

GOLDEN RICE: **Health Issues and Concerns**

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Vitamin A

- Vitamin A is a **fat-soluble vitamin** and is absorbed and **transported with lipids**
- Vitamin A is **stored in the liver**: recorded cases of toxicity in excess consumption of polar bear liver by Arctic explorers

Vitamin A

- A major role of **vitamin A** is as part of the visual **pigment rhodopsin**
- Gene expression
- Maintenance of epithelial tissue
- Regulation of cell growth and differentiation

Vitamin A

- The problem: **Vitamin A deficiency (VAD)**, which can be **life-threatening**
- WHO: **about 124 million children affected**; 250,000-500,000 children go blind every year, about half die within 12 months

(Enserink, M. 2008. Tough lessons from Golden Rice. *Science*, 230: 468-471.)

Vitamin A Deficiency (VAD)

- Dry, hard skin
- Dry cornea and eventual blindness
(Xerophthalmia)
- **Night blindness** (insufficient retinal for rhodopsin formation)
- Impaired immune function

Vitamin A Toxicity

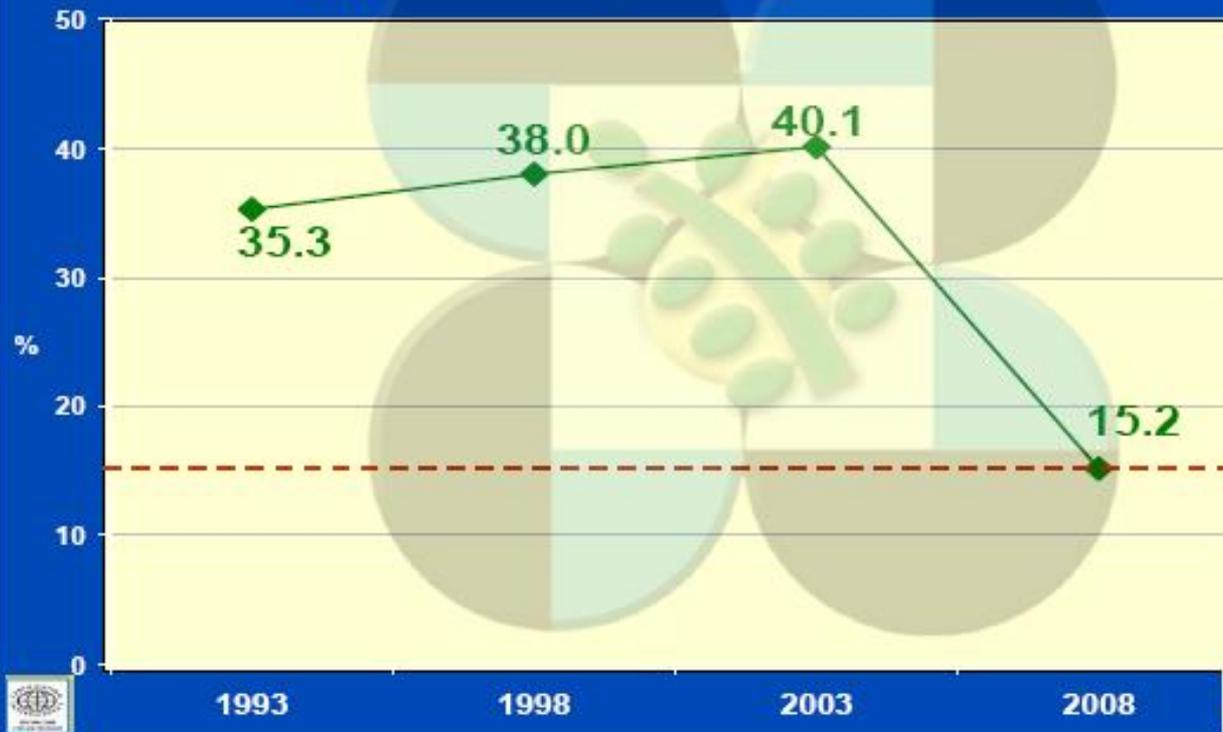
- **Toxic levels** by excess consumption of supplements of pre-formed vitamin A
- **Signs and symptoms** of toxicity
 - ☞ Diarrhea, bulging fontanelles
 - ☞ Nausea, vomiting, poor appetite
 - ☞ Headache, blurred vision, dermatitis
 - ☞ Liver and spleen enlargement
 - ☞ Lack of muscle coordination
 - ☞ Bone abnormalities, congenital defects, cancer

