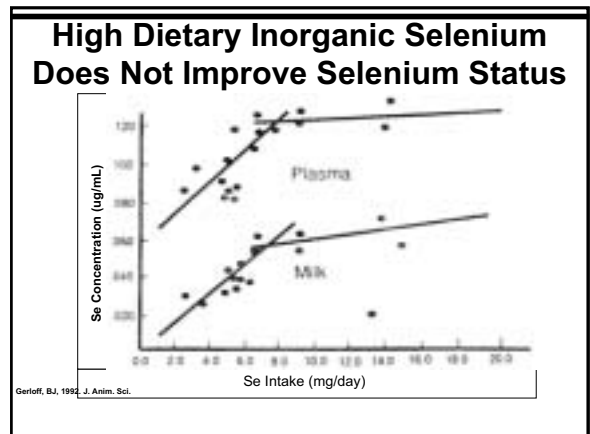
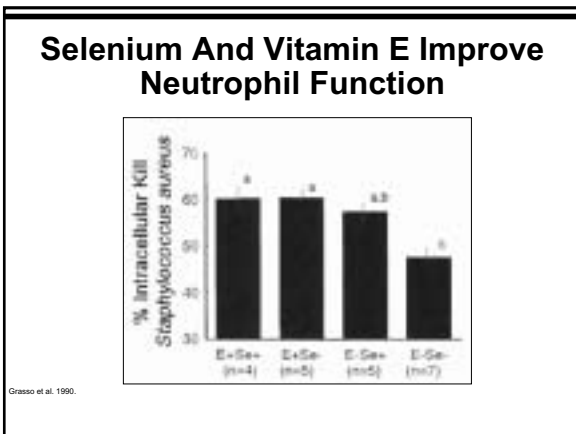
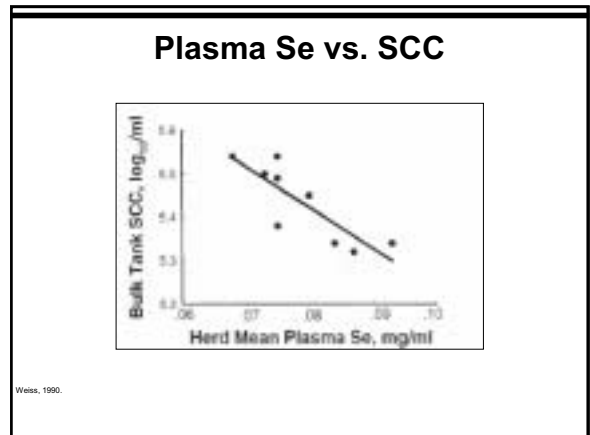
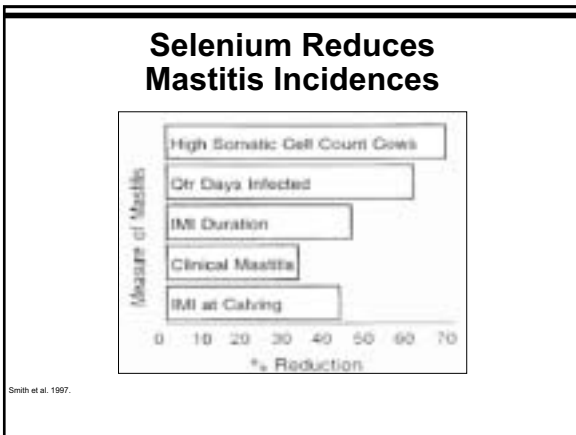
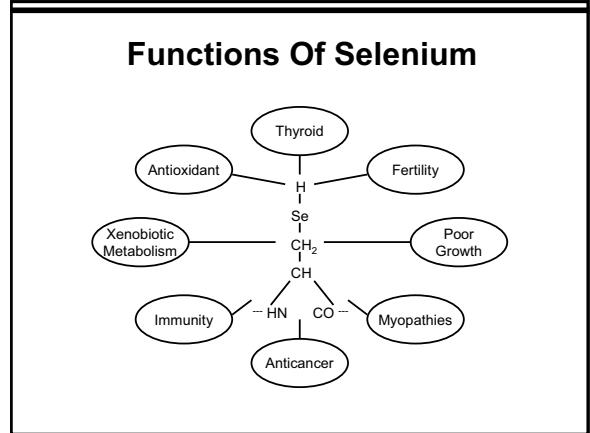


ORGANIC SELENIUM FOR RUMINANTS: WHY SHOULD PIGS AND CHICKENS HAVE ALL THE FUN?

