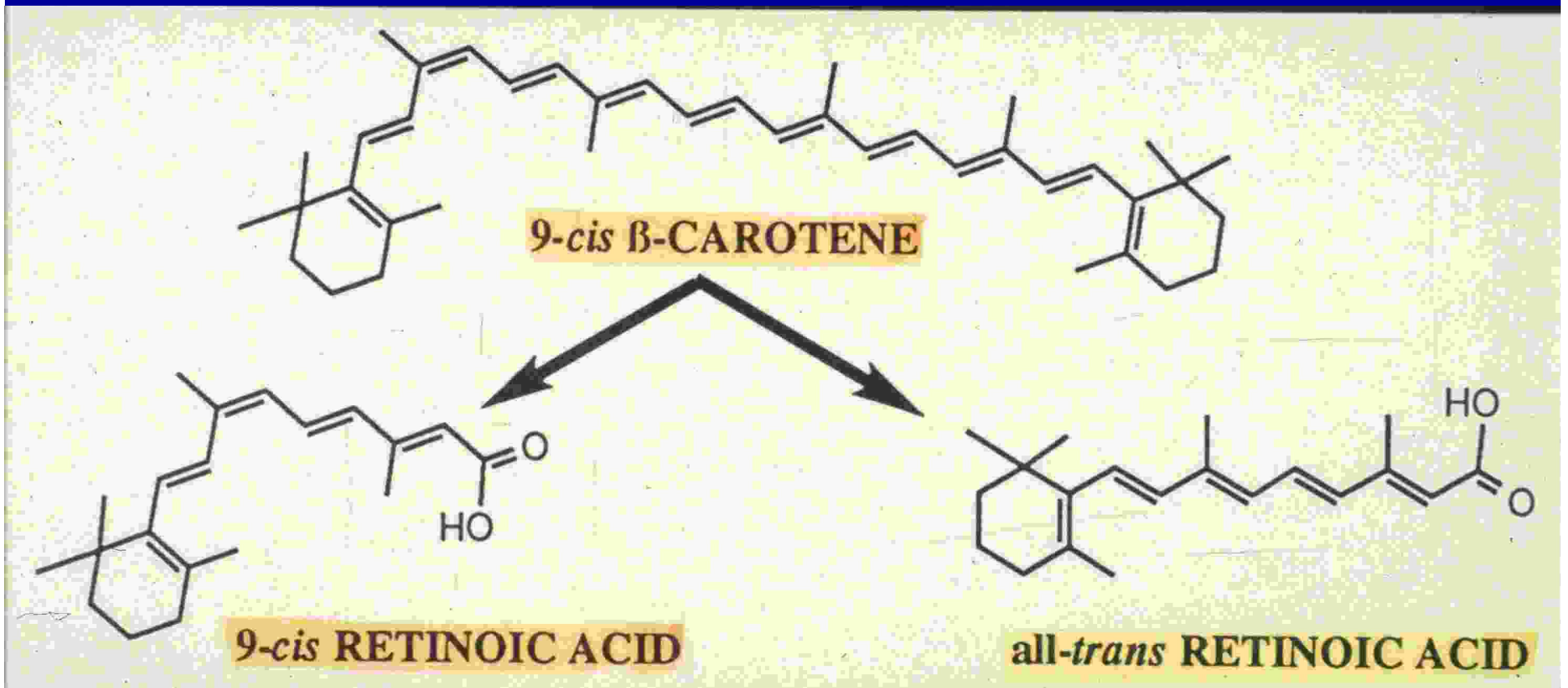
all-trans/9-cis (oily, absorbed)



9-cis (oily, absorbed)



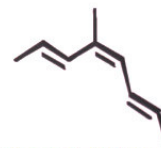
Conversion of cis-Carotenoids to cis-Retinoids



cis/trans BONDS



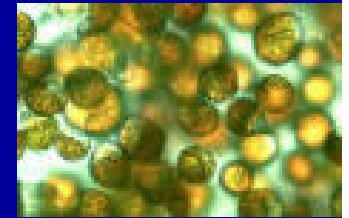
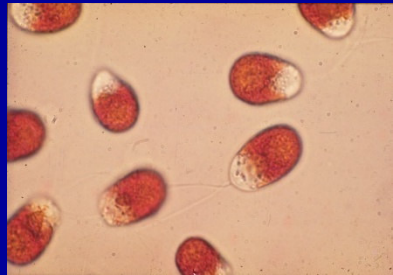
7, 9, 11, all-trans



