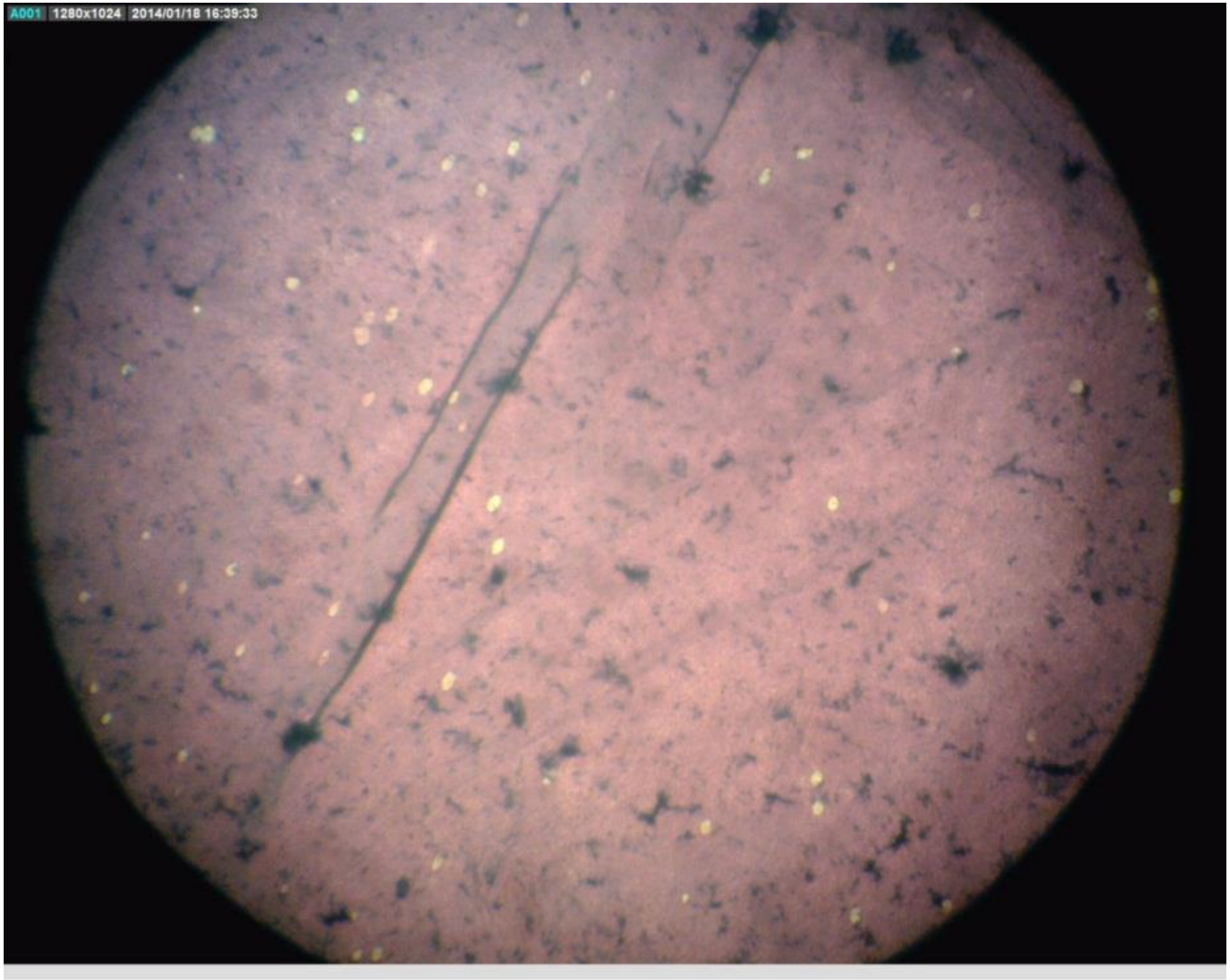
زهر دانشی چون سخن بشنوی      از آموختن یک زمان نغنوی

# مواد مغذی میکرو

## باروری و جوجه درآوری

Speaker: M. Zaghari

