



Selisseo®

**ADISSEO**  
A Bluestar Company



# Oxidative stress in animal production: benefits of organic selenium

Le stress oxydatif en production animale: les bénéfices du Se organique

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Anne-Sophie CONJAT



# Today farm animals are Protein producers !

- The « champions » of our farms
  - Chicken : 40 g to 2400 g in 40 days, 1.7 kg feed per 1 kg chicken
  - Pork : 1 kg to 110 kg in 6 months, 2.6 kg feed per 1 kg pork
  - Dairy cow : 12 000 l milk per year i.e. 40 liters/day
  - Layer hen : 300 eggs per year, 60-65 g per egg
- Protein producers
  - through muscles (meat), eggs (the ideal balanced protein), milk (plus Calcium) ...
- Users of vegetable ingredients than humans cannot use directly : meals (soybean, rapeseed, sunflower (from which we get oils), bioethanol byproducts (DDGS), feed wheats...

# As much difference between 60's and today's sportsmen



than between 60's chickens and today's ones



# What are our challenges at the animal level?

Chicks are eating **daily** almost their digestive tract weight !



1960

Where am I supposed to put all this ?



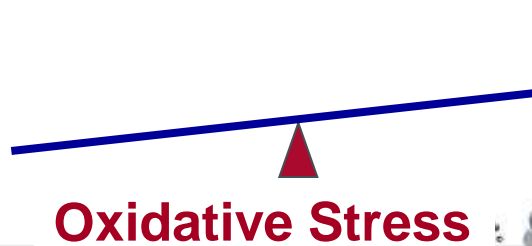
The challenge of the nutritionist: help the animal to transform feed into proteins



2012



**Excess Oxygen**  
=  
**Free Radicals**



**Anti-Oxidant Capacity**





# 3 major levels of antioxidant defence

Free radicals



**First Level**

**Breaking down Free Radicals**

(SOD, catalase,  GPx...)



**Second Level**

**Capturing Free Radicals**

(**glutathione**, vitamin E, carotenoids...)



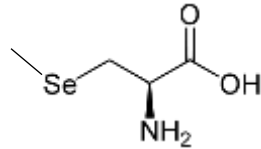
**Third Level**

**Elimination of oxidized products**

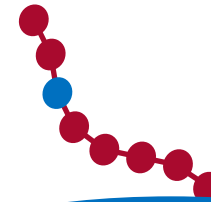
Enzymes to breakdown oxidized lipids & proteins



# SeCys the functional Se for Anti-Oxidant role



Selenomethionine  
(SeMet)

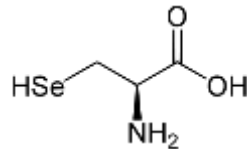


*Se storage form*

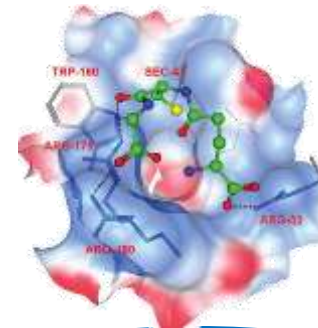
Selenium containing proteins



Trace element



**Selenocysteine:** the 21<sup>st</sup> amino acid  
(SeCys)

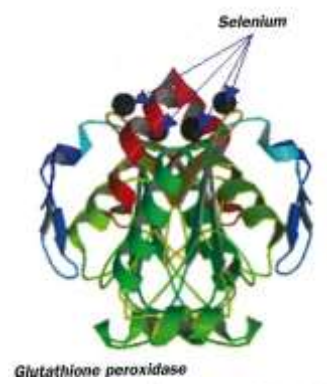
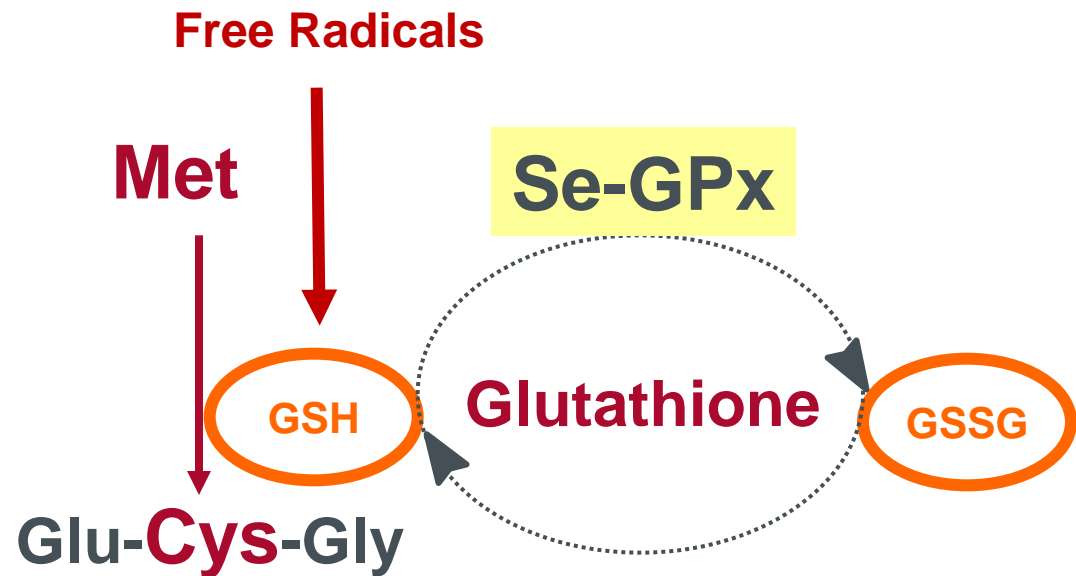