7-trans, 9-cis, 11-trans

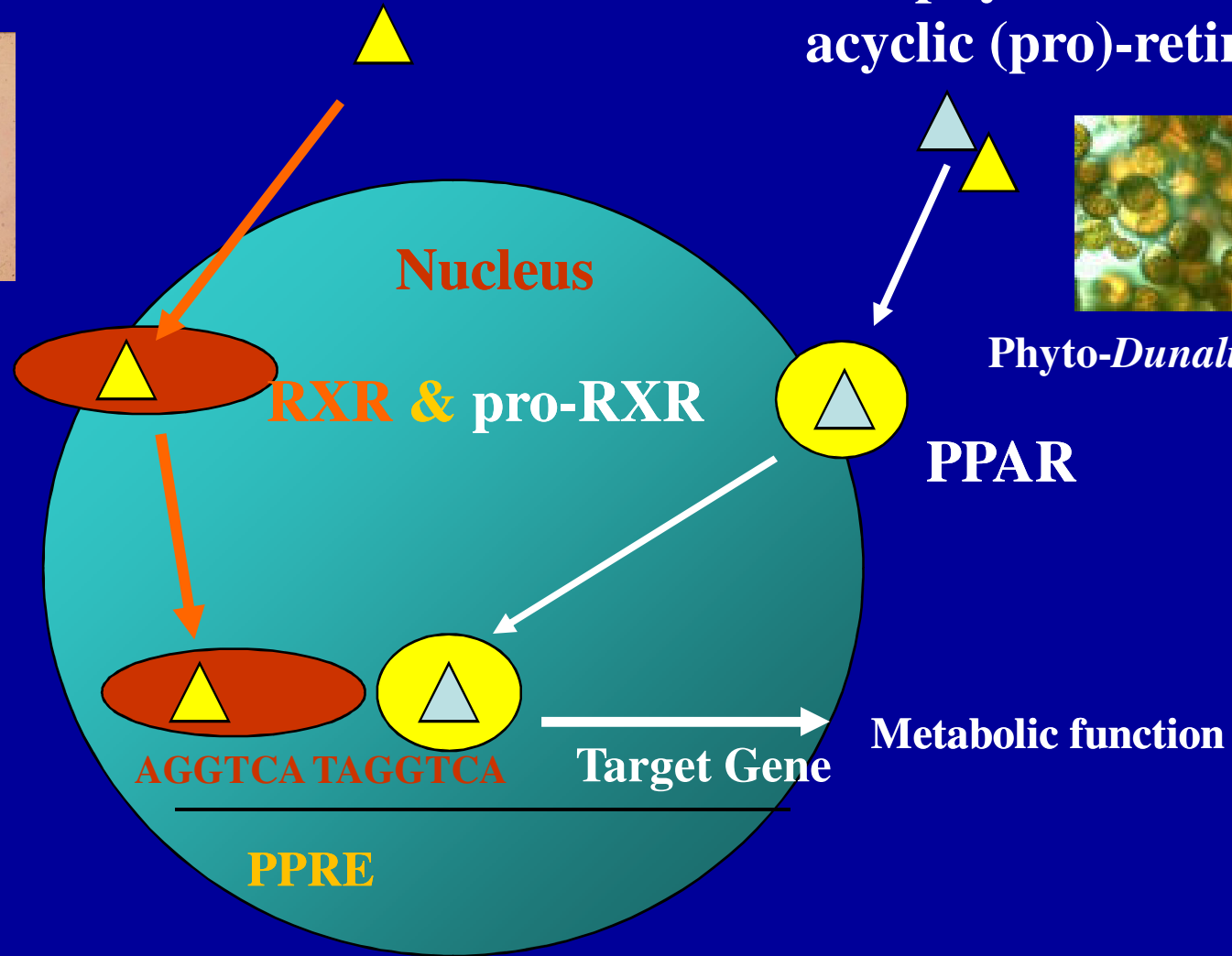
9-cis β -Carotene \longrightarrow 9-cis Retinoic acid

