Vegetable Crops –PLSC 451/551
Lesson 2, Nutrition, Production

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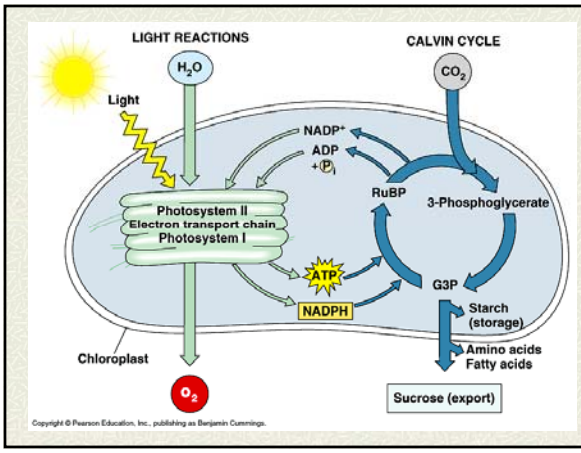
Nutrition

- **Two Important Nutritional Facts:**

1) All foods come directly or indirectly from plants.



Nutrition

- **Two Important Nutritional Facts:**

1) All foods come directly or indirectly from plants.

2) Two-thirds of the worlds population rely on a largely vegetarian diet.

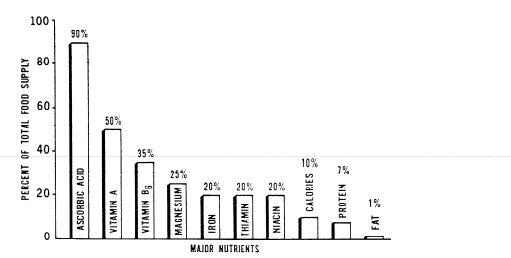


FIGURE 1 Nutritional contribution of fruits and vegetables compared to percentage of total food supply. (From Ref. 5.)

Nutrition

Choice of foods:

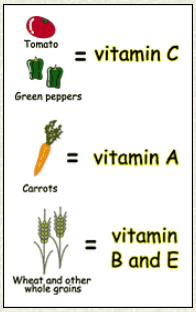
1) Personal, cultural, or religious preferences
2) Availability
3) Cost

Nutrition

- **Macronutrients:**
  - carbohydrates
  - fats
  - essential fatty acids
  - proteins

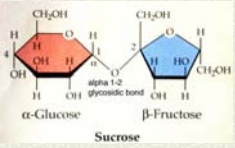
Nutrition

- **Micronutrients:**
  - essential vitamins
  - mineral elements



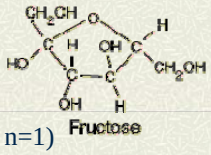
Nutrition - macronutrients

- **Carbohydrates:**
  - The principal energy source, mostly derived from cereals and starchy vegetables
  - Polymers of $C_6H_{12}O_6$



Nutrition - macronutrients

- **Carbohydrates**:



Fructose

Polymers of $(C_6H_{12}O_6)_n$ –

Monosaccharides (simple sugars n=1)
glucose and fructose

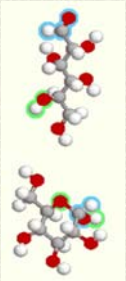
Disaccharides (n=2)
maltose, cellobiose, sucrose, lactose

Nutrition - macronutrients

- **Carbohydrates:**

Polymers of $(C_6H_{12}O_6)_n$ –

Polysaccharides (complex sugars n>50) - starches and fructosans



Nutrition

- **Fiber:**

Polymers of $(C_6H_{12}O_6)_n$

Polysaccharides with additional lignins

Indigestible to humans
soluble and insoluble forms

Nutrition - macronutrients

- **Lipids:**

Organic compounds high in energy

Insoluble in water

Structural components of cell membranes, act in absorption of vitamins, regulation of blood pressure and smooth muscle control, etc.

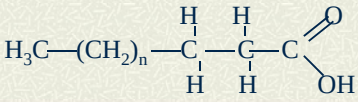
Nutrition - macronutrients

- **Lipids:**

The number of double bonds determines the degree of saturation:

