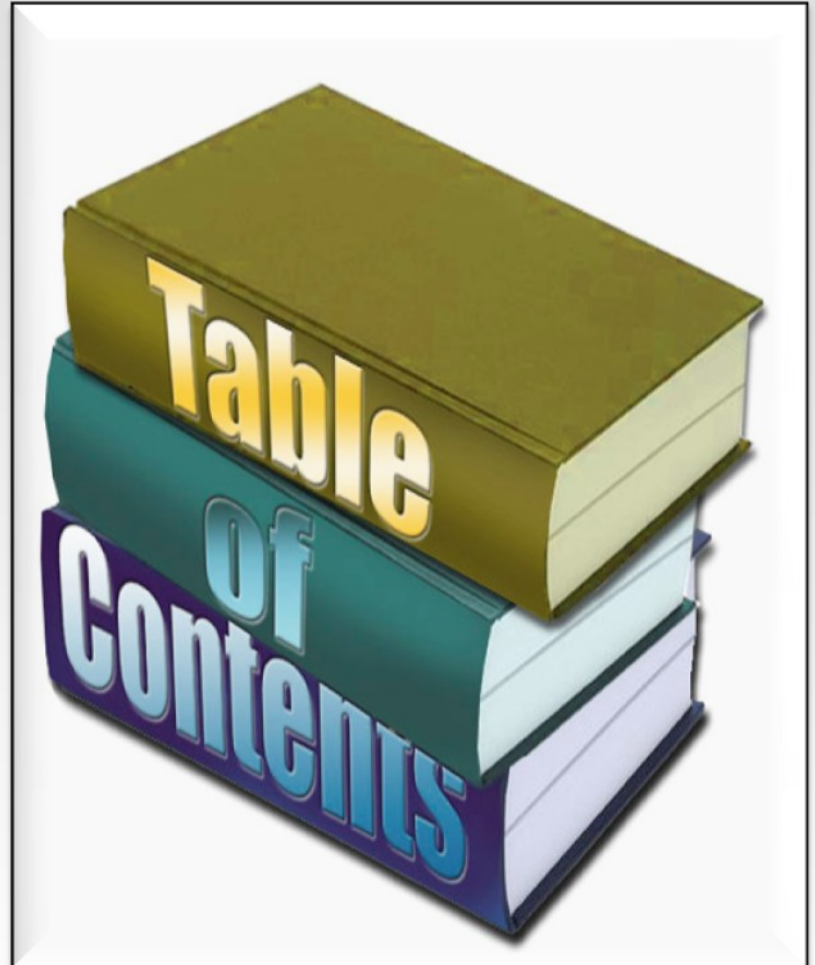


GOLDEN

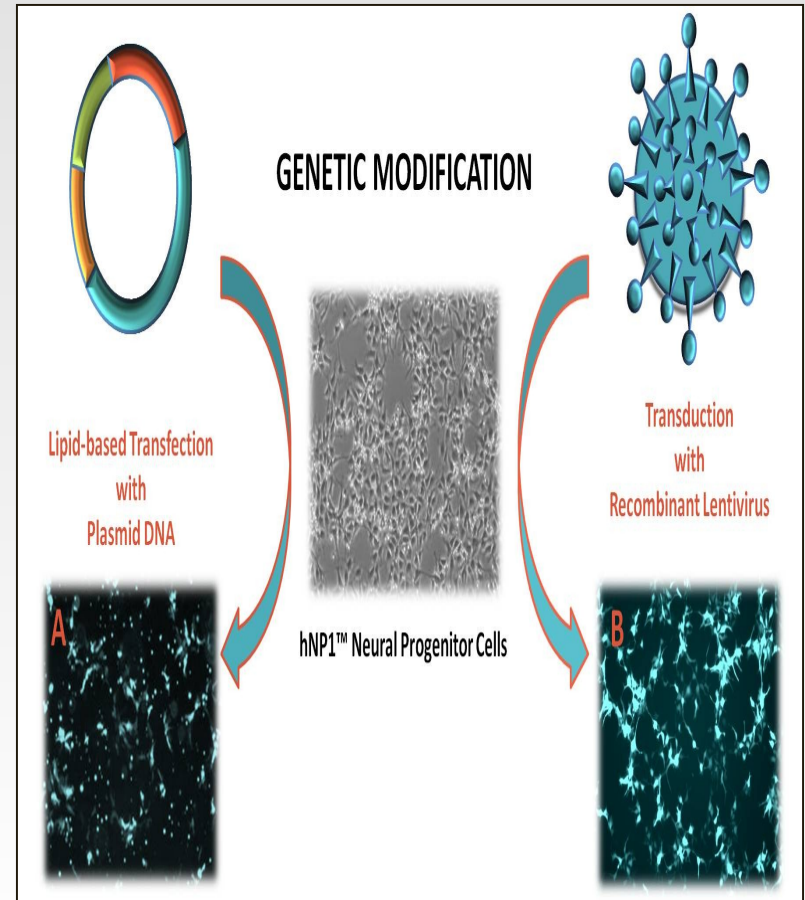


CONTENTS

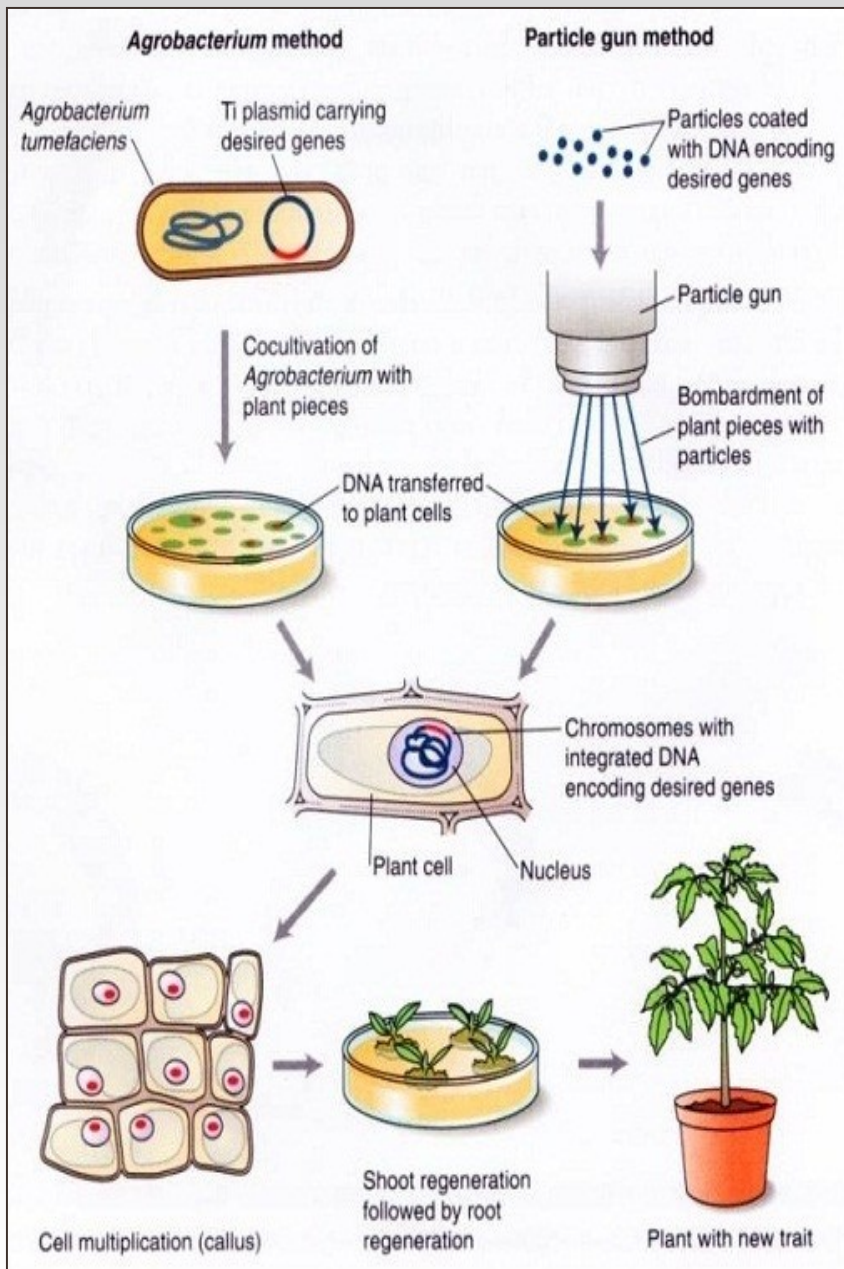
- GENETIC MODIFICATION
- VITAMIN A DEFICIENCY
- GOLDEN RICE
- CONTROVERSIES
- CONCLUSION
- JOURNALS & RESEARCHES
- BIBLIOGRAPHY



GENETIC MODIFICATION



- A unique technique which involves the alteration of DNA in the genes of the cell which determines the cell's hereditary characteristics.
- Currently being used to develop plants and crops that can be grown in adverse conditions. This could have an enormous beneficial impact on world food shortage.
- Produces crops of greater nutritional value.
- US is the main producer of GM crops followed by Canada, Japan and Argentina



