

Nutrigenomics: Needs and Opportunities in the Food and Agricultural Sciences

Joseph T. Spence, Ph.D.
Deputy Administrator
Agricultural Research Service
United States Department of Agriculture

Overview

- n What is the role of agriculture and the food industry?
 - Meeting the nutritional needs of individuals
 - Meeting the needs of producers
 - Improving the nutritional quality of the food supply
 - Providing the best nutritional guidance

What is a Nutrient?

- n Classical nutrients
- n New nutrients
- n Beneficial dietary components
- n Can a substance be a nutrient for one person and not another?
- n Are nutritional components interchangeable?
- n Positive and negative dietary components

Factors that Influence Nutrient Needs

- n Age
- n Gender
- n Physiological state
- n Lifestyle
- n Disease presence
- n Stress
- n Genetics
- n Diet itself

Dietary Reference Intakes

n Vitamins

- Vitamin A, Vitamin C, Vitamin D, Vitamin E, Vitamin K, thiamine, riboflavin, niacin, Vitamin B6, folate, Vitamin B12, biotin, choline

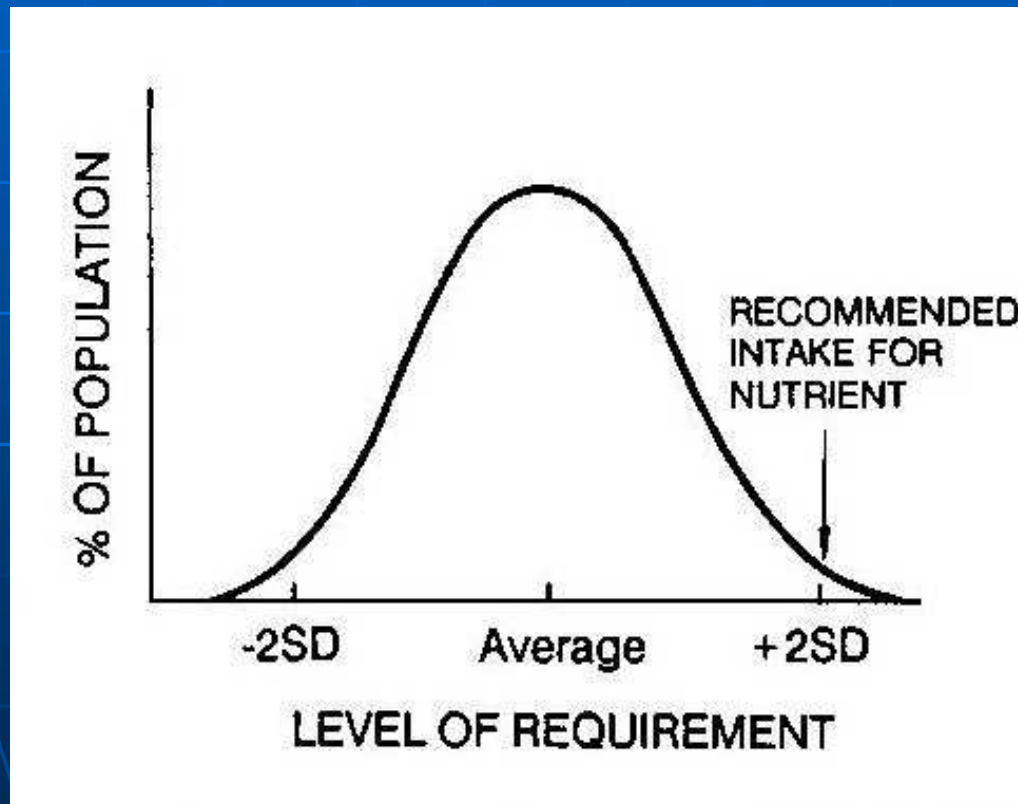
n Minerals

- Calcium, chromium, copper, fluoride, iodine, iron, manganese, molybdenum, phosphorous, selenium, zinc, sodium, chloride