*Se as SeCys in enzyme catalytic site*

Selenoproteins

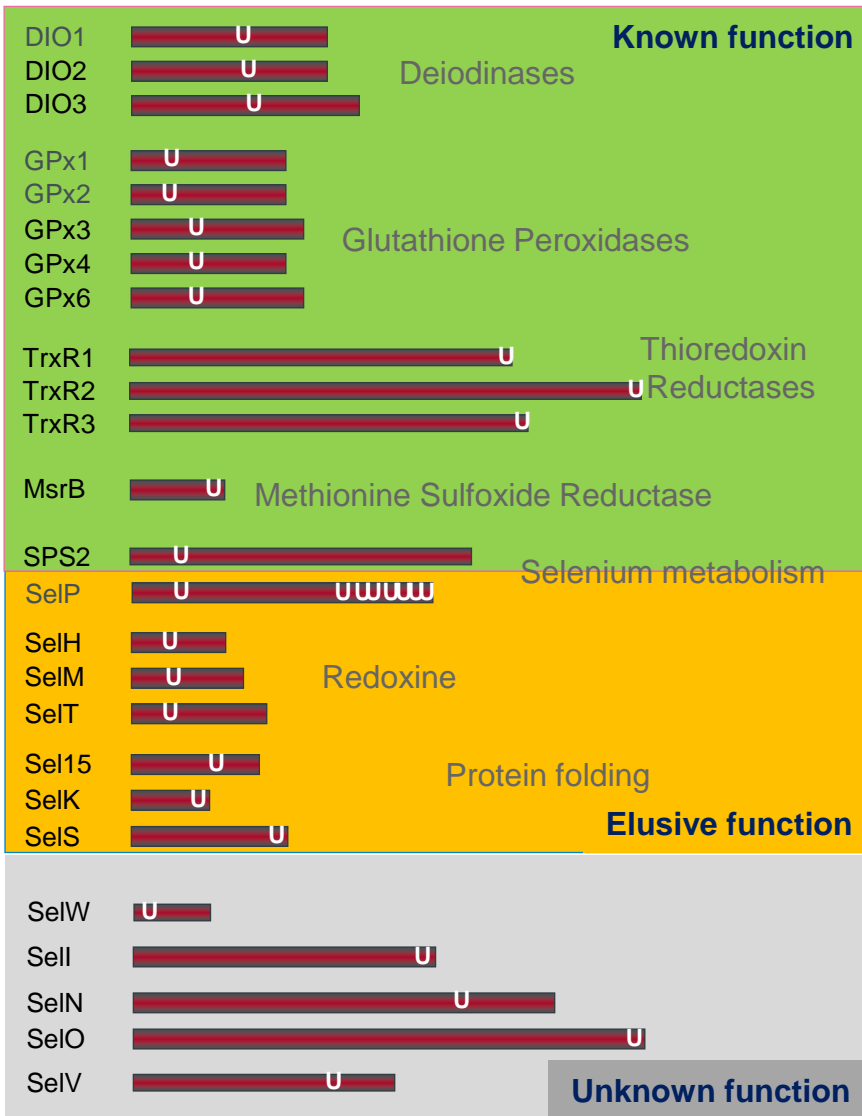


# SeCys: the functional Se





# SeCys: key for functional Selenoproteins



- DIO → Thyroid hormone activation
- GPx → Peroxide detoxification
- TrxR → Thioredoxin regeneration
- MsrB1 → Methionine reduction

**Major roles in Redox regulation**

25 Selenoproteins in most animals





# Different sources of selenium for animal feed

## Mineral Se sources

Selenate

Selenite

## Organic Se sources

SeMet

OH-SeMet

*Intestinal barrier*

SeMet

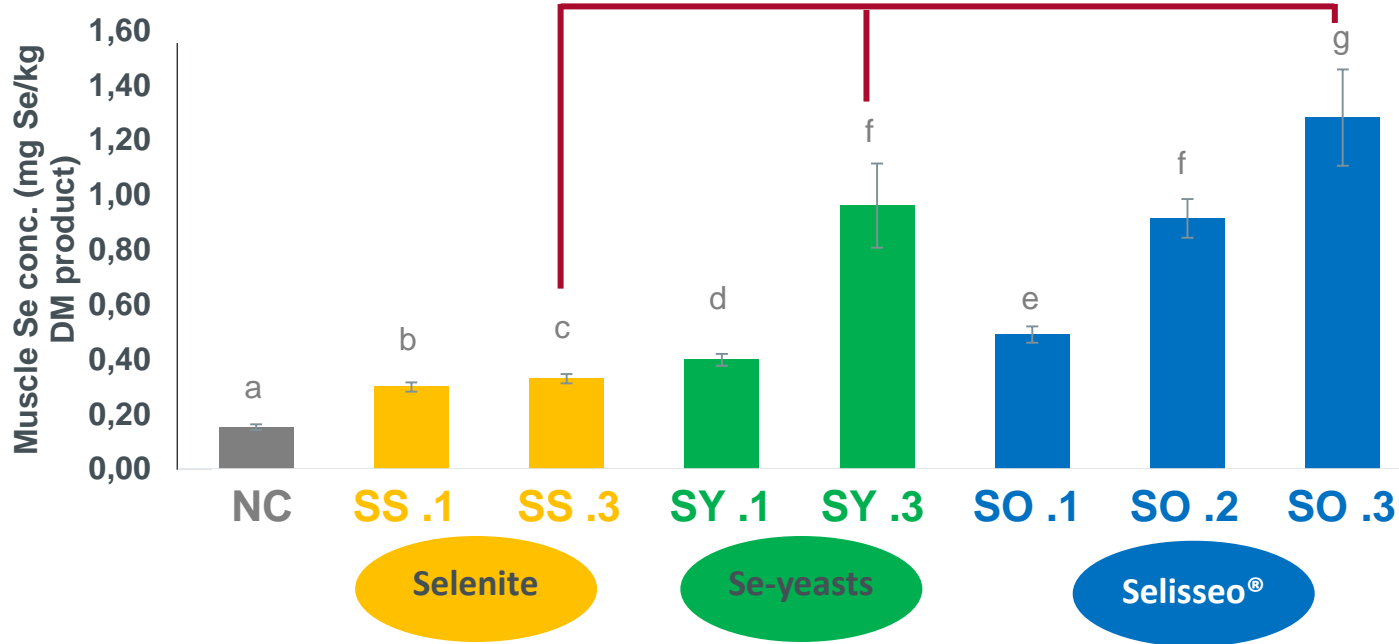
Containing  
proteins

**Selenoproteins**



# OH-SeMet more bioavailable than Se-Yeast

Broiler breast muscle Se concentration



British Journal of Nutrition (2013), 110, 415–424  
 © The Authors 2012  
 doi:10.1017/S0007114512000565