9-cis phytoene \longrightarrow acyclic (pro)-retinoid



Dunaliella

Phyto-Dunaliella



Dunaliella carotenes

Metabolic Molecular Function



マイクロアルジェは、とれただけ人間を幸せにできるがみつ。

The Blessing Of Nature

自然の贈り物

天然ベータカロチン含有食品
NATURAL BETA CAROTENE

ドナリエラ Dunaliella

ハードカプセル



私たちが健康に生きるためには、健康な食物を毎日食べる事が重要です。化学物質や環境ホルモンなど、現在の生活習慣病を引き起こすものは、化学合成品によるものが多いのではないのでしょうか。天然の良さは、様々な必要な成分が混ざっておりこれらが互いに働きあって、安全でかつ幾つかの作用が発揮されます。

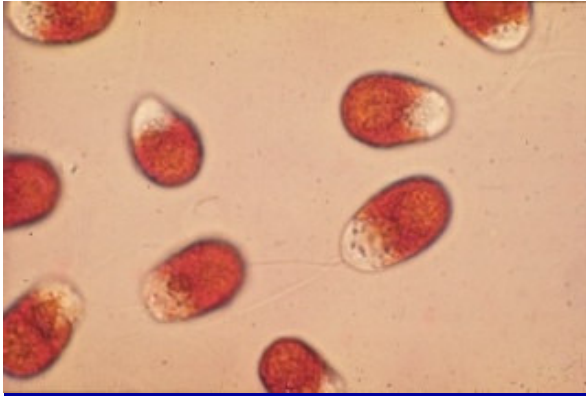


合成でだいじょうぶ!?

