Myths and Realities of Pesticide Residues in Food Crops

Bob Krieger, Ph. D.
Personal Chemical Exposure Program
Department of Entomology
University of California, Riverside

Let us see!

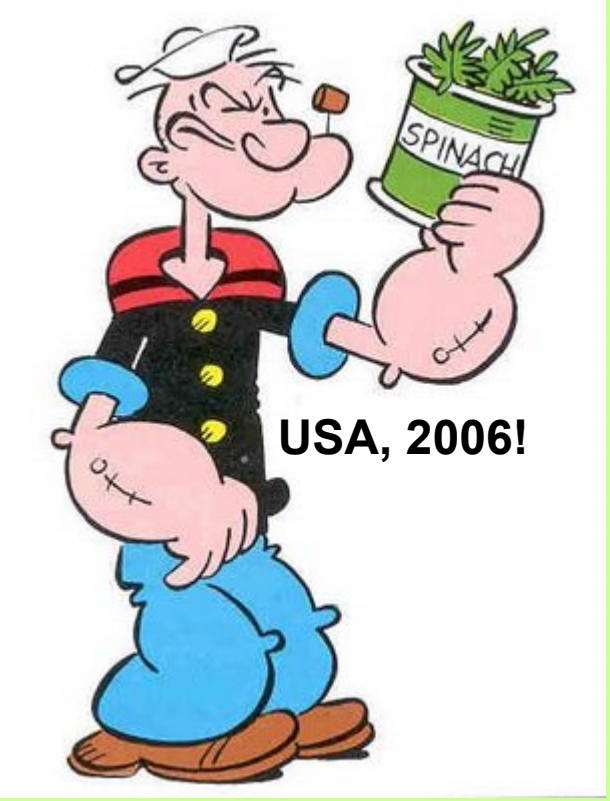
- Origins of concern
- Sprays for produce: Lettuce
- Food purity and safe food
- Hazard and risk

Trace chemical residues became a public concern in the 1960s

Safe Food

- **Biological**
- Microbial contaminants
- *Volatile market orders*
- Illness and death

- **Chemical**
- Pesticide residues
- Residue tolerances
- Hypothetical risk



Causes of Foodborne Illness

Amnesic Shellfish Poisoning and Domoic Acid
Campylobacter jejuni
Ciguatera Poisoning
Clostridium botulinum
Clostridium perfringens
Cyclospora cayetanensis
Hemolytic Uremic Syndrome (E. coli 0157:H7)
Listeria monocytogenes
Paralytic Shellfish Poisoning
Red Tide, PSP and Safe Shellfish Harvesting
Salmonella
Scombroid Poisoning
Shigella
Toxoplasma gondii

Public health experts at CDC in Atlanta estimate that there are more than 70 million cases of foodborne illness in the US every year. Eleven to 13 million in Canada….