Comparative study of a new organic selenium source v. seleno-yeast and mineral selenium sources on muscle selenium enrichment and selenium digestibility in broiler chickens

Mickaël Briens<sup>1</sup>, Yves Mercier<sup>1\*</sup>, Friedrich Rouffineau<sup>2</sup>, Veronique Vaccina<sup>3</sup> and Pierre-Audré Gersert<sup>4</sup>

<sup>1</sup>Adisseo France S.A., <sup>2</sup>Urbio-Trace, Australia

Mineral

Organic but  
60% SeMet

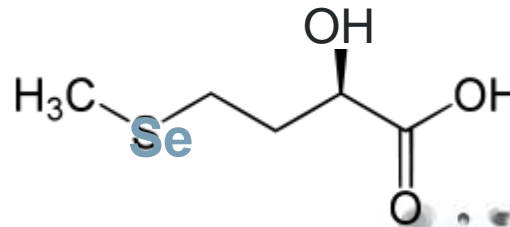
Organic and  
100% OH-SeMet

OH-SeMet or HMSeBA

**METABOLISM AND NUTRITION**

2-Hydroxy-4-methylselenobutanoic acid induces additional tissue selenium enrichment in broiler chickens compared with other selenium sources

Mickaël Briens,<sup>1\*</sup> Yves Mercier,<sup>2\*</sup> Friedrich Rouffineau,<sup>3</sup> Frédéric Merceraud,<sup>4</sup> and Pierre-Audré Gersert<sup>4</sup>

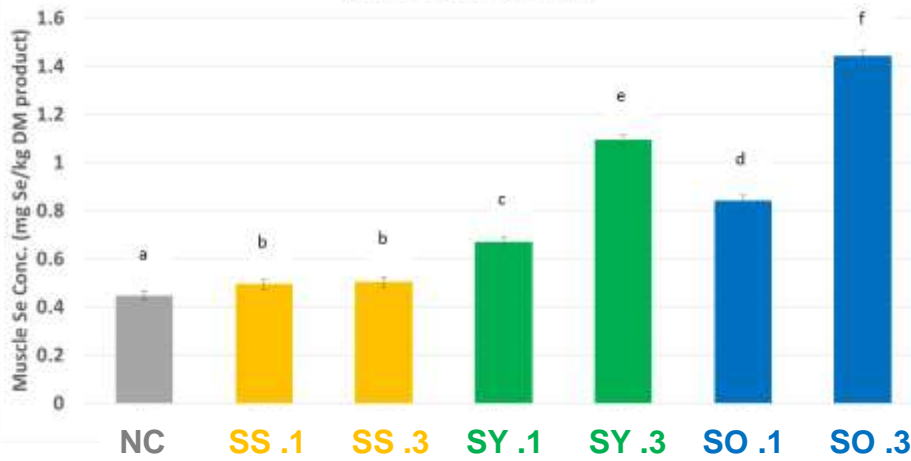


Reference: Briens et al. 2013

# OH-SeMet: more bioavailable Se source in pigs and layers



Muscle Se concentration



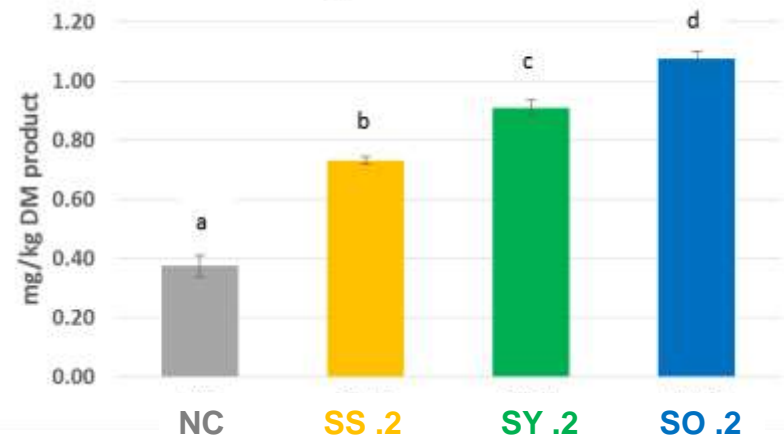
Selenite

Se-yeasts

Selisseo®



Whole egg Se concentration



**JOURNAL OF ANIMAL SCIENCE**

The Premier Journal and Leading Source of New Knowledge and Perspectives in Animal Science

**Evaluation of the efficacy of 2-hydroxy-4-methylselenobutanoic acid on growth performance and tissue selenium retention in growing pigs**  
M. Jalil, M. Briens, F. Rouffineau, P.-A. Geraert and Y. Mercier

J ANIM SCI 2014, 92:182-188.