Mark Engstrom
Diamond V Mills

**Organic Selenium for Ruminants:
Why Should Pigs and Chickens
Have all the Fun?**

Mark Engstrom
Diamond V Technical Services



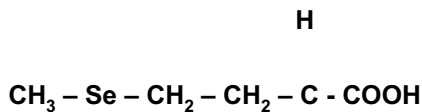
Benefits Of Selenium

- › Reduced RP Incidences
- › Reduced Severity and Prevalence of Clinical Mastitis
- › Reduced Milk SCC
- › Reduced Fertility Problems due to Metritis
- › Reduced Cystic Ovaries
- › Improved Calf Immunity and Survival
- › Reduces Vitamin E requirement (usage)
- › Promotes Thyroid Metabolism

Selenium Yeast

- › 9/3/03—FDA approved selenium yeast as a Se source for beef and dairy cattle (amended from 7/17/02 for swine, turkeys, chickens)
- › Definition includes max of 2% inorganic Se
- › Normal Se regulations and GMP's apply
- › Canada—Feed act reg. numbers

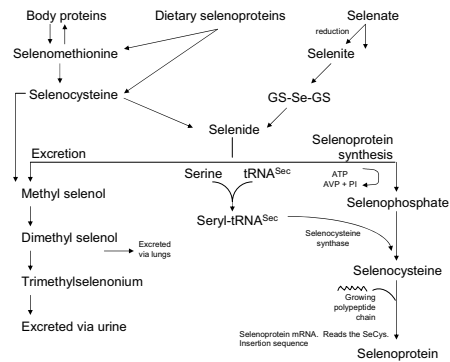
Seleno-Methionine



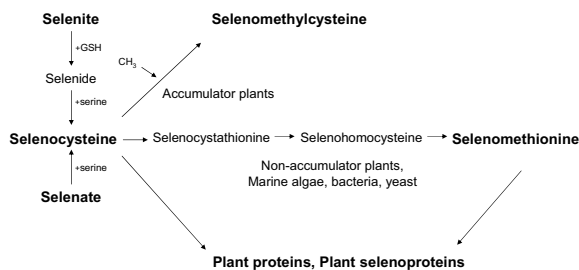
NH_3^+

Animals utilize Methionine and Selenomethionine equally

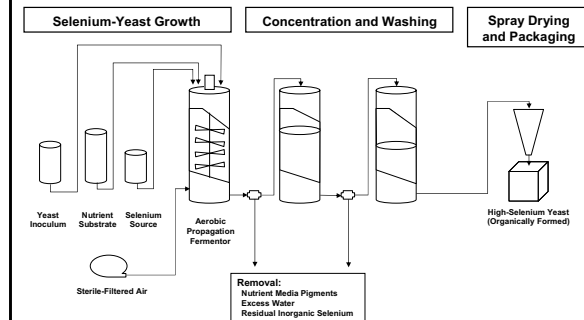
Selenium Metabolism



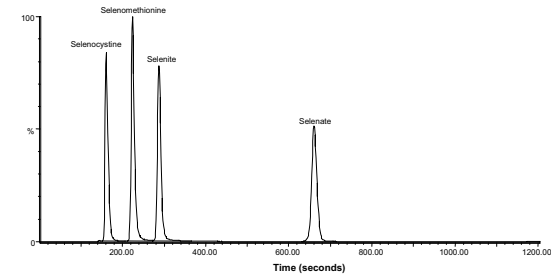
Selenium Assimilation In Yeast



Manufacturing Process For SelenoSource AF



Chromatogram Showing HPLC Trace For Selenium Standards (⁸²Se)