METHODS OF GENE TRANSFER

1

- **INJECTION**

2

- **BIOLIST**

3

- **VECTORS**

4

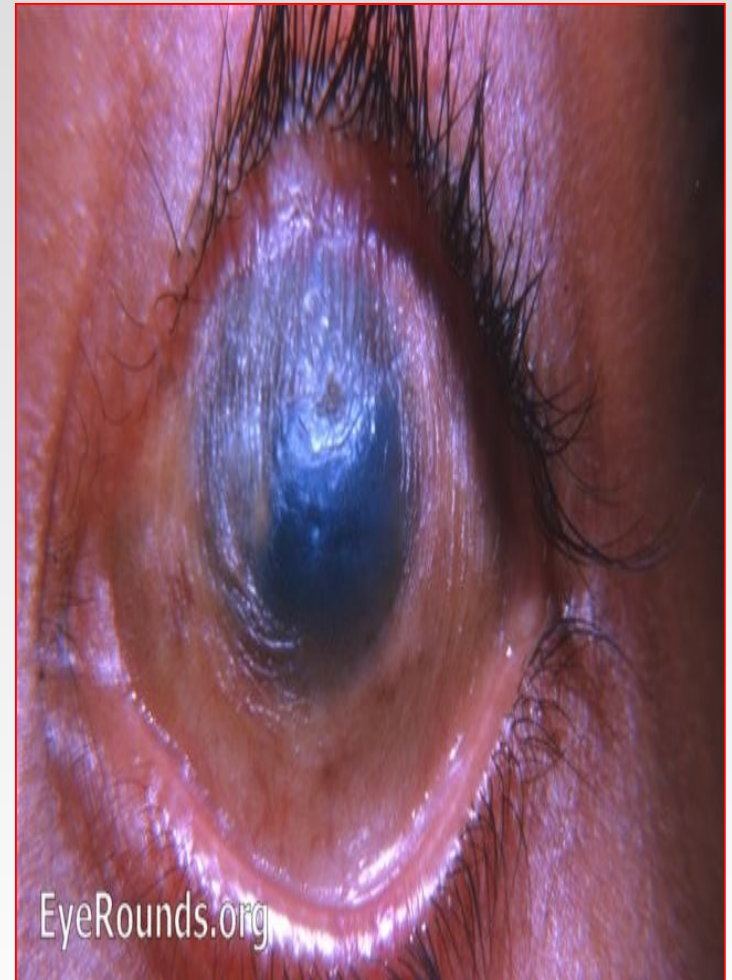
- **PROTOPLASMIC TRANSMISSION**

VITAMIN A DEFICIENCY AND GOLDEN RICE

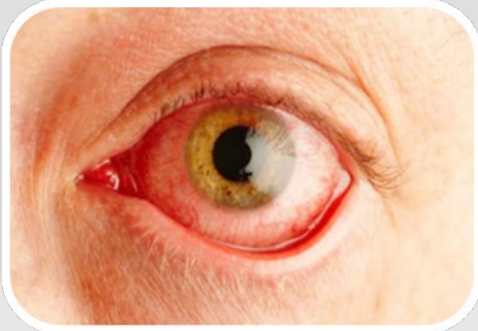


VITAMIN A DEFICIENCY: OUTLINE

- People do not get enough vitamin A or β -carotene from the food they eat contributing to the serious health problems of Vitamin A deficiency.
- 190 million children and 19 million pregnant women are affected globally. Source: WHO)
- Impairs the immune system which increases the risk of death from certain common infections among young children.
- Leading cause of blindness among children with approx 350,000.
- Also particular to pregnant woman and lactating mothers as their nutrients needs increase.