doi: 10.2527/jas.2013-6783 originally published online December 18, 2013

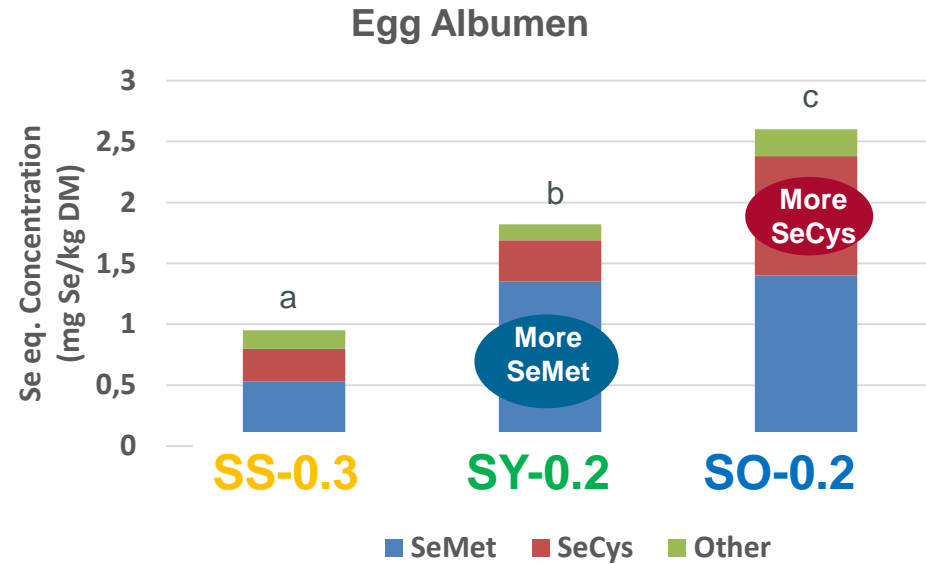
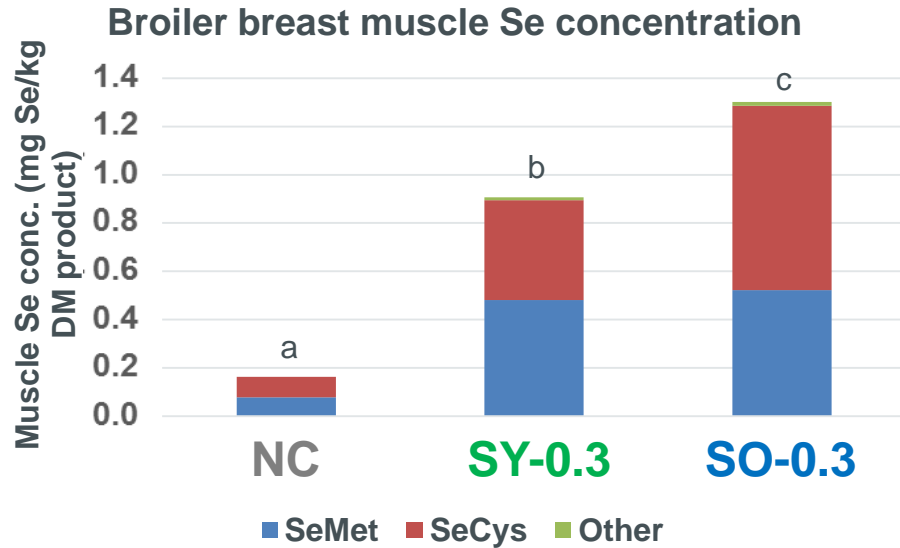
**Effect of 2-hydroxy-4-methylselenobutanoic acid as a dietary selenium supplement to improve the selenium concentration of table eggs<sup>1</sup>**

M. Jalil,\* M. Briens,\*† F. Rouffineau,\* F. Mercierand,‡ P.-A. Geraert,\* and Y. Mercier\*‡

\*Adisseo France S.A.S., 10, Place du Général de Gaulle, 92160 Antony, France; †Institut de Biologie Moléculaire et Cellulaire, 15, Rue René Descartes, 67084 Strasbourg, France; and ‡INRA, UR83, Recherches Avicoles, F-37380 Nouzilly, France



# More functional SeCys with OH-SeMet than Se-Yeasts

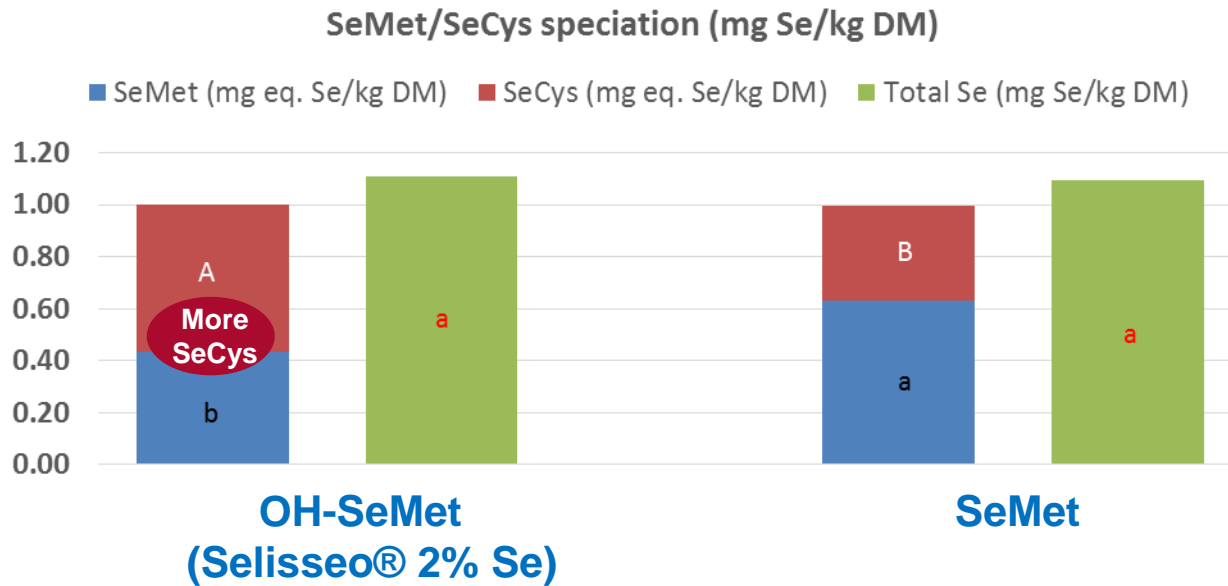


-Organic Se sources are more efficiently transferred  
 -OH-SeMet promotes the functional form of Se: **SeCys**





# Even more SeCys with OH-SeMet vs SeMet



- OH-SeMet: a source of functional Se as SeCys even when compared to pure SeMet
- 7d chick trial