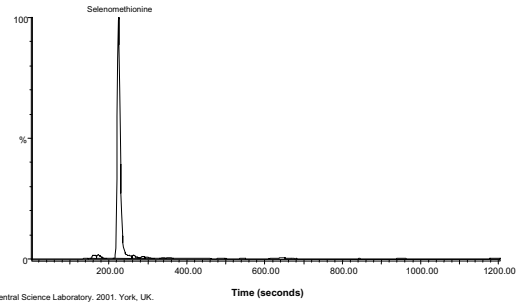


Central Science Laboratory, 2001, York, UK.

SelenoSourceAF™

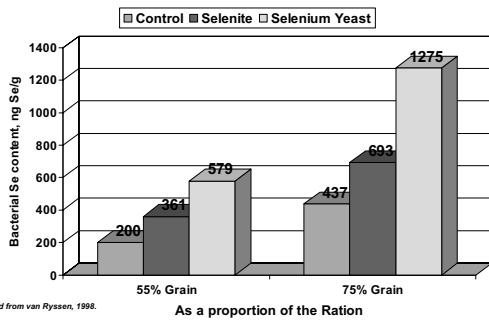
Diamond V

HPLC-Mass Spectrophotometer Trace For SelenoSourceAF



Central Science Laboratory, 2001, York, UK.

Assimilation of Selenium By Rumen Bacteria



Measurement Of Selenium Status

- ▶ Blood Selenium and Glutathione Peroxidase Activity
 - Whole Blood (90 – 120 days)
 - Blood Serum/Plasma (30 – 60 days)
 - Glutathione Peroxidase Activity (90 – 120 days)
- ▶ Liver
 - Fresh sample (90 – 120 days)
 - Glutathione Peroxidase Activity (90 – 120 days)
- ▶ Milk (7 – 14 days)

Reproductive Health

Selenium Reduced RPs, Metritis And Cystic Ovaries

Treatment	Cases		
	*Retained Placenta, %	Metritis, %	Cystic Ovaries, %
Control	32	83 ^a	50 ^a
+ Selenium	10	65 ^b	19 ^b
+ Vitamin E	28	84 ^a	44 ^a
+ Se + Vit E	11	57 ^b	19 ^b

** Different superscripts within columns differ (P < 0.05)
*Harrison and Hancock, 1999; Harrison et al. 1984

Selenium Improves Cow And Calf Immune Status

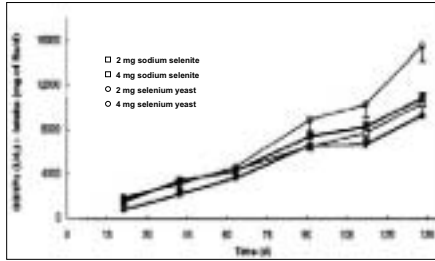
	Selenium in Salt Mixes		
	Selenite, 20 ppm	Selenite, 60 ppm	Selenium Yeast, 60 ppm
Immunoglobulins			
IgG in Serum, g/L			
Cows	22 ^a	35 ^b	31 ^b
Calves	28 ^a	31 ^{ab}	31 ^{ab}
IgG in Colostrum, g/L	70 ^c	92 ^a	78 ^b
IgM in Serum, g/L			
Cows	2.5 ^a	3.9 ^b	5.2 ^c
Calves	2.5 ^a	3.1 ^{ab}	3.9 ^b
IgM in Colostrum, g/L	2.2	3.0	2.5

** Different superscripts within rows differ (P < 0.05)
Awadeh et al. 1998.



Glutathione Peroxidase Activity

GSH-Px Activity Was Higher With Selenium Yeast



Knowles et al., 1999.