"How many are caused by *pesticide residues*?" ***Silence***

Origins of societal concerns about chemicals and pesticide residues…

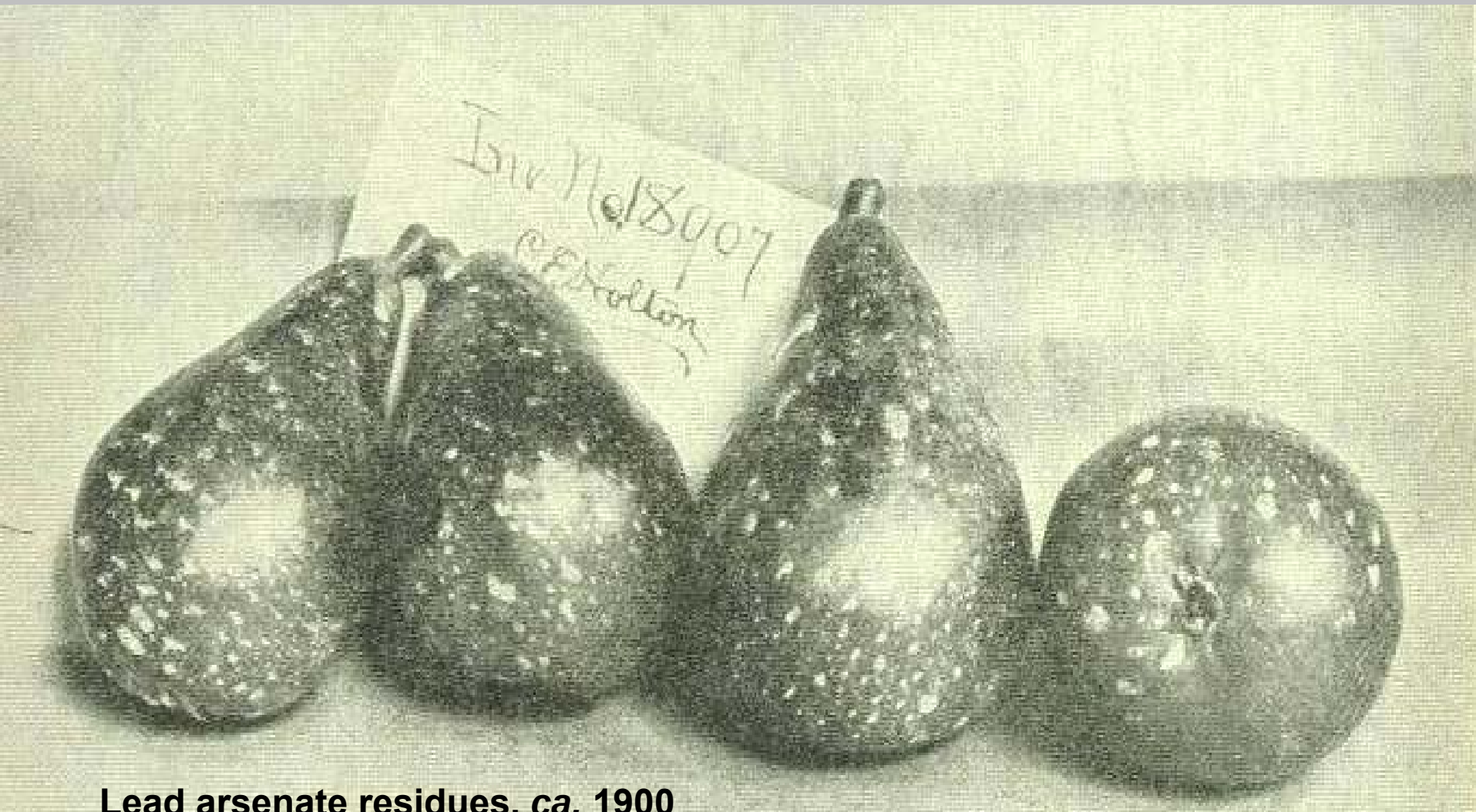
- *Food adulteration, early 1800s*
- *Pure Food Act, 1906*
- *Cranberry Scare of 1959*
- *Silent Spring, 1962*