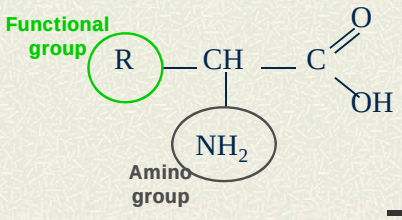
Saturated means NO =

(poly)unsaturated means one or more =



Nutrition - macronutrients

- **Proteins and Amino Acids:**



Nutrition - macronutrients

- **Proteins and Amino Acids:**

Proteins consist of linked amino acids

Animal sources have a higher protein quality than plant sources

- animal protein is limited to world population
- the perfect food source is…

Nutrition - micronutrients

- **Vitamins:**

Essential component of enzymes and enzyme systems

Three are synthesized by intestinal tract bacteria, the rest come from the diet

Classified by their water solubility or fat solubility

Nutrition - micronutrients

- **Vitamins:**

fat soluble or water soluble

Nutrition - micronutrients

- **Minerals:**

Inorganic elements that also function as components of enzyme systems

Macrominerals: Ca, P, Mg, Na, K, Cl

Microminerals: Fe, Cu, Mn, F, Cr, Se, Mo, Co

Nutrition

- **Factors affecting nutrients in plants:**

Genetic background

Growing environment (including pests, diseases)

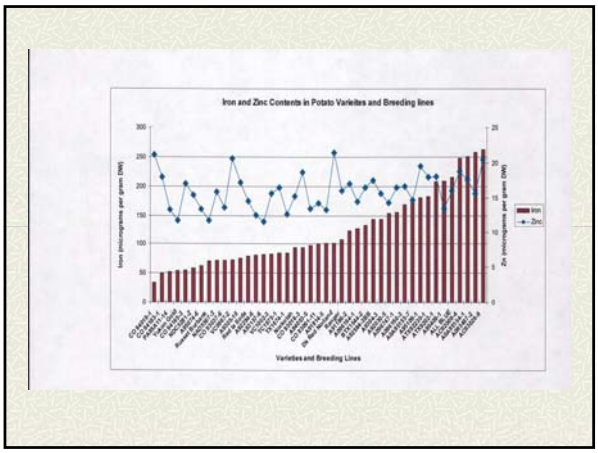
Storage conditions:

A crop's nutrient content is highest at harvest. Minimize losses with proper temperature and humidity.

Nutrition

- **Vitamin C in common potato varieties:**

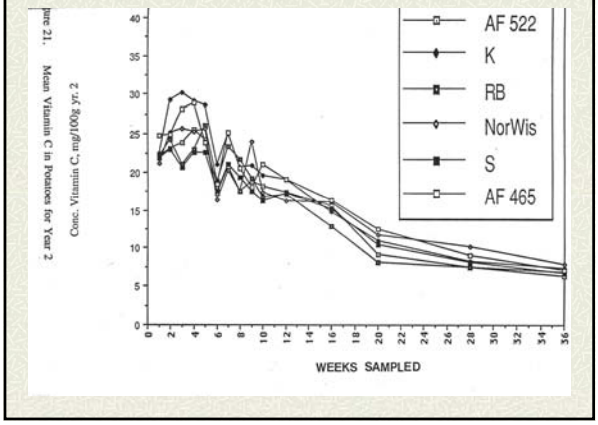
Variety	Vitamin C (mg/100g)
Ranger Russet	29.4
Yukon Gold	29.3
Gem Russet	26.1
Chipeta	25.3
Snowden	18.8
NorDonna	16.5
Cherry Red	14.9



Nutrition

- **Vitamin C in Canadian growing regions:**

Location	Vitamin C (mg/100g)
Alberta	12.0
Saskatchewan	14.9
Manitoba	20.7
Ontario	17.8
New Brunswick	14.5
Nova Scotia	6.5



Nutrition – Vital Crops

- **Carbohydrate**
  - white potato
  - sweet potato
  - dry beans
  - cassava
  - yam
  - taro (aroids)
  - plantain
- **Fat**
  - mature seed of some legumes, and cucurbits

Nutrition – Vital Crops

- **Protein**
  - beans
  - peas
  - sweet corn
  - leafy crucifers
- **Pro-Vitamin A**
  - carrot
  - squash
  - squash
  - green leafy vegetables
  - pepper
  - green peas, beans
  - orange/yellow flesh sweet potato

Nutrition – Vital Crops

- **Vitamin C**
  - crucifers
  - immature bean seed
  - tomato
  - bean sprouts
  - pepper
  - white potato
  - melons
  - many leafy vegetables
- **Minerals**
  - crucifers
  - most other leafy vegies

Vegetables – Specific Nutrition

Vegetable	Calories	Fat	Cholesterol	Sodium
Potato	100	0	0	0
Tomato	35	1	0	0
Lettuce	15	0	0	0
Onion	60	0	0	0
Carrot	35	0	0	0
Sweet corn	80	2	0	0
Broccoli	45	1	0	2
		%DV	%DV	%DV

Vegetables – Specific Nutrition

Vegetable	Calories	Fat	Cholesterol	Sodium
Cucumber	15	0	0	0
Sweet potato	130	0	0	2
Squash	20	0	0	0
Asparagus	25	0	0	0
Celery	20	0	0	4
Bell Pepper	30	0	0	0
		%DV	%DV	%DV