Nikken Sohonsa Co. Network The Far East & Japan Markets



Natural Carotenoids

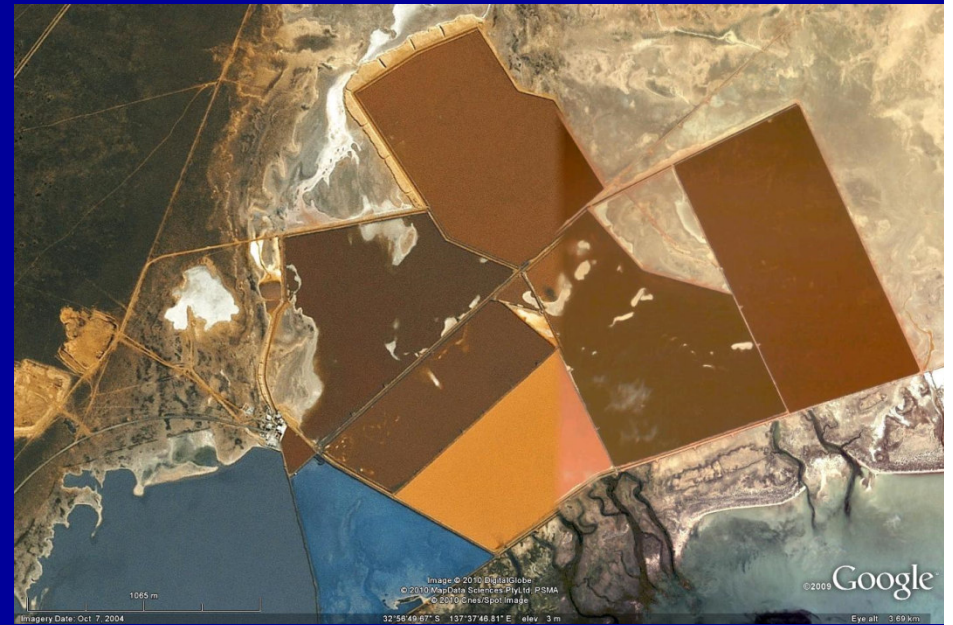


Production Cost

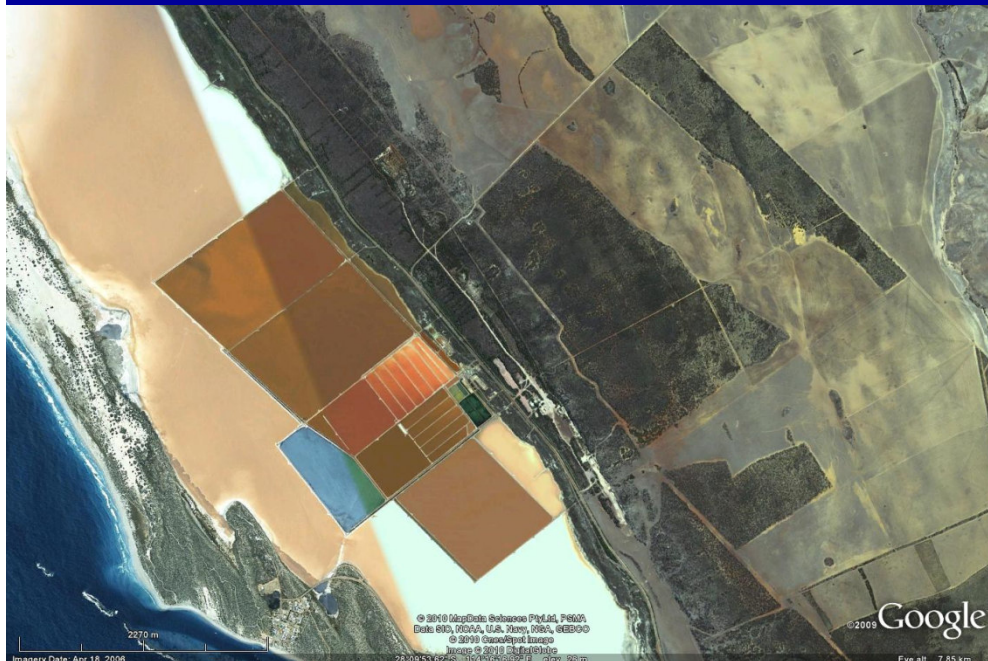
NBT *Dunaliella* Plant
(10 Hectares Plant)

| Item | <i>Dunaliella</i> NBT Ltd., Eilat, 2009 |
|---|--|
| | Cost in US\$/year |
| → Manpower | 500,000 (20 workers) |
| → Electricity (\$0.125/KW) | 180,000 |
| Fertilizers (N,P,K, Fe) and other chemicals | 36,000 |
| Domestic Land City Taxes | 50,000 |
| → CO ₂ (\$400/ton) | 120,000 |
| → Sea Water (\$0.25/m3) | 200,000 |
| Fresh Water | 20,000 |
| Other supplies and Miscellaneous | 30,000 |
| Total | <u>1,136,000</u> |
| Yearly production of dry algae biomass | 70 tons (2g/m ² /day) |
| Cost of 1Kg dry <i>Dunaliella</i> | <u>\$16.23/kg</u> |

Cognis, Whayalla (Adelaide), Australia 400 hectares



Cognis, Hutt Lagoon, West Australia 400 hectares



The Alga *Dunaliella*

Biodiversity, Physiology, Genomics and Biotechnology

The Alga *Dunaliella*
Biodiversity, Physiology, Genomics and Biotechnology

About the Book

The green microalga *Dunaliella* has received renewed attention due to its biotechnology applications including production of high-value compounds as well as generation of biofuels. The scope of the present volume 'The Alga *Dunaliella*: Biodiversity, Physiology, Genomics, and Biotechnology' is wider than the first book on *Dunaliella* by Avron and Ben-Amotz published in 1992, and presents a broad collection of state-of-the-art reviews on a variety of fundamental and applied research fields involving *Dunaliella*. The 21 contributions written by leading international experts cover not only basic science regarding cultivation of *Dunaliella*, biodiversity, life-cycle, pigments and photosynthesis, but also the applied fields of bioreactor design, production of valuable compounds, biofuels, bioremediation, genetic engineering.