Pesticide Residues on Produce

- Residue tolerance
- Consumer exposure
- Health impact

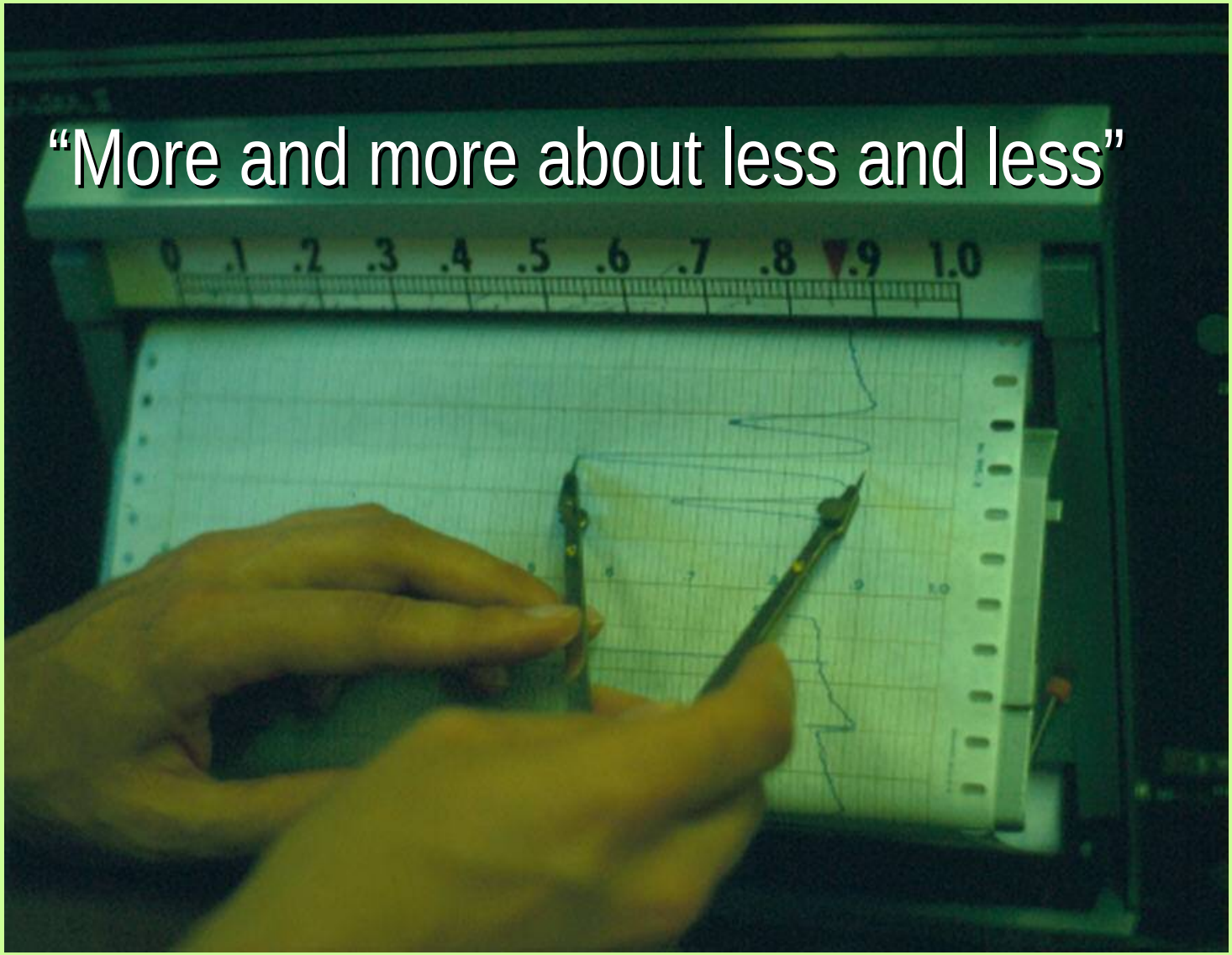
- Good Ag Practice
- Consumption x ppm
- Risk?
  - Chemical
  - Exposure
  - *Harm*

“Pesticide residues are a condition of production…”
Harvey Wiley, founder FDA 1906



Lead arsenate residues, *ca.* 1900


“…to be on the safe side, she doesn’t buy.”
1959


“More and more about less and less”
0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0

If apples and pears looked like that, and foodborne illnesses sicken and kill,

why are pesticides perceived as such a threat to health

in developed countries of the world?

Personal perspective on pesticide residues…

The public revulsion for pesticides is magnified by the thought they will become part of us.

B. Krieger, 2008

Lettuce

- **Pest**
- First choice!
- *Free*
- Simple needs
- Sole support

- **Consumer**
- Harvest!
- Co$t
- Complex nutritional requirements
- Multiple uses

Lettuce Sprays

acephate acetamiprid azoxystrobin BTs benefin bensulide carbaryl chloropicrin neem oil cymoxanil cyflythrin cypermethrin cyromazine diazinon 1,3-dichloropropene dicloran dimethoate dimethomorph endosulfan famoxadone fenamidone fosetyl-al glyphosate imidacloprid indoxacarb iprodione lambda-cyhalothrin malathion maneb mefenoxam metam sodium methomyl methoxyfenozide methyl bromide oxydemeton-Me paraquat permethrin propylpyzamide pyraclostrobin spinosad sulfur

Pesticide Residues: Total Diet Studies,1991-2003

acephate	cypermethrin	DCPA
DDE	demeton-S sulfone	diazinon
dicloran	dieldrin	dimethoate
endosulfan I	endosulfan II	endosulfan sulfate
methamidophos	methomyl	mevinphos
omethoate	permethrin	vinclozolin