Vegetables – Specific Nutrition

Vegetable	Carbohydrates	Fiber	Sugars	Protein
Potato	9	12	3	4
Tomato	2	4	4	1
Lettuce	1	4	2	1
Onion	5	12	9	2
Carrot	3	8	5	1
Sweet corn	6	12	5	3
Broccoli	3	20	3	5
	%DV	%DV	g	g

Vegetables – Specific Nutrition

Vegetable	Carbohydrates	Fiber	Sugars	Protein
Cucumber	1	4	2	1
Sweet potato	11	16	7	2
Squash	1	8	7	2
Asparagus	1	8	2	2
Celery	2	8	0	1
Bell Pepper	2	8	4	1
	%DV	%DV	g	g

Vegetables – Specific Nutrition

Vegetable	Vitamin A	Vitamin C	Calcium	Iron
Potato	0	45	2	6
Tomato	20	40	2	2
Lettuce	4	6	2	2
Onion	0	20	4	2
Carrot	270	10	2	0
Sweet corn	2	10	0	2
Broccoli	15	220	6	6
	%DV	%DV	%DV	%DV

Vegetables – Specific Nutrition

Vegetable	Vitamin A	Vitamin C	Calcium	Iron
Cucumber	4	10	2	2
Sweet potato	440	30	2	2
Squash	6	30	2	2
Asparagus	10	15	2	2
Celery	2	15	4	2
Bell Pepper	8	190	2	2
	%DV	%DV	%DV	%DV

Medicinal Plants - Questions

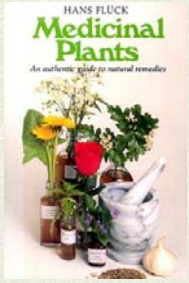
Plants contain thousands of physiologically active compounds – which are beneficial, which are harmful?

At what growth stage is concentration maximized and how is that standardized?

Are the benefits psychological or physiological?

Medicinal Uses – Traditional vs Folk

- Natural drugs produced by plants and fungi were historically used for medicinal and spiritual reasons
- Most current medicines are derived from or synthesized based on natural plant products



Medicinal Plants

- **Herbalism - still active today**

  Knowledge accumulated by trial and error, safety and effectiveness learned through repeated use over time

  Reputed cures for cancer, bad breath, fever, headaches, freckles, properties for aphrodisiacs, cures for diabetes

Medicinal Crops and Uses

- Garlic and allium sp. - cure everything
- Gingseng - love potion
- Chicory – wart removal
- Brassica – cancer curing, antidote for poisonous mushrooms
- Bitter melon – hemorrhoids, tumors, burns
- India cycad seed – laxative

Medicinal Plants and Uses

- Yams, foxglove – digitalis (heart medicine)
- Rhubarb – eradicate ringworm
- Pepper – capsaicin to reduce pain, psoriasis, arthritis, allergies

The MAJOR MEDICAL benefit of veggies is to provide a healthy source of carbohydrates, fiber, vitamins, minerals, and other nutrients.

Toxicants and Anti-nutrients

- The same physiologically active compounds that give plants medicinal properties can make them toxic
- Plants have many such compounds in a wide range of concentrations
- Toxicants includes proteins, alcohols, organic acids, resins, tannins, terpinoids, phenols, minerals, and other reactive compounds

Toxicants

- Proteins - polypeptides and amines, inhibit metabolic processes and are allergenic
- Alcohols – neurovascular poisons
- Non-amino organic acids – associated with soluble salts (sodium oxalate) result in kidney damage

Toxicants

- Resinoids, tannins, phenols, and terpinoids – cause skin irritations and decrease protein digestibility
- Mineral toxins – interfere with vitamin functioning, absorption of certain nutrients, interfere with respiratory function, high accumulations of certain metals are poisonous

Toxicants

- Physiological functions and/or damage:
  - allergies
  - enzyme inhibitors
  - respiratory inhibitors
  - nervous system
  - nutrient / mineral absorption
  - hormonal interference

Toxicants

- Physiological functions, damage:
  - anti-metabolites
  - anti-vitamins
  - carcinogens, tumorigens, teratogins
  - physiological disorganization and irritants
  - birth defects
  - mechanical injury

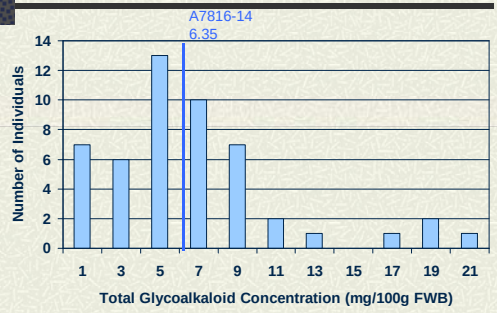
Plant Families with Toxicants

- Asteraceae – Lettuce – nitrates and alkaloids
- Brassicaceae – Crucifers – goitrogens and cholinesterase inhibitors
- Chenopodiaceae – beets, spinach – oxalic acid, saponins, nitrates
- Fabaceae – Legumes – allergens, cyanogenic glycosides, hemmaglutenins, etc