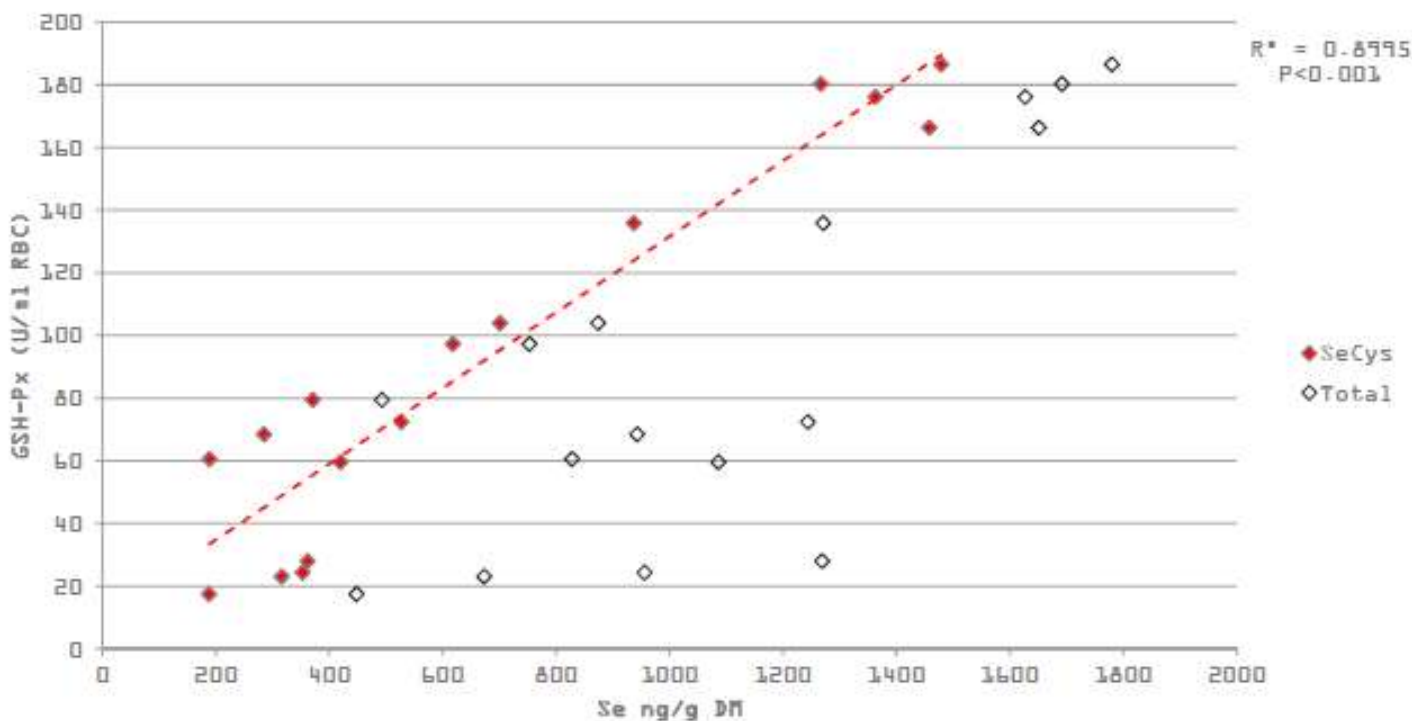


# More SeCys would mean more AOX activity

## Blood



### Correlation between whole blood SeCys and GSH-Px activity



Juniper & Bertin, 2011

Mean data taken from sheep, cattle, turkey



# What benefits from organic selenium ?

Better reproduction, Increased hatchability.  
Enhanced live piglets and day old chicks.



Less drip loss, less...  
Better shell strength...  
Enriched Selenium

**Better  
Reproduction**

**Meat & Egg  
Quality**

Less...er stress.  
drop

**Stress  
Resistance**

# OH-SeMet influences breeder & progeny AOX status

Broiler breeders

Progeny

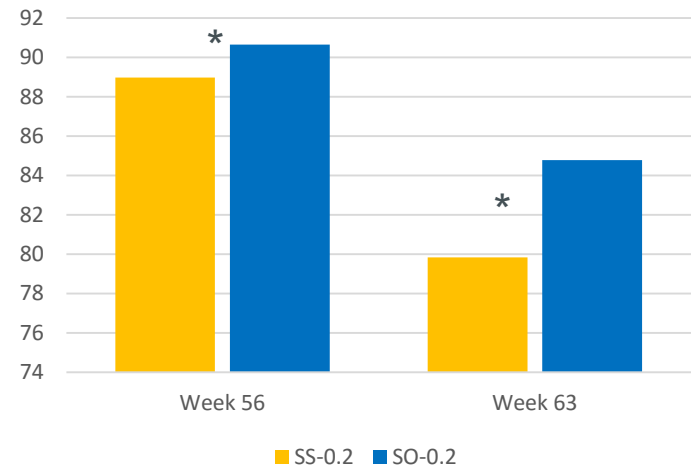


Fed from week 52 to 63:

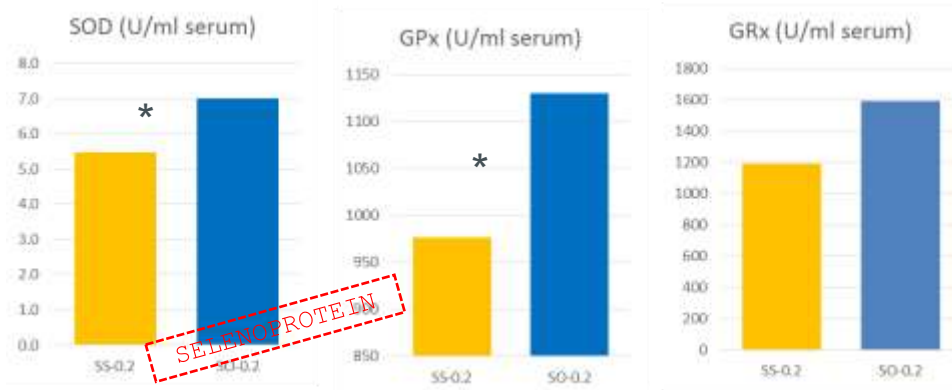
- Sodium selenite (SS)
- OH-SeMet or Selisseo® (SO)

Raised under chronic heat stress (India)

Hatchability (%)



## Enhancing animal AOX status



**SELENIUM PROTEIN**

# OH-SeMet the efficient Se for breeders



| Parameters                           | OH-SeMet       | SeY          |
|--------------------------------------|----------------|--------------|
| Fertility rate (%)                   | 96.57 ± 0.71 * | 93.02 ± 1.91 |
| No. chicks hatched alive             | 224 ± 15.6     | 212 ± 13.1   |
| Hatching yield (%)                   | 64.00 ± 4.47   | 60.64 ± 3.74 |
| Shell strength (kg/cm <sup>2</sup> ) | 3793 ± 173.1 * | 3599 ± 152.9 |
| Haugh unit                           | 74.3 ± 1.79    | 70.86 ± 1.37 |