Golden Rice: Hi-tech Solution

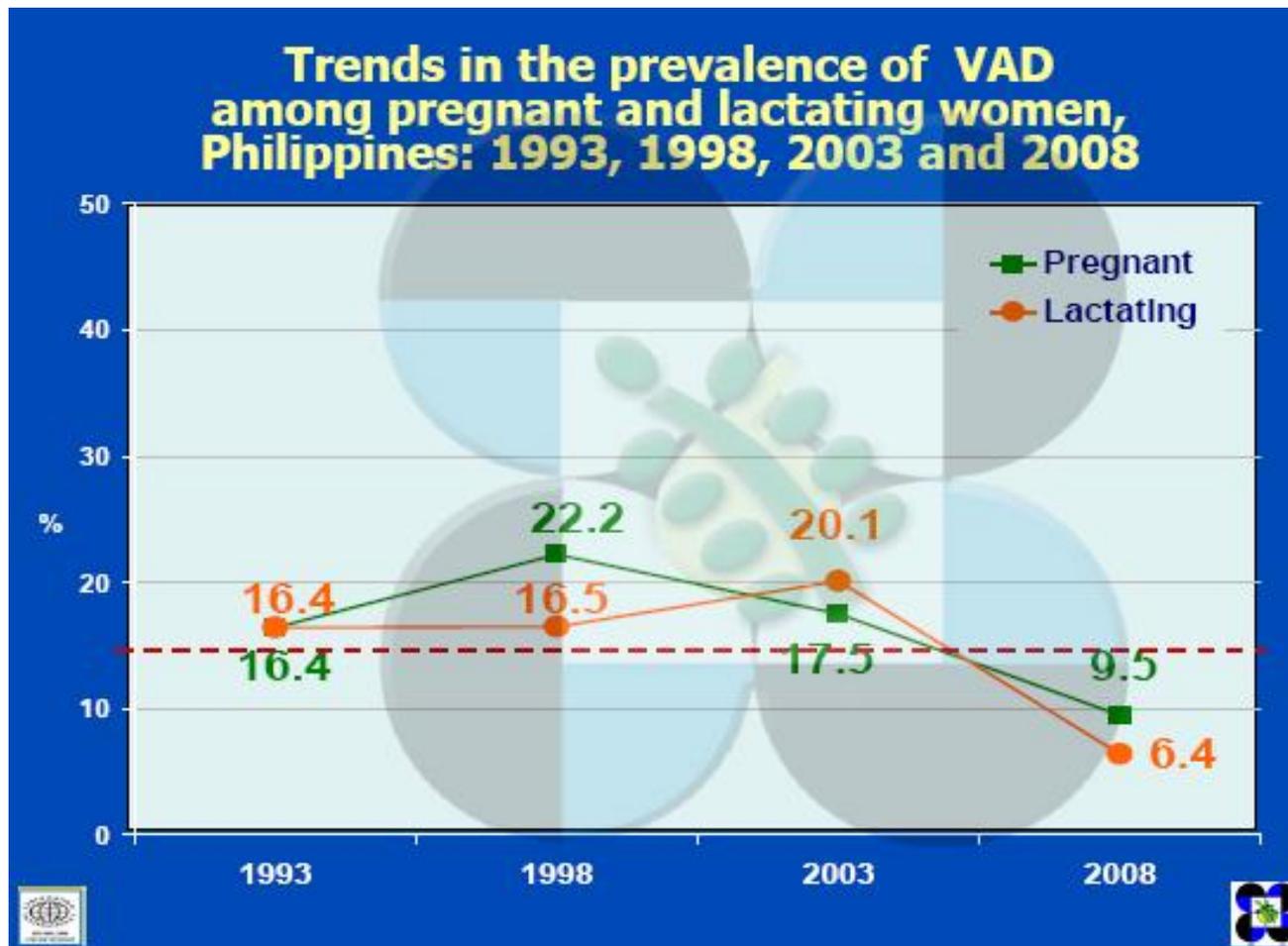
- Is Vitamin A deficiency still a significant problem in the Philippines
- Is Vitamin A deficiency a condition that requires pharmacotherapy (drugs)?
- Is golden rice food or a drug?
- Are there better alternatives to golden rice?