CLINICAL FEATURES OF VITAMIN A DEFICIENCY



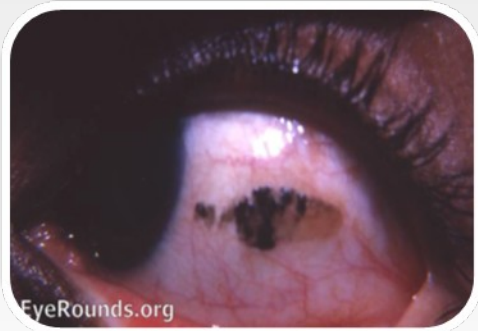
NIGHT BLINDNESS



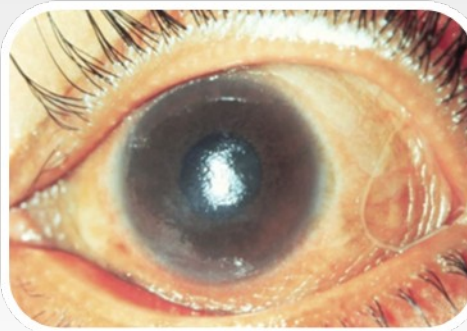
CONJUNCTIVA



XEROSIS



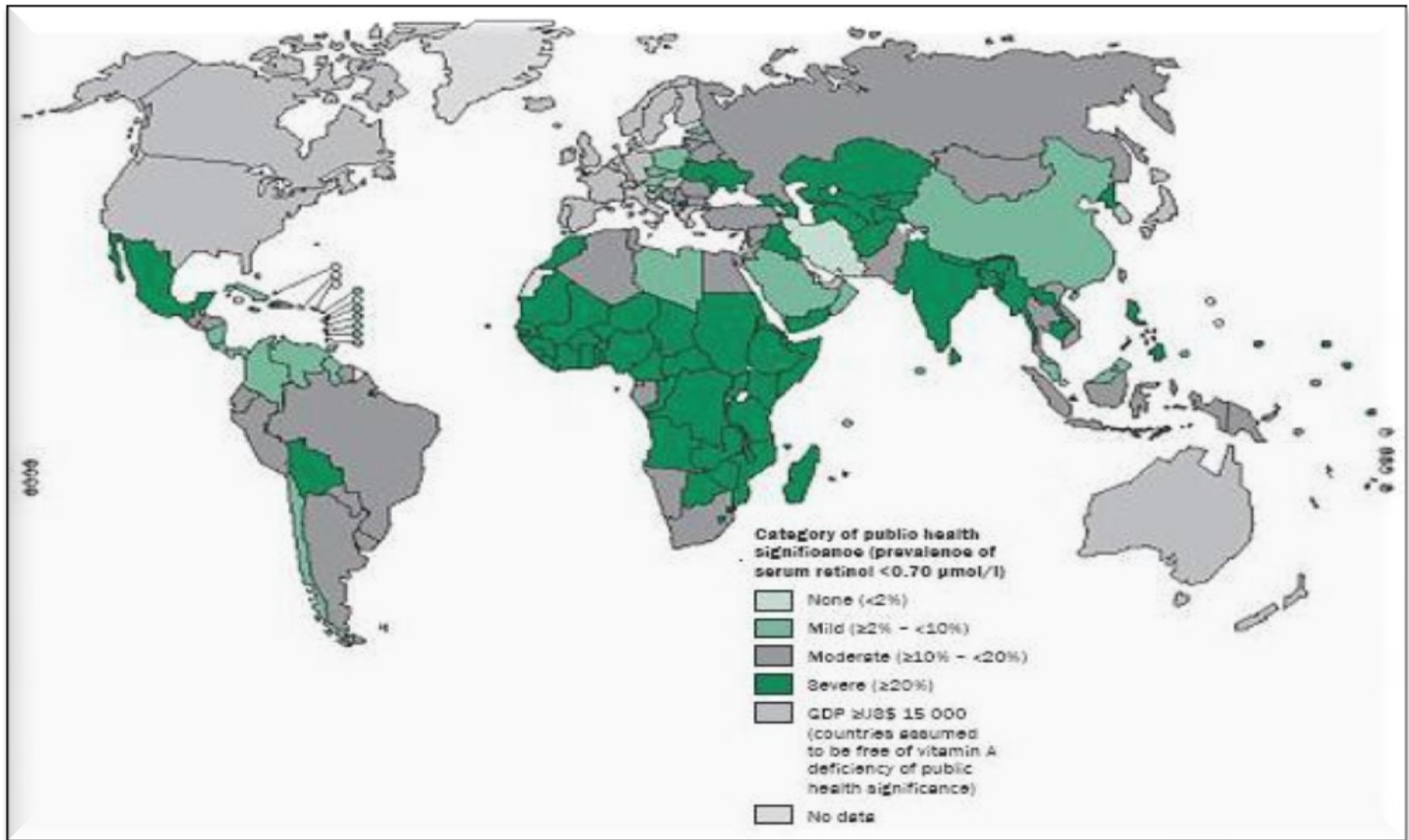
BITOT'S SPOTS



CORNEAL XEROSIS



KERATOMALACIA



WHO, Global Prevalence of Vitamin A Deficiency in Populations at Risk: WHO global database on vitamin A deficiency, WHO, Geneva, 2009.

SOURCES OF VITAMIN A



WHY GOLDEN RICE?

- Continuing and widespread nature of VADD has led people to develop to investigate a number of potential solutions
- Develop staple foods that have increased levels of b-carotene.
- Close link between rice dependency and VADD led researchers in Switzerland and Germany to develop Golden rice
- Developed a transgenic line of rice with increased levels of β -carotene.
- Human body is able to develop carotenoids



GOLDEN RICE



INTRODUCTION

- A genetically modified food crop
- Contains β -carotene which is golden in color.
- Is intended to be used in combination with existing approaches to reduce Vitamin A deficiency.



- Developed in Europe and made its debut in Asia in January 2001.
- Also called as pro-vitamin A enhanced rice.
- Has the potential to reach many people including those who do not have reliable access to or cannot afford other sources of Vitamin A.



syngenta

WHO DEVELOPED GOLDEN RICE?

Professors Ingo Potrykus (ETH Zurich) and Peter Beyer (University of Freiburg), who in a collaborative effort were able to show that production of β -carotene could be turned on in rice grains using a minimum set of transgenes.