8 weeks  
supplementation at  
0.3 ppm  
10 replicates

OH-SeMet or Selisseo®

**+ 12 chicks over 350 eggs**





# What benefits from organic selenium ?



Less mortality under stress.  
Less performance drop during weaning.  
Better performance under heat stress,  
dietary challenges, immune challenges



# OH-SeMet for a better start of growth

Broiler breeders



x



Progeny



Fed for 3 months  
with different Se sources at 0.2 ppm:

- Sodium selenite (**SS**)
- Se-yeast (**SY**)
- Selisseo® or OH-SeMet (**SO**)

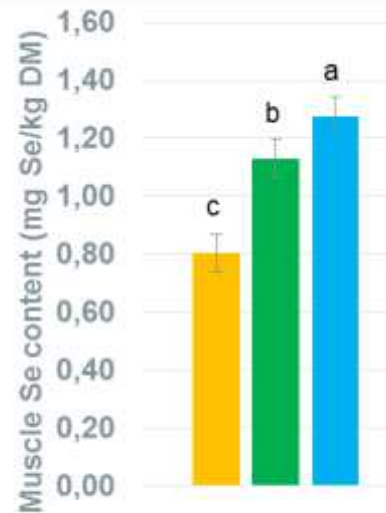
Raised under standard  
conditions (France)

Fed only **SS**:



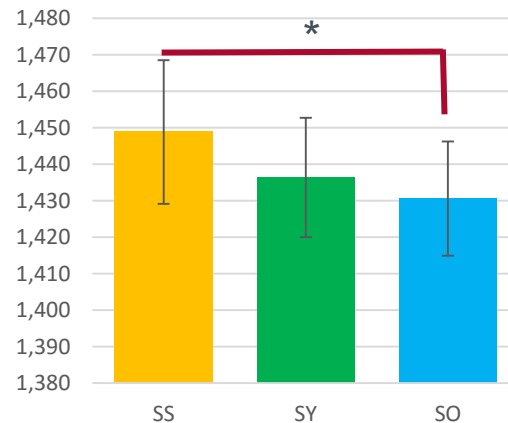
## Selenium as OH-SeMet

- Efficiently transferred to progeny
- Optimal growth of the progeny



Day old chick muscle Se level

## FCR(0-21 days)



# OH-SeMet for better growth under hot conditions



**Broiler Chickens**  
Male Arbor Acres  
0 to 35 days

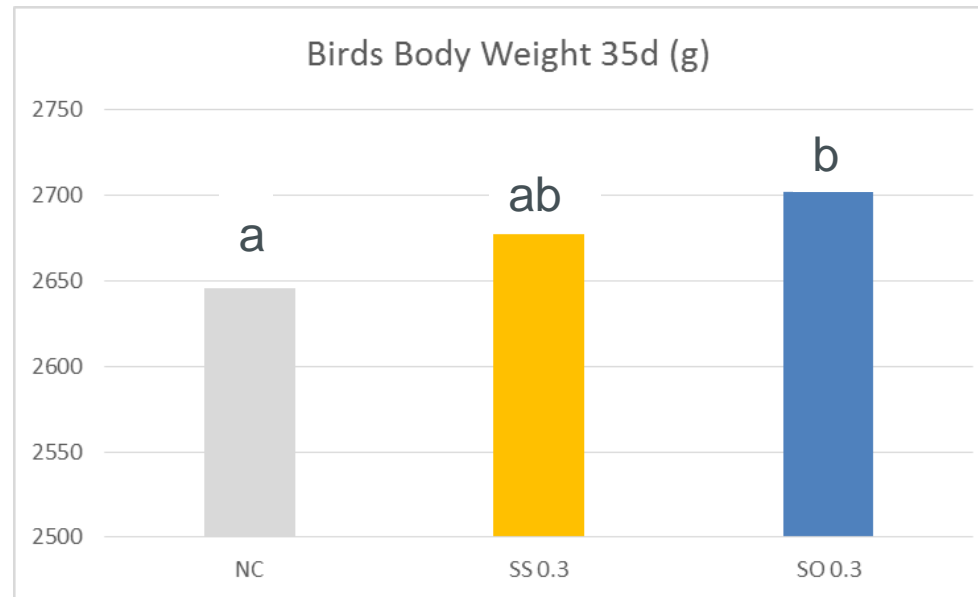
*Raised under Mild  
Chronic Heat Stress  
(Thailand)*  
⚡ -29-33°C  
-90% RH



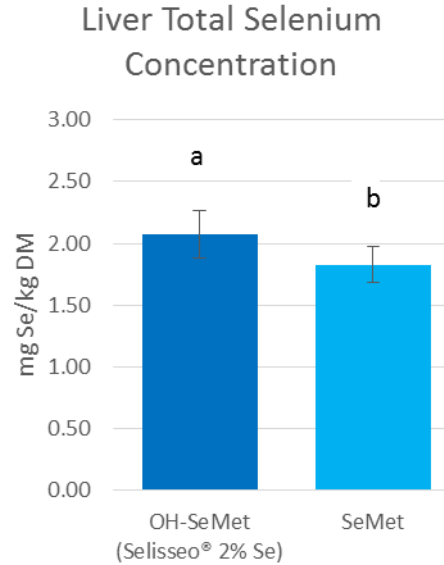
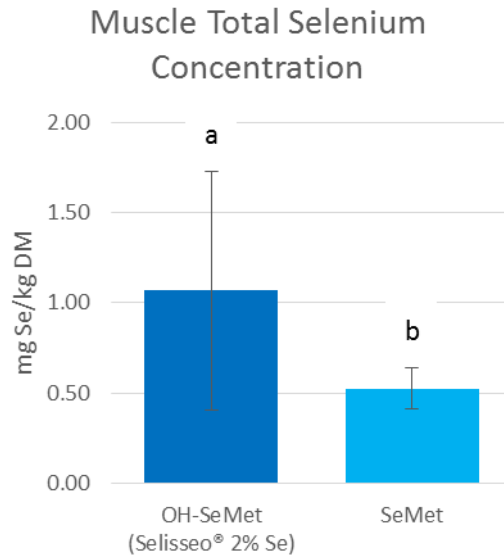
NC  
SS  
SO