Available at: www.minatoyoor.com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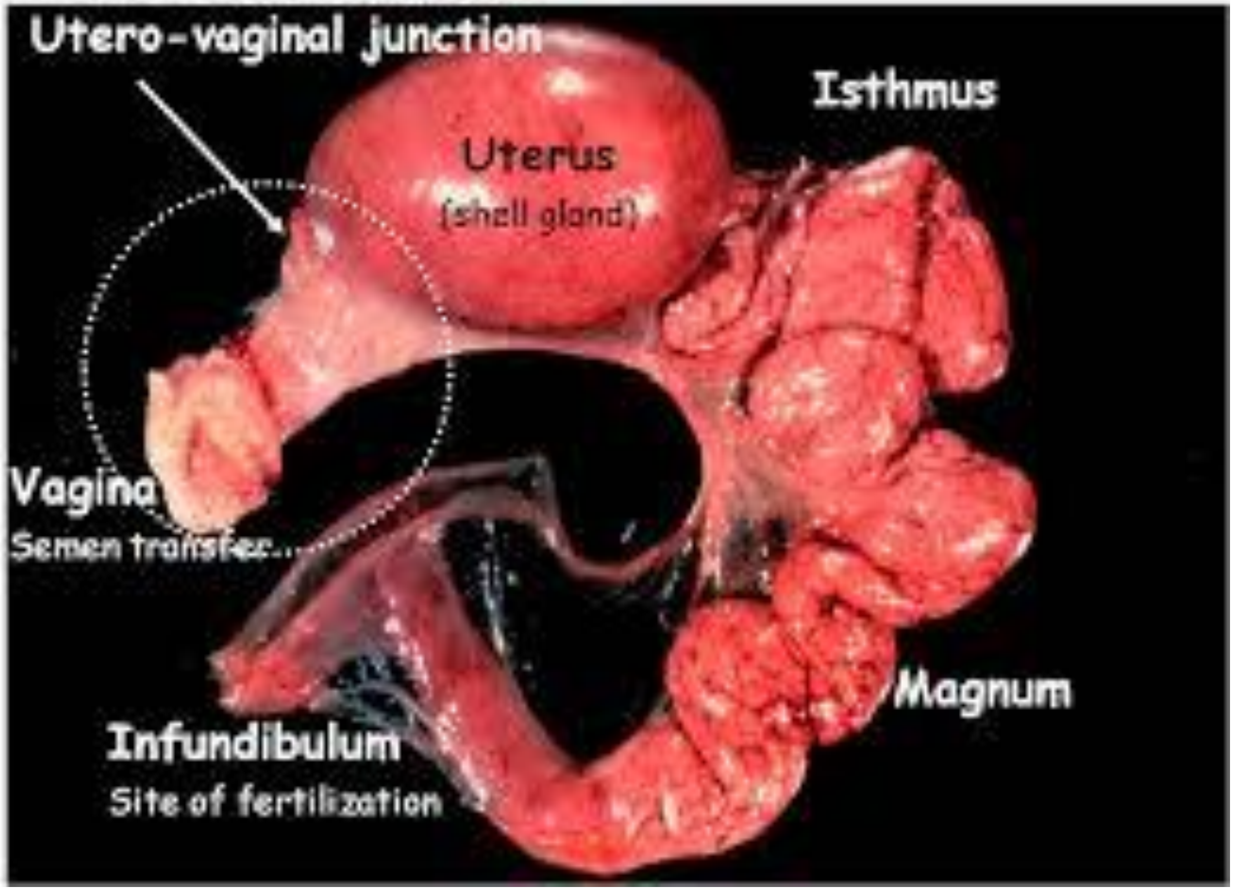