**“EAT ORANGE ,WE REALLY MEAN IT!”- THE
GOLDEN RICE HUMANTARIAN BOARD.**

NUTRIENT CONTENT

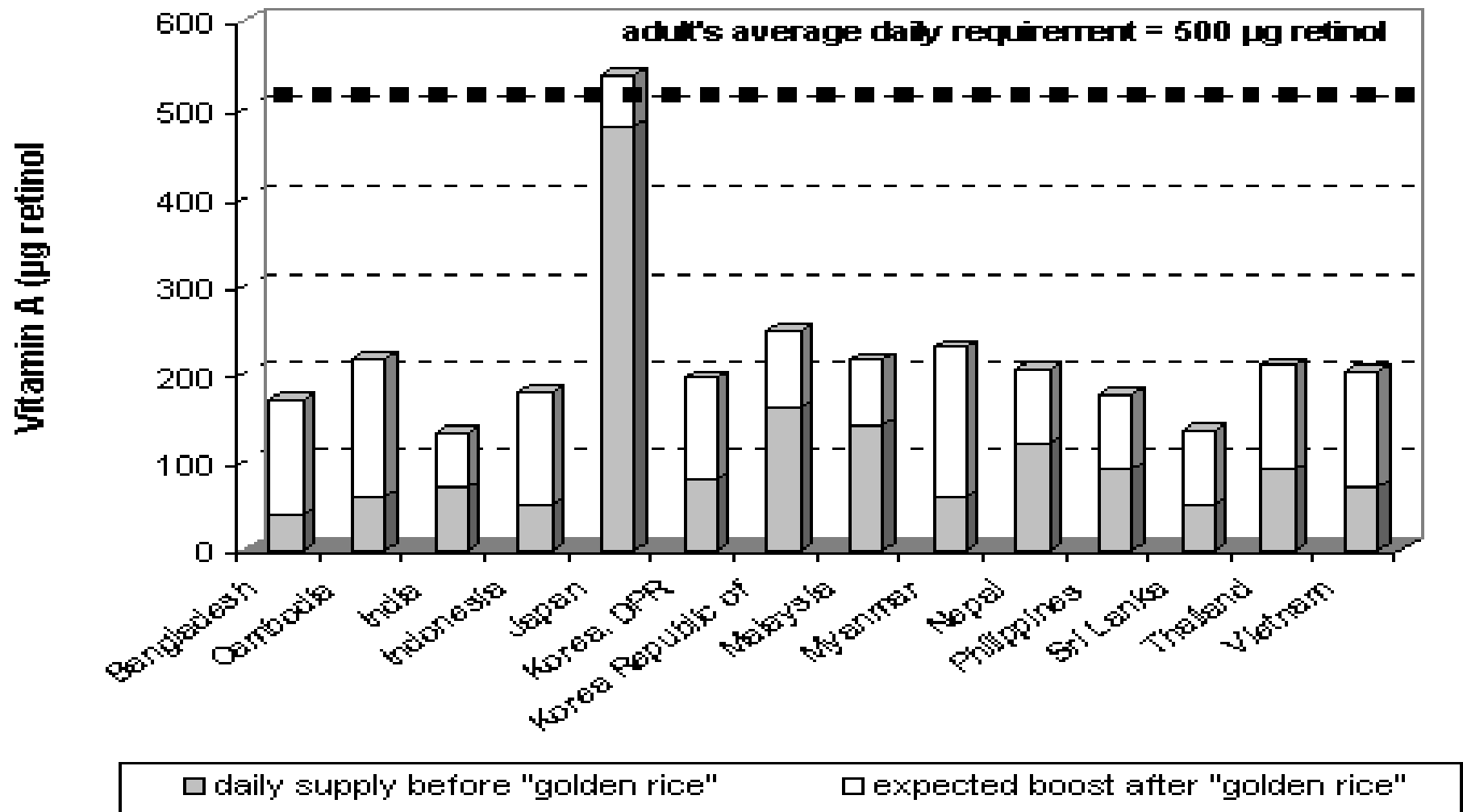


AVAILABILITY OF GOLDEN RICE

- Philippines
- Bangladesh
- Indonesia
- India
- Many parts of Africa and South America

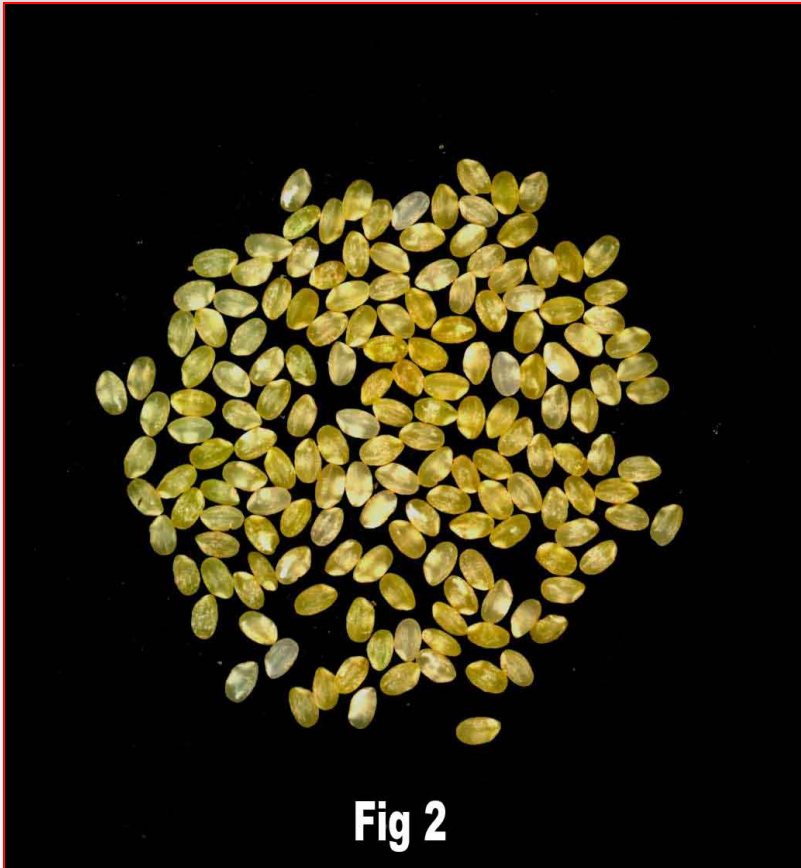


Golden rice: Solving Vitamin A deficiency? Vitamin A supply where rice is a staple



SOURCE: WHO 2000

BENEFITS OF GOLDEN RICE



- **Increased yields**
- **Disease/pest resistance**
- **Climatic change resistance**
- **Enhanced nutrition**
- **Environmental benefits**



DISADVANTAGES OF GOLDEN RICE



- **Environmental impact**
- **Excess vitamin and mineral intake/ toxicity**
- **Health risks**
- **Profiting-** Some GM Rice developers develop GM Rice with added benefits such as higher yields or disease resistance, but also prevent the seeds of the strain of rice from growing by making the transgenic crop sterile. This means the farmer has to buy new seeds from the developer every year, increasing the profits of the GM Rice developer.