no Se added  
selenite  
OH-SeMet

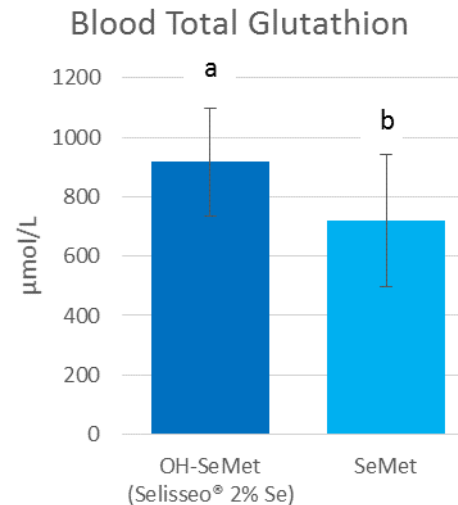
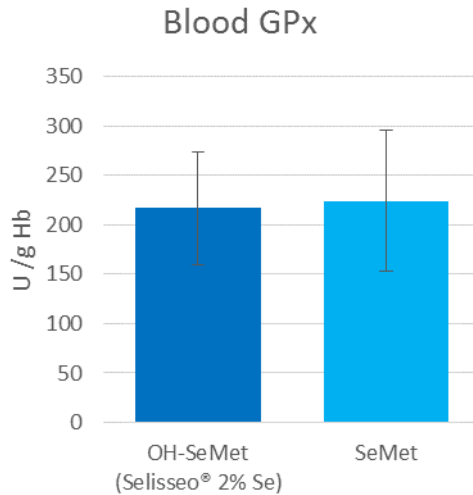
0.3 ppm Se  
0.3 ppm Se



# OH-SeMet an efficient source in fattening pigs



**Supplemented for 8 weeks  
at 0.2 ppm Se**



# What benefits from organic selenium ?



Meat & Egg  
Quality

Less drip loss, less oxidation  
Better shell strength.  
Enriched Se egg/meat.



# OH-SeMet effects the PUFA egg content

|                                | Control | HMSeBA | SEM   | <i>P</i> value |
|--------------------------------|---------|--------|-------|----------------|
| Yolk fatty acid, % on total FA |         |        |       |                |
| C16:0 palmitic                 | 25.40   | 24.20  | 0.059 | 0.012          |
| C16:1 n-7 palmitoleic          | 2.40    | 2.00   | 0.044 | 0.053          |
| C17:0 margaric                 | 2.16    | 1.20   | 0.029 | 0.015          |
| C18:0 stearic                  | 8.94    | 8.40   | 0.035 | 0.062          |
| C18:1 n-9 oleic                | 31.10   | 32.00  | 0.056 | 0.009          |
| C18:2 n-6 linoleic             | 18.50   | 19.50  | 0.038 | 0.012          |
| C20:4 n-6 arachidonic          | 6.80    | 7.50   | 0.022 | 0.041          |
| C22:6 n-3 DHA                  | 4.70    | 5.20   | 0.031 | 0.039          |
| Σ SFA                          | 36.50   | 33.80  | 0.097 | 0.023          |
| Σ MUFA                         | 33.50   | 34.00  | 0.115 | 0.061          |
| Σ PUFA                         | 32.16   | 33.40  | 0.101 | 0.022          |

*DHA* docosahexaenoic acid, *SFA* saturated fatty acids, *MUFA* monounsaturated fatty acids, *PUFA* polyunsaturated fatty acids

Tufarelli et al., 2015

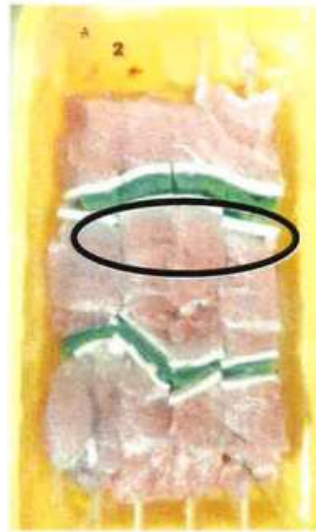


# Color of meat : an issue for the consumers

- Thigh meat color influences consumer behavior



Grade 1



Grade 4

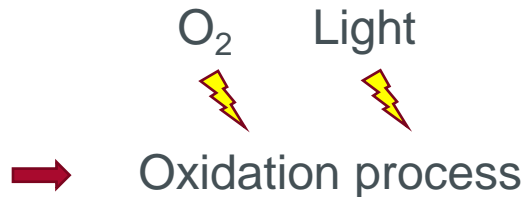


Not sold  
Economical loss

Day 1 Day 10

## Color

- pHu,
- Myoglobine
- Microbiology

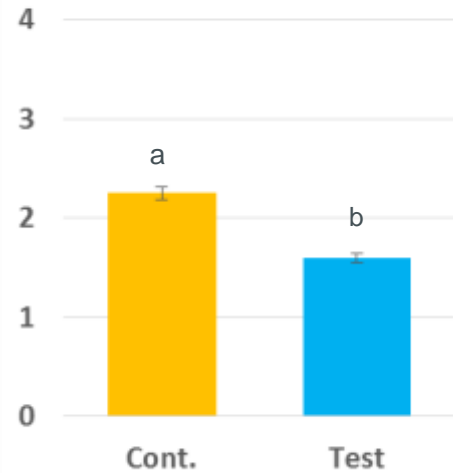




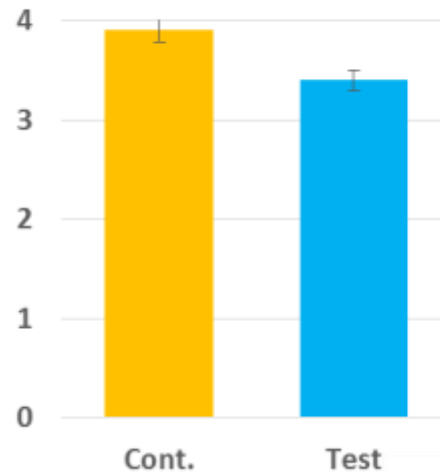
# OH-SeMet improved meat color stability