n Macronutrients

- Water, carbohydrate, fiber, fat, linoleic acid, alpha-linolenic acid, protein

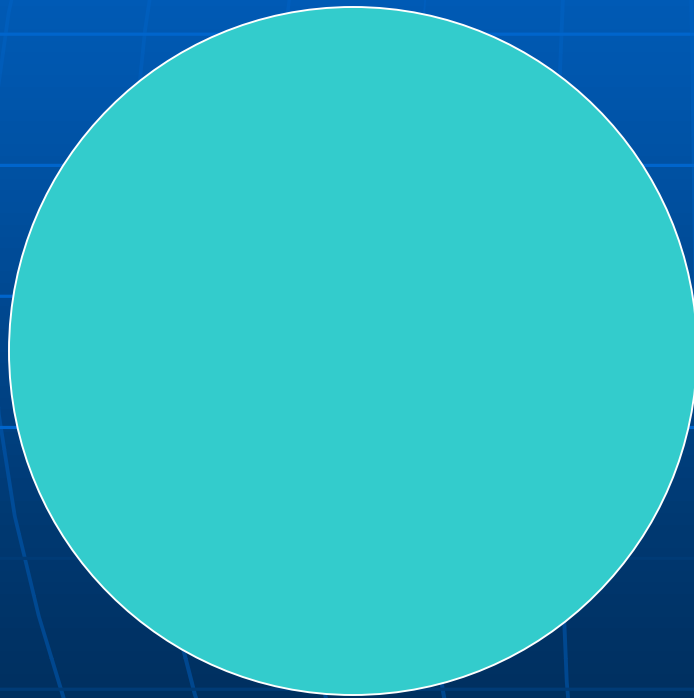
RDA Determination



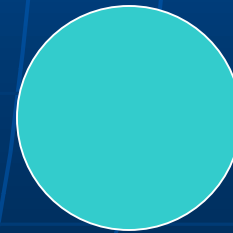
Beaton (1985) AJCN 41: 155-164

Individual Dietary Requirements

Large population with no effect



Group of individuals
who have requirement



Development of Enhanced Foods

- n Functional foods
- n Are benefits universal or only to particular individuals?