FDA, March 2007

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FDA, March 2007

Pesticide Residues on Lettuce in Total Diet Studies, 1991-2003

Pesticide Residue	Samples	>LOQ	Trace	Amount in ppm (ug pesticide/g lettuce)		
				Mean	Min	Max
acephate	44	21	5	0.0054	0.001	0.040
dimethoate	44	10	6	0.0015	0.0009	0.017
methamidophos	44	13	4	0.0011	0.0002	0.011

FDA, March 2007

Average and Maximum Dosages of Pesticide Residues per Serving

- Consumption/serving 72 g
- Exposure = Consumption x Residue (ppm)

  72 g *x* ug pesticide/g lettuce

- Body weight 50 kg ♀ 70 kg ♂

- Exposure/body weight = Dosage/serving

Pesticide Exposure: Lettuce

• Serving size	• 72 g lettuce
• Most toxic pesticide residue on lettuce	• acephate
• Highest amount 1991-2003	• 0.040 ppm
• Dose per serving	• 72g *x* 0.040ug/g= 3ug

Food Purity

A BASIC HUMAN CONCERN

Food as Food

Nutrition Facts

Biochemicals

Trace Chemical Constituents

Lettuce

Nutrition Facts

Serving Size 1 cup shredded 72g (72 g)

Amount Per Serving

Calories 10	Calories from Fat 1
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat	
Cholesterol 0mg	0%
Sodium 7mg	0%
Total Carbohydrate 2g	1%
Dietary Fiber 1g	3%
Sugars 1g	
Protein 1g	

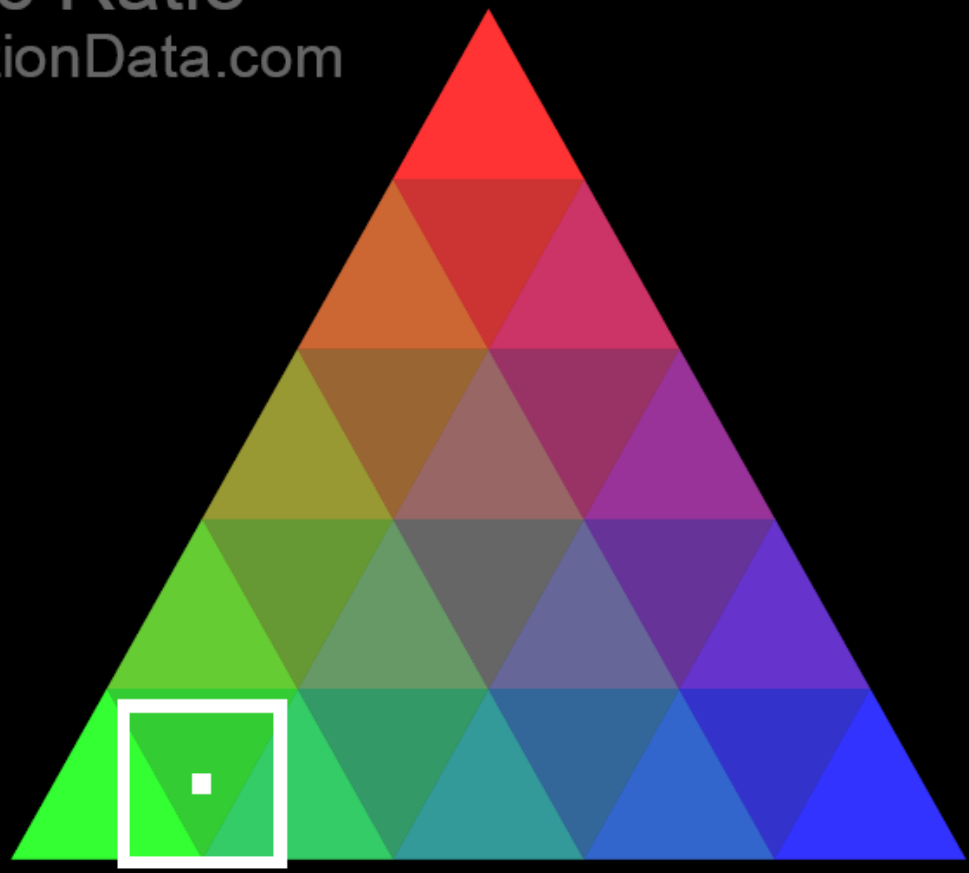
Vitamin A	7%	• Vitamin C	3%
Calcium	1%	• Iron	2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Caloric Ratio