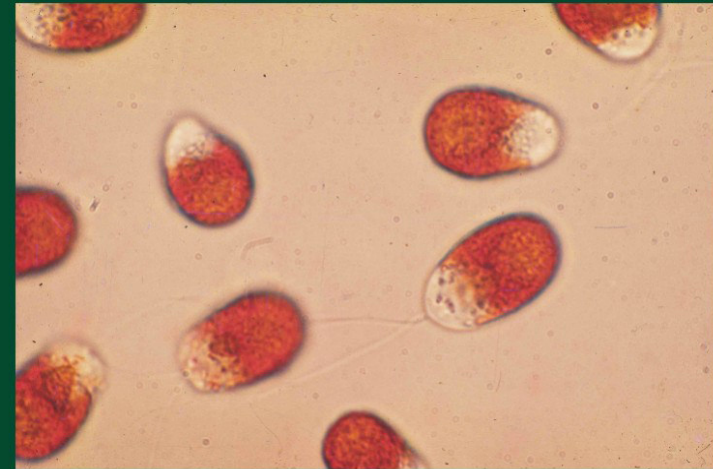
This book is an essential read for researchers in the field, while at the same time providing a valuable resource for teaching of advanced undergraduate, graduate, and postgraduate students who are interested in algae.

About the Editors

Dr. Ami Ben-Amotz is Emeritus Professor of Marine Phycology at the National Institute of Oceanography (NIO) in Haifa, Israel. He initiated research on the biology, physiology, biochemistry and biotechnology of *Dunaliella* in long collaboration with the late Prof. M. Avron of the Weizman Institute of Science (WIS). The fruitful cooperation led the way to establishment of the commercial *Dunaliella* production plant in Eilat. Prof. Ben-Amotz served as Head of the Department of Marine Biology at NIO and Head of the *Dunaliella* Section at the WIS, Chief Scientist of Nature Beta Technologies Ltd., (NBT) and recently as Chief Scientist of Nikken Sohonsha Co., Japan. Prof. Ben-Amotz served as President of the 8th International Marine Biotechnology Conference, held in Eilat in March 2007.

Dr. Jürgen Polle is an Associate Professor in the Department of Biology and Associate Director of the Aquatic Research & Environmental Assessment Center at Brooklyn College of the City University of New York. He received his Doctorate in Biology from the Georg-August University in Göttingen, Germany and he is an alumnus of the German National Merit Foundation. He performed postdoctoral research from 1997 to 2002 at the University of California at Berkeley. At Brooklyn College, Dr. Polle's focus on the alga *Dunaliella* resulted in creation of the *Dunaliella* Culture Collection at Brooklyn College (DCCBC) with the webpage www.dunaliella.org. Dr. Polle is a member of the consortium responsible for the genome sequencing of *Dunaliella salina*. Currently, he mentors several graduate students in his laboratory.

Dr. D.V. Subba Rao is a biological oceanographer, and Emeritus Scientist at the Bedford Institute of Oceanography (BIO), Canada. His research and teaching activities took him to CSIRO, Australia, The Johns Hopkins University, Baltimore, and Kuwait Institute for Scientific Research. Based on data collected on natural populations and algal cultures he is author/co-author of over hundred papers in peer reviewed journals on phytoplankton ecology, physiological ecology, primary production, picoplankton, red tides, phycotoxin episodes, ballast water introductions of exotic organisms, tsunamis and marine life, and impact of mega engineering projects on marine environment. He currently serves as editor of Journal of Oceanography. Dr. Subba Rao has edited two books "Pelagic Ecology Methodology" (Balkema, 2002) and "Algal Cultures, Analogues of Blooms and Applications" (Science Publishers, 2006).



Editors
Ami Ben-Amotz
Jürgen E. W. Polle
D.V. Subba Rao



Editors
Ami Ben-Amotz
Jürgen E.W. Polle
D.V. Subba Rao

Thank You