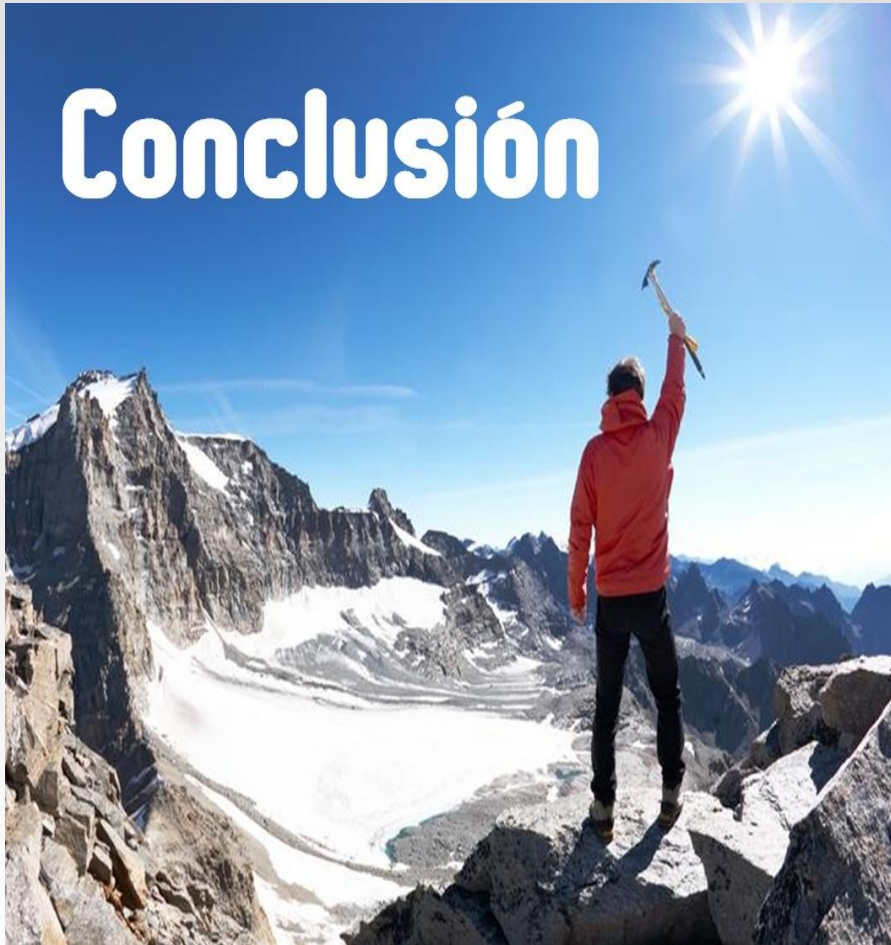
CONTROVERSIES OF GOLDEN RICE



- Actual concentrations of golden rice was even lower than originally stated.
- Bioavailability of the vitamin A is not possible as its absorption is depended on other factors not addressed by golden rice.
- Risk to human health and even surrounding environment.



CONCLUSIO



- No doubt good source of vitamin A
- Market raised enormous expectations.
- Prime interest was to introduce agriculture biotechnology
 - Other internationally recognized programs have achieved considerable progress in alleviating vitamin A deficiency. These programs will continue to be essential in the future in solving problems locally.
 - In contrast, the long-term problems posed by Golden Rice could turn out to be much greater than any benefits.



RESEARCHES DONE SO FAR...



TANG G, QIN J, DOLNIKOWSKI GG, RUSSELL RM, GRUSAK MA. "GOLDEN RICE IS AN EFFECTIVE SOURCE OF VITAMIN A". AMERICAN JOURNAL OF CLINICAL NUTRITION 2009;89:1776-83

- Aim:** To determine the vitamin A value of intrinsically labeled Golden Rice in Humans.
- Procedure:** Golden rice were grown hydroponically with heavy water(with deuterium oxide) to generate deuterium labeled b-carotene in the rice grains. Golden rice servings of 65-98g(130-200 cooked rice) containing 0.99-1.53 mg b-carotene were feed to 5 healthy volunteers (3 women and 2 men) with 10g butter. A reference dose of retinyl acetate(0.4-1.0mg) in oil was given to each volunteer 1 week before ingestion of golden rice dose. Blood samples were conducted over 36 days.
- Results:** Our results showed that Golden rice provide d 0.24-0.94mg retinol and thus the conversion factor of golden rice to b-carotene is 3.8+- 1.7to 1 with a range of 1.9-6.4 by weight, or 2.0+-0.9 to 1 with a range of 1.0-3.4 to by moles.
- Conclusion:** b- carotene derived from Golden rice is an effectively converted to vitamin A in humans.

TANG G, WANG Y, DALLAL GA, GRUSAK MA, RUSSELL RM 2012. "b - CAROTENE IN GOLDEN RICE IS AS GOOD AS B- CAROTENE IN OIL AT PROVIDING VITAMIN A TO THE CHILDREN"¹⁻⁴ AMERICAN JOURNAL OF CLINICAL NUTRITION 96: 658-664

Aim: To compare the Vitamin A value of b- carotene in GR and in spinach with that of pure b- carotene in oil when consumed by children.