76%	8%	16%
Carbs	Fats	Protein

Food Energy

Amounts Per Selected Serving		%DV
Calories	10.1 (42.3 kJ)	1%
Calories from Carbohydrate	7.7 (32.2 kJ)	
Calories from Fat	0.8 (3.3 kJ)	
Calories from Protein	1.6 (6.7 kJ)	
Calories from Alcohol	0.0 (0.0 kJ)	

Carbohydrates

Amounts Per Selected Serving		%DV
Total Carbohydrate	2.3 g	1%
Dietary Fiber	0.9 g	3%
Starch	0.0 g	
Sugars	1.4 g	
Sucrose	36.0 mg	
Glucose	655 mg	
Fructose	720 mg	
Lactose	0.0 mg	
Maltose	0.0 mg	
Galactose	0.0 mg	

Fats & Fatty Acids

Amounts Per Selected Serving		%DV
Total Fat	0.1 g	0%
Saturated Fat	0.0 g	0%
4:00	0.0 mg	
6:00	0.0 mg	
8:00	0.0 mg	
10:00	0.0 mg	
12:00	0.0 mg	
13:00	–	
	0.0 mg	
14:00		
15:00	–	
16:00	11.5 mg	
17:00	–	
18:00	1.4 mg	
19:00	–	
20:00	–	
22:00	–	
24:00:00	–	
Monounsaturated Fat	0.0 g	
14:01	–	
15:01	–	
16:1 undifferentiated	0.7 mg	
16:1 c	–	
16:1 t	–	
17:01	–	
18:1 undifferentiated	2.9 mg	
18:1 c	–	
18:1 t	–	
20:01	0.0 mg	
22:1 undifferentiated	0.0 mg	
22:1 c	–	
22:1 t	–	
24:1 c	–	
Polyunsaturated Fat		
16:2 undifferentiated	–	
18:2 undifferentiated	15.1 mg	
18:2 n-6 c,c	–	
18:2 c,t	–	
18:2 t,c	–	
18:2 t,t	–	
18:2 i	–	
18:2 t not further defined	–	
18:03	37.4 mg	
18:3 n-3, c,c,c	–	
18:3 n-6, c,c,c	–	
18:4 undifferentiated	0.0 mg	
20:2 n-6 c,c	–	
20:3 undifferentiated	–	
20:3 n-3	–	
20:3 n-6	–	
20:4 undifferentiated	0.0 mg	
20:4 n-3	–	
20:4 n-6	–	
20:5 n-3	0.0 mg	
22:02	–	
22:5 n-3	0.0 mg	
22:6 n-3	0.0 mg	
Total trans fatty acids	–	
Total trans-monoenoic fatty acids	–	
Total trans-polyenoic fatty acids	–	
Total Omega-3 fatty acids	37.4 mg	
Total Omega-6 fatty acids	15.1 mg	

Learn more about these fatty acids and their equivalent names

Protein & Amino Acids

Amounts Per Selected Serving		%DV
Protein	0.6 g	1%
Tryptophan	6.5 mg	
Threonine	18.0 mg	
Isoleucine	13.0 mg	
Leucine	18.0 mg	
Lysine	17.3 mg	
Methionine	3.6 mg	
Cystine	3.6 mg	
Phenylalanine	16.6 mg	
Tyrosine	5.0 mg	
Valine	17.3 mg	
Arginine	10.8 mg	
Histidine	6.5 mg	
Alanine	18.0 mg	
Aspartic acid	90.0 mg	
Glutamic acid	140 mg	
Glycine	10.8 mg	
Proline	7.2 mg	
Serine	18.0 mg	
Hydroxyproline	–	