Scoring Day 8



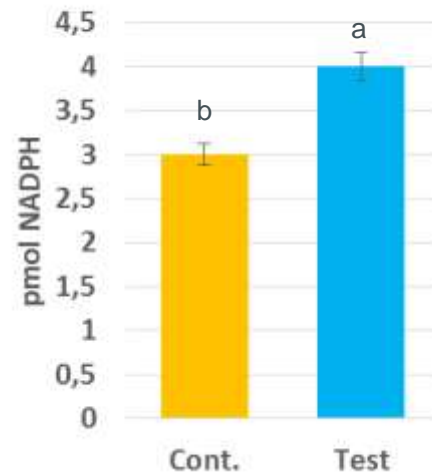
Scoring Day 13



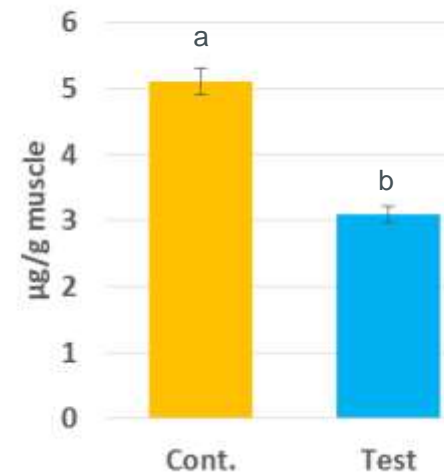
4 weeks supplementation 0.2 ppm  
OH-SeMet (Test) vs Selenite (Cont.)  
Grade Maker male Turkeys

a  
b

GPx muscle Day 1



MDA muscle Day 13

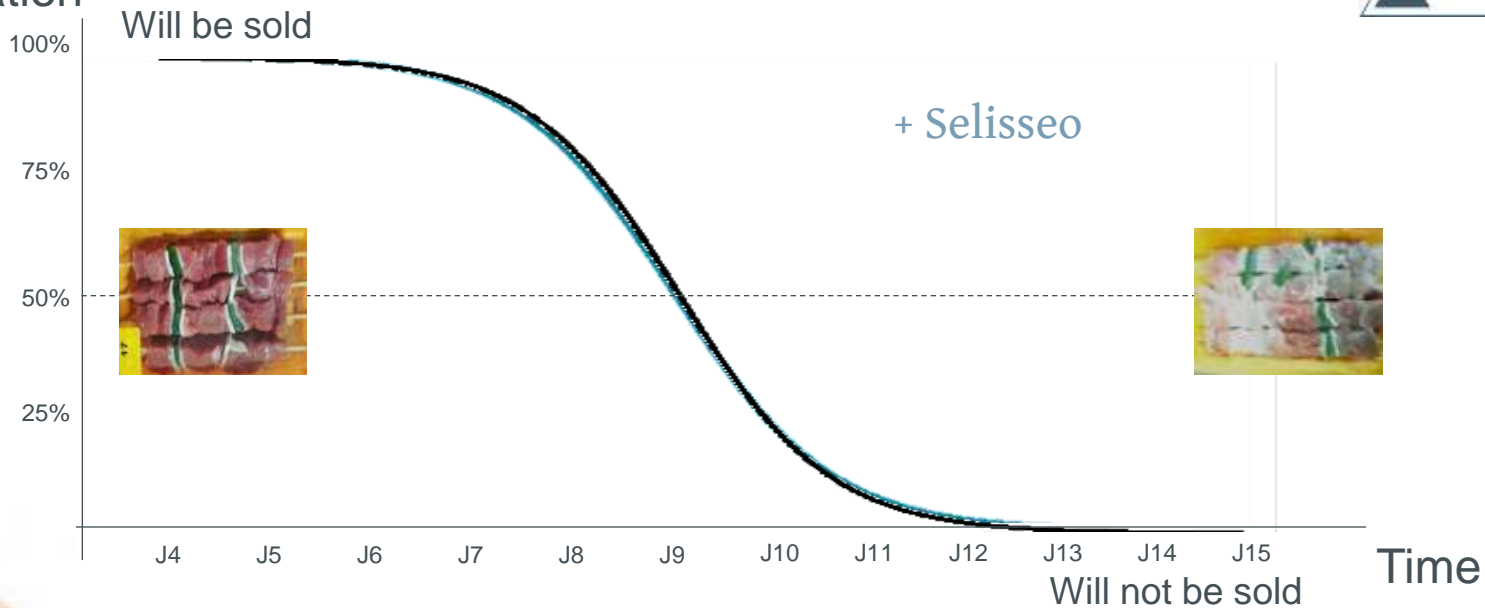


# Better quality of meat and eggs



Coloration

Turkey thigh meat



OH-SeMet improves meat color stability  
 +1,5 days of storage\*  
 i.e.  
 54% saleable after 10d (vs # 8% with Selenite)\*

OH-SeMet is a tool for meat producers

\* = results of trials done on turkey thigh meat.

Turkey were supplemented with Selisseo 4 weeks before slaughter.



## Take Home Messages

- Animals can be used as models for humans for antioxidant purpose
- High growth genetic potential = High Feed Intake = Higher Metabolism thus Oxidative Stress
- Enhancing synthesis of selenoproteins (SeCys) will improve the resistance to stress
  
- Our animals do not read the menus !!!
- When it works, it works !!





# However what about Feed additives and Health claims?

- Se is not considered as an anti-oxidant, it is a trace mineral
- Thus organic Se such as OH-SeMet is considered a source of Se and not an anti-oxidant
- OH-SeMet is registered in EU (EFSA and EC) as a Nutritional Additive, Trace minerals
- Antioxidants: only considered as in feed antioxidants (technological additives), there is no AOX category for the animals
- We cannot claim antioxidant benefits of new sources of Se even if everybody knows the role of Se in selenoproteins
- A new source of Se could also be registered as a Zootechnical additive thus with a specific dossier on benefits which cannot be health claims