Plant Families with Toxicants

- Poaceae – bamboo – cyanogenic glucoside (decreases with boiling)
- Polygonaceae – rhubarb – oxalic acid, glucoside, and leaf tissue poison
- Solanaceae – potatoes and tomatoes - alkaloids and protease inhibitors peppers - capsaicin

Family A7816-14 Selfed



Vegetable Crops - Production

Major Producing Countries

China	125,500 mt x 1000
India	60,000
United States	32,700
Turkey	18,500
Italy	13,000

Vegetable Crops

Production Systems

Traditional – large-scale, mechanized

Organic – usually small-scale, alternative methods

Subsistence – very small-scale, low-input

Vegetable Crops - Production

Major Vegetable Crops Worldwide:

Potato	288,200 mt x 1000
Cassava	153,600
Sweet Potato	123,800
Tomato	70,600
Cabbage	40,400
Onions	30,000
Yams	28,100
Watermelon	27,100

Vegetable Crops - Production

Acreage produced in the U.S.:

Potato	1,424,100 acres
Sweet Corn	687,000
Tomato	408,700
Snap beans	275,500
Green peas	268,900
Lettuce	235,400
Watermelons	184,600
Cucumbers	159,620

Vegetable Crops - Production

Acreage produced in the U.S.:

Onions	154,900
Broccoli	134,200
Carrots	119,700
Cantaloupe	113,800
Cabbage	85,300
Asparagus	73,500
Peppers	65,700
Lima beans	56,700

Vegetable Crops - Production

Acreage produced in the U.S.:

Cauliflower	47,400
Garlic	37,000
Spinach	34,500
Celery	26,900
Beets	7,500
Brussel sprouts	4,200
Endive	3,100
Eggplant	2,600

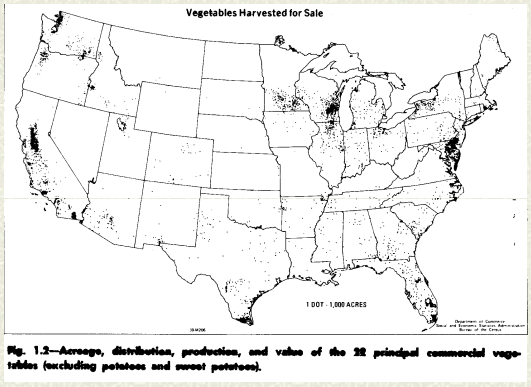
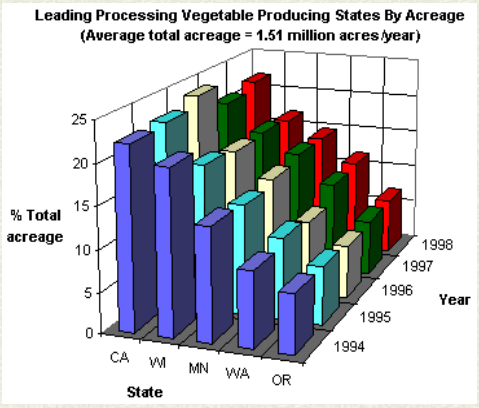
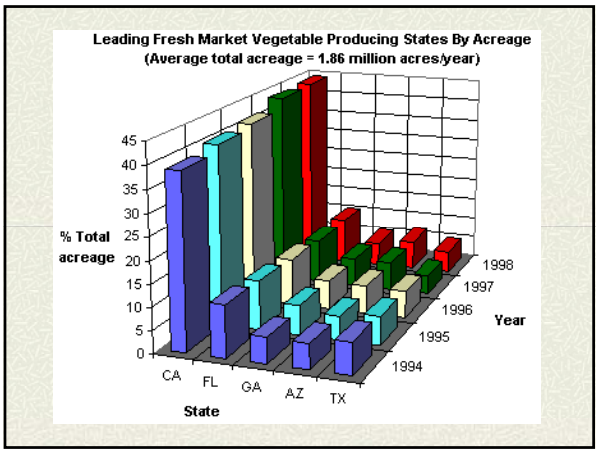


Fig. 1.2—Acreage, distribution, production, and value of the 22 principal commercial vegetables (excluding potatoes and sweet potatoes).




Leading Fresh Market Vegetable Producing States By Acreage
(Average total acreage = 1.86 million acres/year)
% Total acreage
45
40
35
30
25
20
15
10
5
0
CA
FL
GA
AZ
TX
State
1998
1997
1996
1995
1994
Year