Vitamins

Amounts Per Selected Serving		%DV
Vitamin A	361 IU	7%
Retinol	0.0 mcg	
Retinol Activity Equivalent	18.0 mcg	
[illegible] Carotene	2.9 mcg	
[illegible] Carotene	215 mcg	
[illegible] Cryptoxanthin	0.0 mcg	
Lycopene	0.0 mcg	
Lutein+Zeaxanthin	199 mcg	
Vitamin C	2.0 mg	3%
Vitamin D	–	–
Vitamin E (Alpha-Tocopherol)	0.1 mg	1%
Beta-Tocopherol	0.0 mg	
[illegible]-Tocopherol	0.1 mg	
[illegible]	0.0 mg	
Vitamin K	17.4 mcg	22%
Thiamin	0.0 mg	2%
Riboflavin	0.0 mg	1%
Niacin	0.1 mg	0%
Vitamin B6	0.0 mg	2%
Folate	20.9 mcg	5%
[illegible]	20.9 mcg	
[illegible]	0.0 mcg	
[illegible] Folate	20.9 mcg	
Vitamin B12	0.0 mcg	0%
Pantothenic Acid	0.1 mg	1%
Choline	4.8 mg	
Betaine	0.1 mg	

Minerals

Amounts Per Selected Serving		%DV
Calcium	13.0 mg	1%
Iron	0.3 mg	2%
Magnesium	5.0 mg	1%
Phosphorus	14.4 mg	1%
Potassium	102 mg	3%
Sodium	7.2 mg	0%
Zinc	0.1 mg	1%
Copper	0.0 mg	1%
Manganese	0.1 mg	4%
Selenium	0.1 mcg	0%
Fluoride	–	

Sterols

Amounts Per Selected Serving		%DV
Cholesterol	0.0 mg	0%
Phytosterols	7.2 mg	
Campesterol	–	
Stigmasterol	–	
Beta-sitosterol	–	

Other

Amounts Per Selected Serving		%DV
Alcohol	0.0 g	
Water	68.9 g	
Ash	0.3 g	
Caffeine	0.0 mg	
Theobromine	0.0 mg	

Trace Chemical Constituents

Trace Elements (ppb; ug/kg fw): Lettuce

Iceburg			Romaine	
As	12		As	13
Cd	47		Cd	71
Cr	15		Cr	52
Cs	1.8		Cs	4.2
Cu	440		Cu	523
Hg	27		Hg	39
Mn	1440		Mn	2019
Ni	59		Ni	67
Pb	10		Pb	13
Se	3.1		Se	1.5
U	0.3		U	1.0
Zn	1809		Zn	2090

Sanchez, 2008

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FDA, March 2007

No Effect Levels

• Dietary (months)	Neurotoxicity (mg/kg bw)
• acephate	0.12
• dimethoate	0.2
• methamidophos	0.13

How little is OK?