Liver Selenium

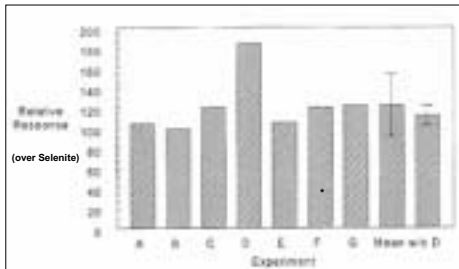
Selenium Yeast Was More Bioavailable

Diet	Selenium Conc.*	Relative Bioavailability, %
Control	920 ± 239	
2 mg Se/d Inorganic	1930 ± 317	100
2 mg Se/d Selenium Yeast	2430 ± 352	126
4 mg Se/d Inorganic	2710 ± 432	100
4 mg Se/d Selenium Yeast	3820 ± 241	145

*nmol of Se/kg of fresh liver.
Knowles et al. (1999)

Whole Blood

Selenium Yeast Was More Bioavailable Than Selenite



* Experiment G based on blood plasma
Weiss, 2002.

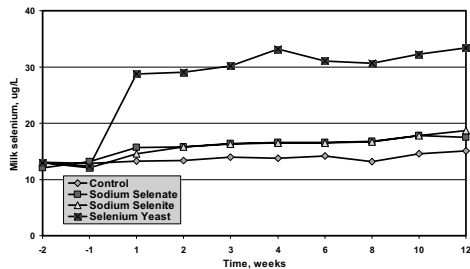
Selenium Adequacy In Holsteins

Selenium Status	Blood, ng/mL		Whole blood GSH-Px*
	Serum	Whole blood	
Deficient	<40	10 – 40	0 – 15
Marginal	40 – 70	50 – 90	15 – 25
Adequate	>70	>100	>25

*mU/mg of hemoglobin
Stowe and Heird, 1992.

Milk

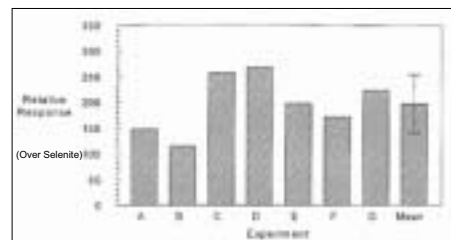
Selenium Yeast Was More Bioavailable



Adapted from Ortman and Pehrson, 1999.

Milk

Selenium Yeast Was About 2X More Bioavailable



Weiss, 2002.

Bioavailability

Selenium Yeast Has Higher Absorption And Is Retained Longer

Indicator	Inorganic Selenium	Selenium Yeast
Gut Absorption, %	100	108 – 115
Whole Blood or Plasma, %	100	100 – 130
Blood GSH-Px, %	100	100 – 128
Liver, %	100	126 – 145
Milk, %	100	120 – 270

Compiled from Knowles et al. (1999) and Weiss (2002)

Recommendations

SelenoSourceAF Has Higher Bioavailability And Is Retained Longer In The Body Than Sodium Selenite

Circumstance	Supplemental Selenium Yeast	
	% of Total Se	mg Se/kg diet
Dry	50-100%	0.15-0.3
Early Lactation, Stressed, Older Cows (>3 rd parity)	67 - 100%	0.2-0.3
Mid to Late Lactation	50%	0.15 – 0.3
Low Se Forages or High Sulfur or Iron in Soils or Water	67 – 100%	0.2 – 0.3
Calf and Heifers	50 – 100%	0.15 – 0.3

Candidate Herds For Selenium Yeast

- › High SCC
- › High RFM's
- › High metritis
- › High Sulfur water (> 500 ppm)
- › Non-responsive to 6-12 mg selenite
- › MuSe users

Selenium Requirement In Dairy

- › Requirements: 0.3 mg/kg of diet (NRC)
- › Chronic toxicity can occur when cattle are fed 5 to 40 mg of selenium/kg of diet for extended time periods
- › Acute toxicity can occur when cattle are fed 10 to 20 mg of selenium/kg of body weight
- › Signs of toxicity include sloughing of hooves, lameness, loss of hair, and emaciation