Is Vitamin A deficiency still a problem?

**Trends in the prevalence of vitamin A deficiency (VAD) among children, 6 mos – 5 yrs
Philippines: 1993, 1998, 2003 and 2008**



Is Vitamin A deficiency still a problem?



Is Vitamin A deficiency still a problem?

Comparison of prevalence of VAD: Philippines, 1998 – 2008

Age/ Physiologic State	No. of Participants		VAD (%)		Decrease
	1998	2008	1998	2008	1998 vs 2008
Children, 6 mos- 5y	14,291	2408	38.0	15.2	22.8**
Pregnant	2,963	483	22.2	9.5	18.7**
Lactating	3,165	860	16.5	6.4	11.1 **

**** Significant at 0.01**



Does Vitamin A deficiency require drugs?

According to WHO, **tried and tested remedies** for VAD have already “**averted an estimated 1.25 million deaths since 1998 in 40 countries**”

Does Vitamin A deficiency require drugs?

Preventive Supplementation

Strategies	Target	Doses
Regular or routine clinical supplementation	Pregnant women with no signs of xerophthalmia	1 cap. of 10,000 I.U. of vitamin A 2x a week to start from 4 th month of pregnancy until delivery
Regular or routine clinical supplementation	Lactating women with no signs of xerophthalmia	1 cap. -200,000 I.U. of vitamin A within one month after delivery

(Reference: DOH Guidelines on Vitamin A Supplementation A.O. 3-A, Jan. 10, 2000)

Is golden rice food or a drug?

- Original Golden Rice (GR1): produces only 1.6 $\mu\text{g}/\text{gm}$ of carotenoids
a child would have to eat more than 10 kg/day to get sufficient dose
- In gut, β -carotene (Pro-vitamin A) generates retinal \rightarrow Vitamin A or retinoic acid (RA)
RA and its metabolites are toxic and teratogenic

Golden Rice: Problems as a GMO



Skin allergies reported by farmers and agriculture workers while working in cotton fields during boll burst stage 2005:

Bt Cotton in India – human allergies

[Ashish Gupta, Ashish Mandloi & Amulya Nidhi, 2005: "An Investigation report on Impact of Bt Cotton on farmers' health"]

Golden Rice: Problems as a GMO



2007 study by Vavilov's Agrarian University in Russia:

Right mouse: fed with GM soya; Left mouse fed with non-GM soya. **GM-soya has impact on the size of the litters and on the mortality of the young**

Golden Rice: Problems as a GMO



2005 study by Irina Ermakova:

- Offspring of GM-soy-fed rats die, with growth abnormalities
- Right: 20-day old rat from GM soy-fed study group
Left: 19-day old rat from non-GM soy fed control group

Are there better alternatives to golden rice?

FOOD

- 👍 Liver, meat
- 👍 Eggs
- 👍 Green leafy and deep colored vegetables
- 👍 Moringa (malunggay), taro (gabi) leaves, carrots, spinach, sili, kamote, alugbati
- 👍 Fruits: mango, papaya, bayabas, duhat

What should be done for Vitamin A deficiency and malnutrition?

- **Food diversification/sustainable agriculture**
- Long-term strategy that involves the community
- **Genuine land reform**
- Social determinants of health

Precautionary Principle

“When there are reasonable grounds to indicate **potential harm to health and environment, precautionary action should be taken** even if cause and effect relationship has not been established scientifically.”

References

- Hansen M. Golden Rice and Bt crops: Unanswered safety and efficacy questions. University of Philippines Los Baños; 24 August 2011
- Food and Nutrition Research Institute. 2008 National Nutrition Survey Results for Vitamin A. 2008
- Quijano R. Health Risks of Genetically Modified Food. August 2011