Method: Children aged 6-8 years were randomly assigned to consume GR or spinach or b- carotene in an oil capsule. The GR and spinach b- carotene were enriched with deuterium with the highest abundance molecular mass. Retinyl acetate in an oil capsule was administered as a reference dose. Serum samples were collected from the samples by using gas chromatography.

Results: Using the response of retinyl acetate (0.5mg) as a reference, our results(with the help of AUC of molar enrichment at days 1,3,7,14 and 21 after labeled doses) showed that the conversions of pure b-carotene(0.5 mg), GR b- carotene(0.6mg), and spinach b- carotene(1.4mg) to retinol were 2.0, 2.3 and 7.5 to 1 by weight respectively.

Conclusion: b- carotene in GR is an effective source as pure b-carotene in oil and better than in spinach at providing Vitamin A to the children.

**MUZHINGI T, GADAGA TH,AH,GRUSAK M, RUSSELL RM,TANG G,
“YELLOW MAIZE WITH HIGH b- CAROTENE IS AN EFFECTIVE SOURCE OF
VITAMIN A IN HEALTHY ZIMBABWEAN MEN”. AMERICAN JOURNAL OF
CLINICAL NUTRITION 2011;94:510-519**

Aim: To determine the vitamin A value of yellow maize b-carotene in humans.

Method: Eight healthy Zimbabwean men volunteered for the study. On day 1 after a fasting blood draw, subjects consumed 300 g yellow maize porridge containing 1.2 mg b-carotene, 20 g butter, and a 0.5-g corn oil capsule. On day 8, fasting blood was drawn, and subjects consumed 1 mg retinyl acetate in a 0.5-g corn oil capsule and 300 g white maize porridge with 20 g butter. Thirty-six blood samples were collected from each subject over 36 d. Concentrations and enrichments of retinol and b-carotene in labeled doses and serum were determined with the use of HPLC, gas chromatography-mass spectrometry, and liquid chromatography- mass spectrometry.

Results: The area under the curve (AUC) of retinol from 1.2 mg yellow maize b-carotene was 72.9 nmol d, and the AUC of retinol from 1 mg retinyl acetate was 161.1 nmol d. The conversion factor of yellow maize b-carotene to retinol by weight was 3.2 1.5 to 1.

Conclusion: 300 g cooked yellow maize containing 1.2 mg b-carotene that was consumed with 20.5 g fat showed the same vitamin A activity as 0.38 mg retinol and provided 40–50% of the adult vitamin A Recommended Dietary Allowance

HOA TTC ,NGHIA PT, “EXPRESSION OF b- CAROTENE IN ADVANCED PROGENIES DERIVED FROM DIFFERENT BACKCROSSES OF THE HIGH YIELDING RICE VARIES TO THE TRANSGENIC GOLDEN RICE LINES” OMONRICE2010 ;17:1-7

Aim: To express b- carotene in the Japonica transgenic lines to the three Vietnamese high-yielding varieties of Indica type.

Method: The contents of carotenoid and its components including b -carotene of the progenies of BC3F3,BC3F4 and BC3F5 were measured. The backcrosses with AS996 and OM1490 as the recurrent parents showed higher expression of b-carotene in the progenies than the backcross with OM2031, indicating the genetic background of the recurrent parent affected the expression level of -carotene in the progenies. In the BC3F5, a number of promising lines showing high expression level of -carotene were identified and selected.

Results : The results showed that the expression of b-carotene depended on the backcross. The results of this study revealed the possibility to develop high-yielding varieties containing high content of b- carotene

Conclusion: The results of this study present the success in developing high-yielding rice varieties of Indica type contained b -carotene by backcrossing the transgenic japonica golden lines opening up a practical application of golden rice in production.

AMIN L, AZLAN NOOR AA, AHMAD J, SAMIAN AL,HARON MS,"ETHICAL PERCEPTION OF GOLDEN RICE IN MALAYASIA"; MALAYASIAN JOURNAL OF ENVIRONMENTAL MANAGEMENT; 2010, 11(2):71-78