Human consumption at highest residue level to achieve No Effect Dosage

- 72 g Servings

50 kg female 2000

100 kg male 4000

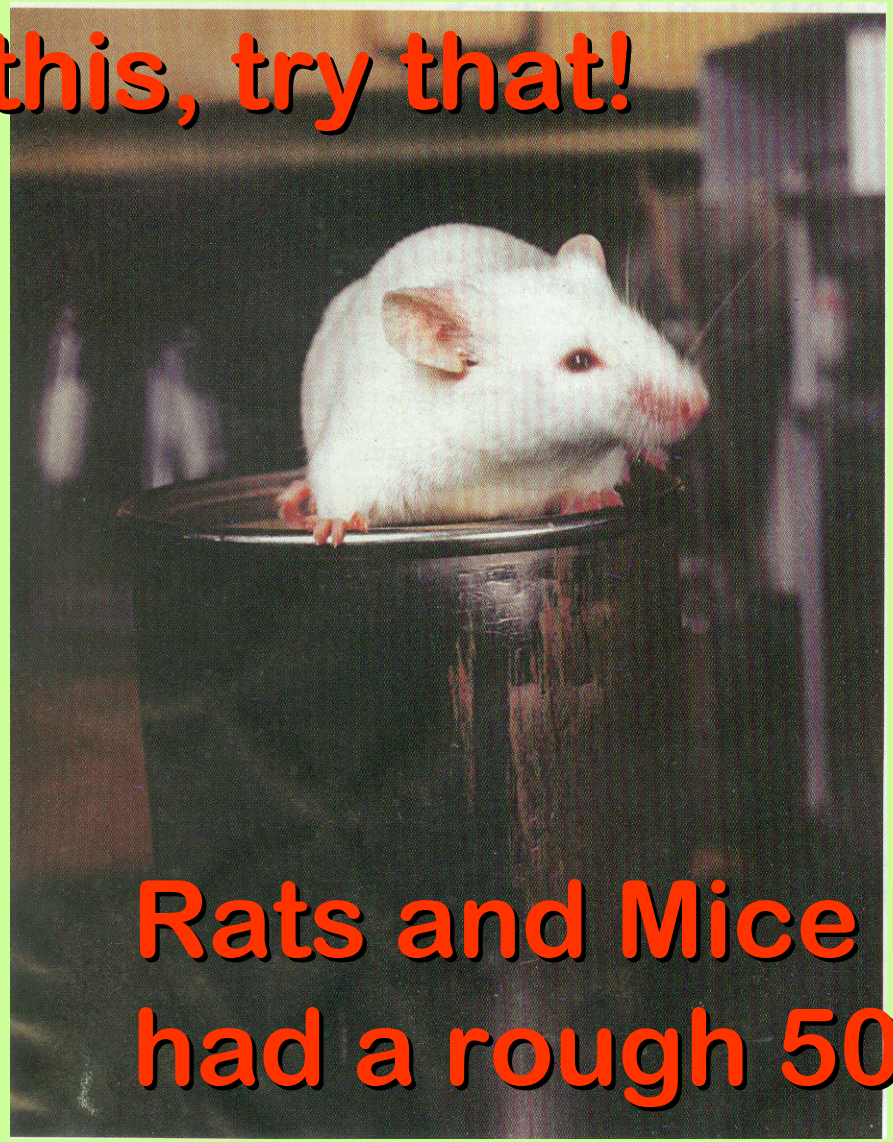
- Fresh Iceberg Lettuce
- ~317 pounds
- 6+ crates! (per day)

Hazard and Risk are not the same!

- **Hazard**
- Kinds of harm a chemical can have.
- Usually from animal testing
- Laboratory testing

- **Risk**
- Likelihood a harmful effect will happen.
- First concern is people
- Conditions of use

Take this, try that!



Rats and Mice have had a rough 50 years!

Risk

Things in our environment are not associated with risk unless a vulnerable population is exposed and harm results.

Risk$_{\text{None/Big numbers!}}$? Just a minute…

Chemicals, including pesticides, are not associated with *risk* unless a vulnerable group of people are *exposed* and show a *harmful* response.

1.Chemical

2.Exposure

3. Harm

Issues for discussion of food and pesticide residue issues…

- Be specific as possible about concerns
- Work within experience and facts
- Use results of scientific study
- Recognize uncertainty—but don't be paralyzed by what is not known
- ***The plural of anecdotal is not evidence!***


Focus consumer concern on produce as wholesome, nutritious food…

The Supply Depends Upon Your Having Vegetables and Fruits To Sell

- Pests eat lettuce---they don't pay!
- You can't afford to give lettuce away!
- If you use pesticides, there will be a very small, invisible chemical residue on organic or conventional lettuce.
- Even the amounts of the most toxic sprays are so small a person can't eat enough in a day to get the No Effect dosage for a rat!

Demonstrating safe pest management…

Six basics…

- Everything goes someplace.
- Exposure is inevitable at some level.
- Even zero isn't none!
- Exposure is not an effect.
- *How little is OK?* Usual amounts.
- What is *usual*? Heed the label.


Lettuce Spray!
acephate acetamiprid azoxystrobin BTs benefin bensulide carbaryl chloropicrin neem oil cymoxanil cyflythrin cypermethrin cyromazine diazinon 1,3-dichloropropene dicloran dimethoate dimethomorph endosulfan famoxadone fenamidone fosetyl-al glyphosate imidacloprid indoxacarb iprodione lambda-cyhalothrin malathion maneb mefenoxam metam sodium methomyl methoxyfenozide methyl bromide oxydemeton-Me paraquat permethrin propylpyzamide pyraclostrobin spinosad sulfur