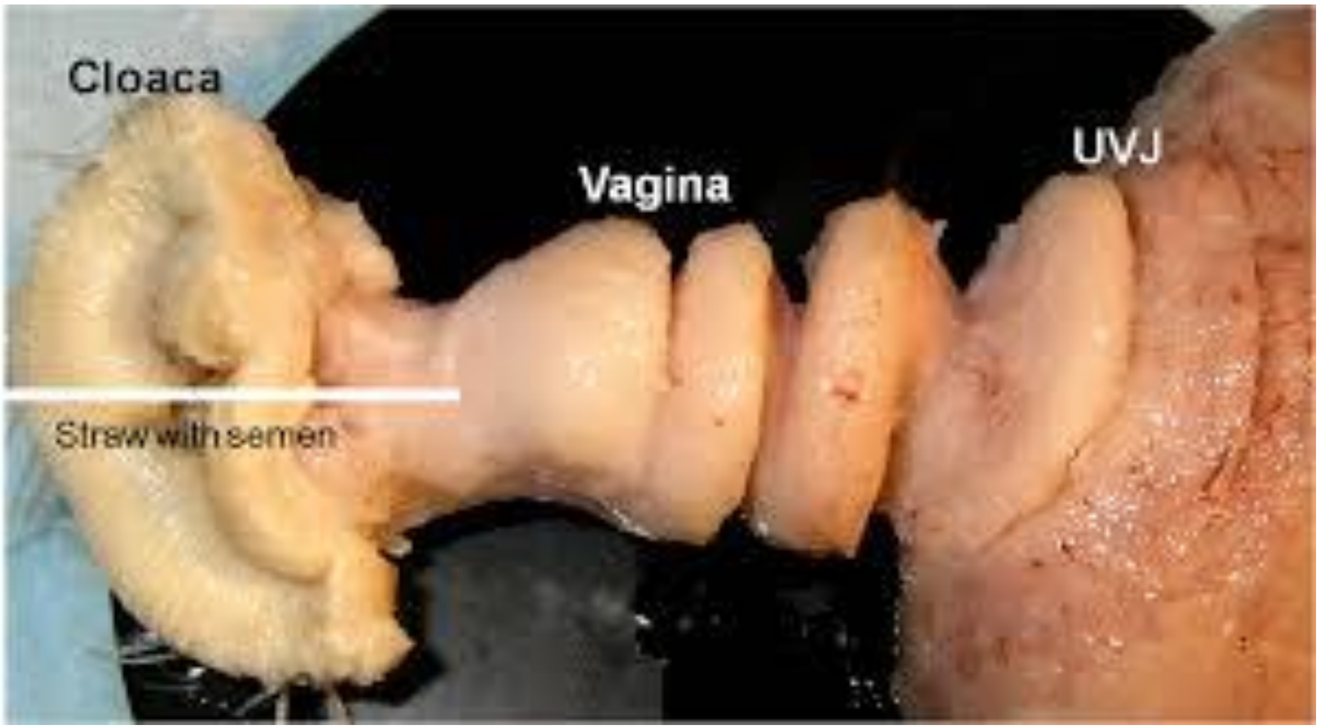
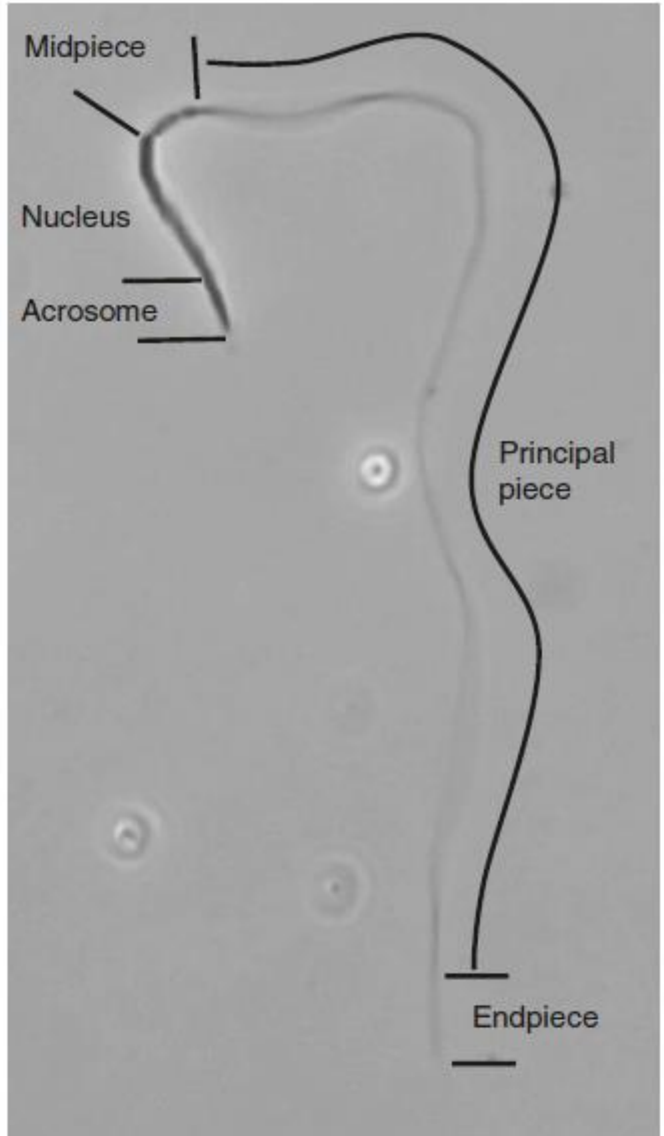

Utero-vaginal junction
Isthmus
Uterus
(shell gland)
Vagina
Semen transfer...