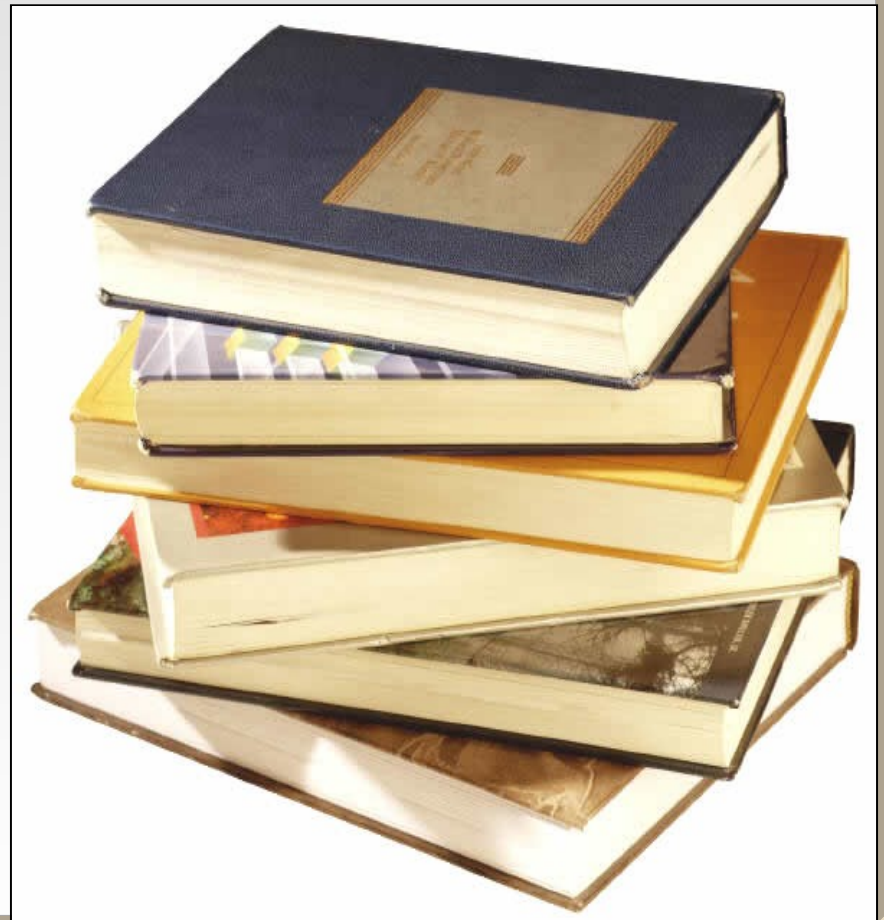
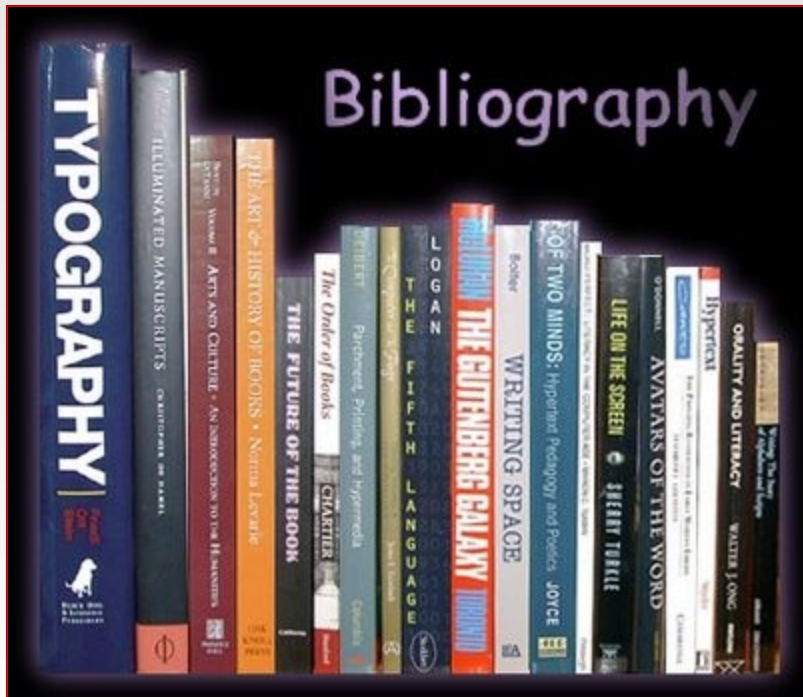
Aim: To identify the relevant ethical dimensions and to study the Muslims' perception of the ethical aspects of golden rice.

Method: A set of questionnaire comprising of the ethical aspects of golden rice was distributed and completed by 208 Muslims residing in the Klang Valley area includes -Putrajaya and Kuala Lumpur was chosen as sampling area because the population in this area met the various requirement needed in this study. Data analysis was carried out using the SPSS (Statistical Package for Social Science). There are 2 tests used: factor analysis and reliability test (Cronbach's alpha). Factor analysis is commonly used to refine and reduce scale items and question to form a smaller number of coherent subscales

Results: Results of factor analysis showed that there are four components or dimensions of ethical aspects of golden rice. The dimensions are familiarity, perceived risks, denying benefits (if not carried out) and ethical acceptance. Cronbach alpha values for the all dimensions were good: familiarity ($\alpha=0.82$), denying benefits ($\alpha=0.77$), perceived risks ($\alpha=0.78$) and ethical acceptance ($\alpha=0.84$).

Conclusion: The Muslim respondents were moderately accepting of the ethical aspects of Golden Rice as it only involved the transfer of gene from plant to plant (carrot gene to rice) and the benefit is obvious to the consumers

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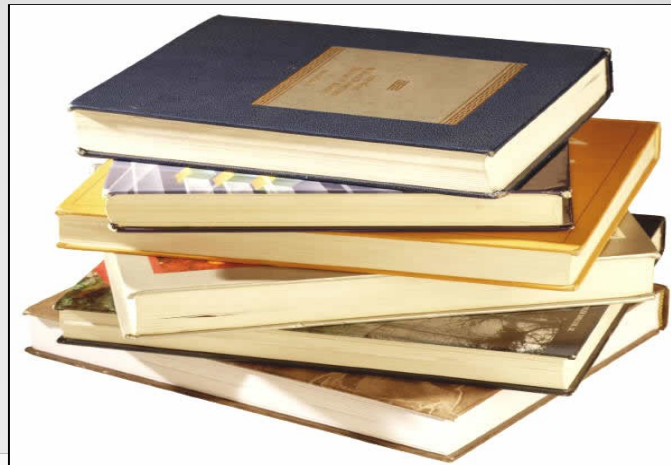
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THANK YOU....