Commodities

Normal quantities of
beneficial dietary
components

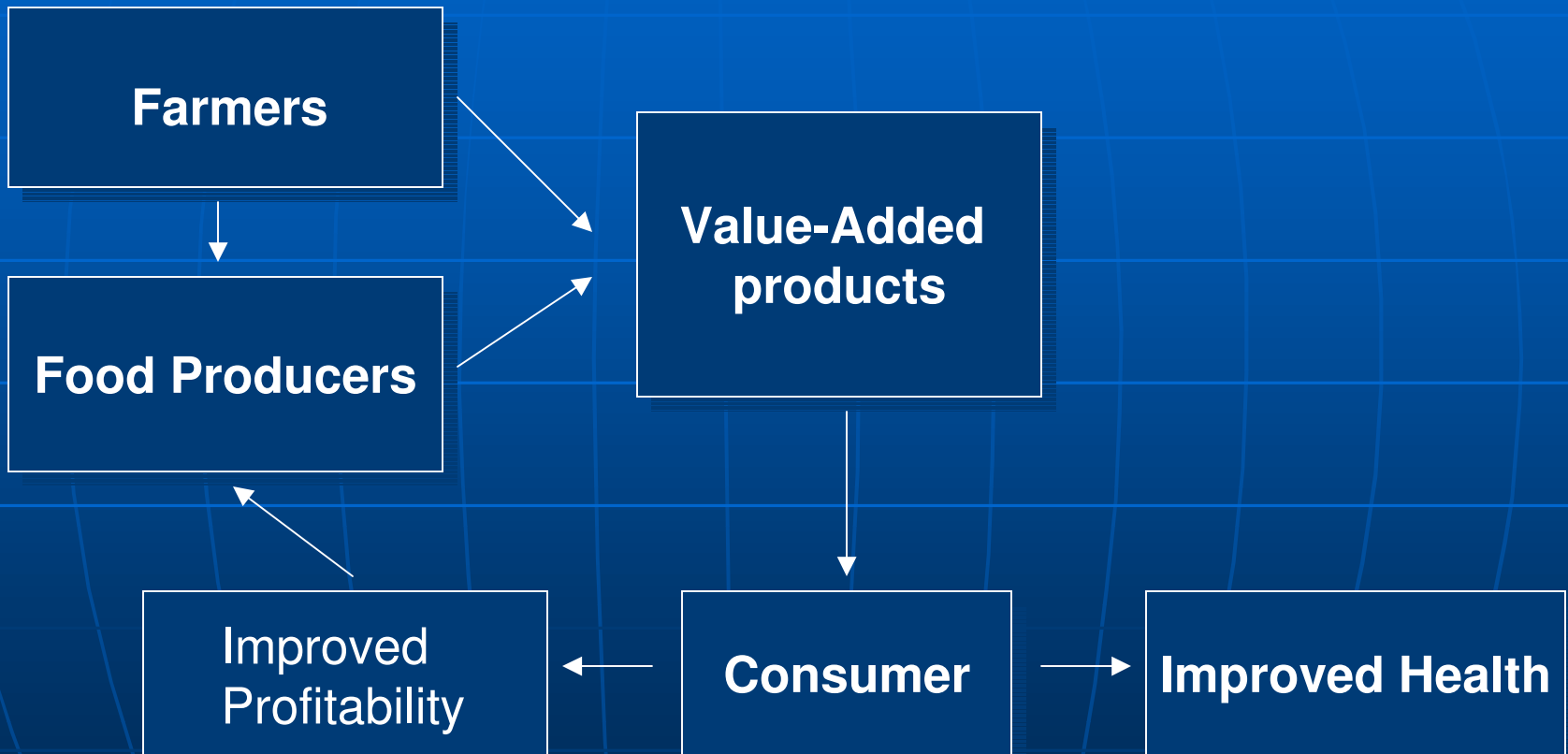


Enhanced levels of beneficial
dietary components

Improvements to Commodities

- n Improvement of crops to provide over expression of beneficial dietary components
- n Insertion of beneficial components
- n Improvement of animal products
- n Use of nutrigenomics in food animals to increase yield and improve feed efficiency

Value-Added Products

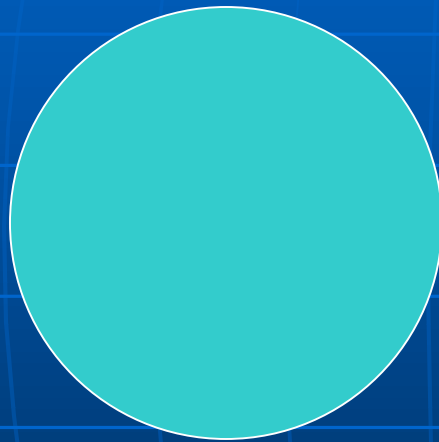


Dietary Guidance

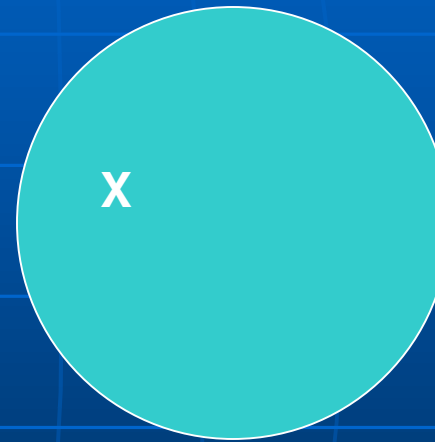
- n *Dietary Guidelines for Americans* published every five years
- n Form basis for policy and educational needs
- n Population based
- n Produced jointly by USDA and DHHS using a panel of external advisors
- n *What are the implications of nutrigenomics?*

Population vs. Individual (negative nutrient)

Low Cholesterol



High Cholesterol



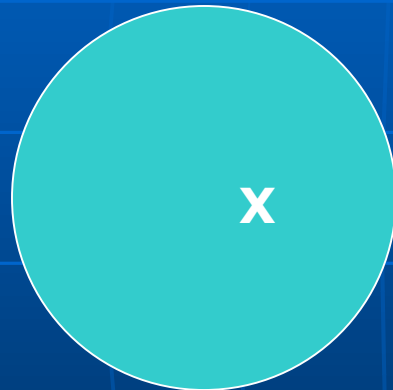
**General agreement about population based
recommendations**

**However, can not be used to accurately predict
risk for any one individual in the population**

Individual vs. Population (positive dietary component)

Low intake

High intake



Might be easier to identify the needs of individuals

Might be more difficult to make population based recommendations

Concerns

- n Do we have adequate biological markers?
- n Do we have appropriate genetic markers?
- n Is the desired effect related to a single dietary component?
 - Are there other components that can have a similar or the same effect
- n Do we know what the beneficial component is?
 - Does it matter?
- n How can we educate consumers?

Concerns (continued)

- n Must be related to composition of the overall diet
- n Can we increase the amount of the component in an individual's diet without negative consequences?
- n Is there a tolerable upper limit?
- n Can we control the level of intake of the dietary component?
- n Can we segregate and identify enhanced commodities and foods?

Future Directions

- n Identification of clear nutritional benefits for individuals
- n More clearly identify the benefits
 - Health claims
 - Identification of non-traditional nutrients
- n Improvements in the food supply
- n Value added for producers
- n Possible use of supplements that have clear benefits