Magnum
Infundibulum
Site of fertilization


Cloaca
Vagina
UVJ
Straw with semen


Midpiece
Nucleus
Acrosome
Principal piece
Endpiece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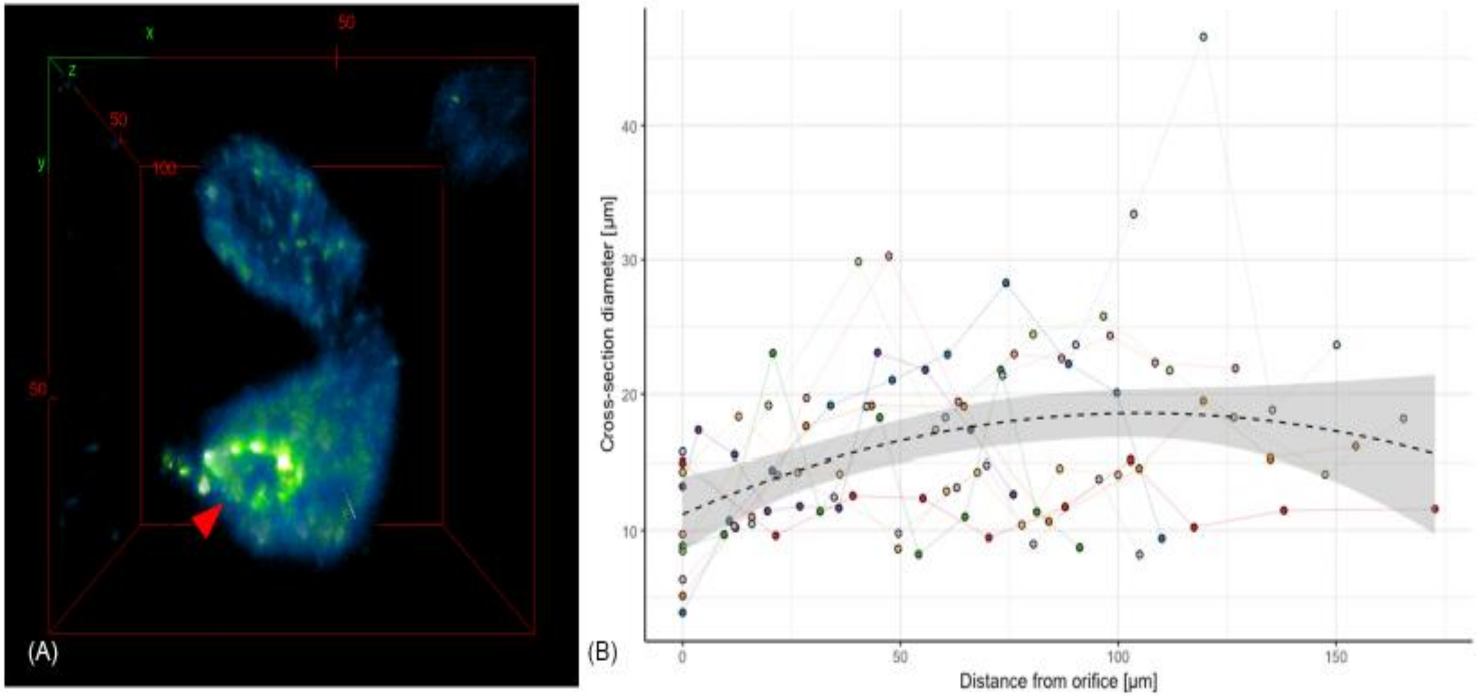
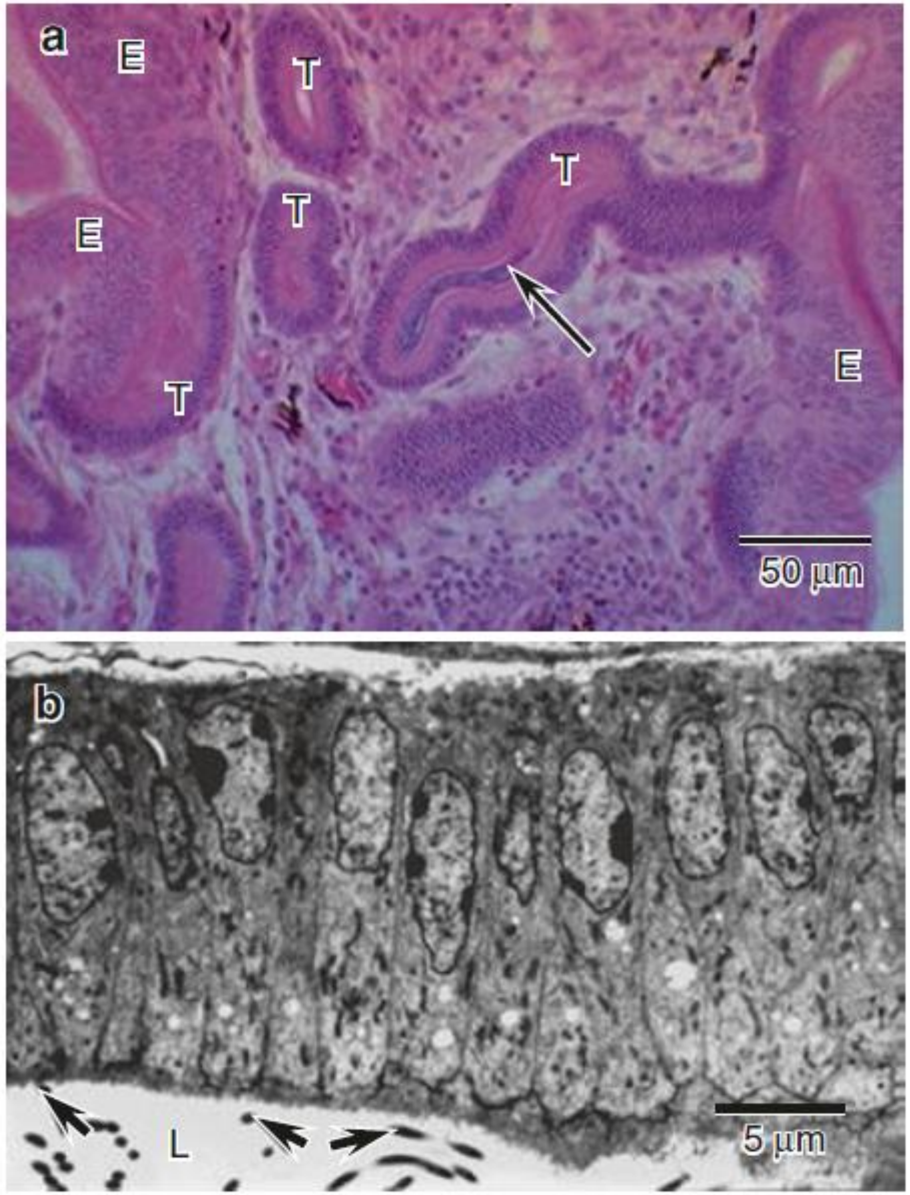
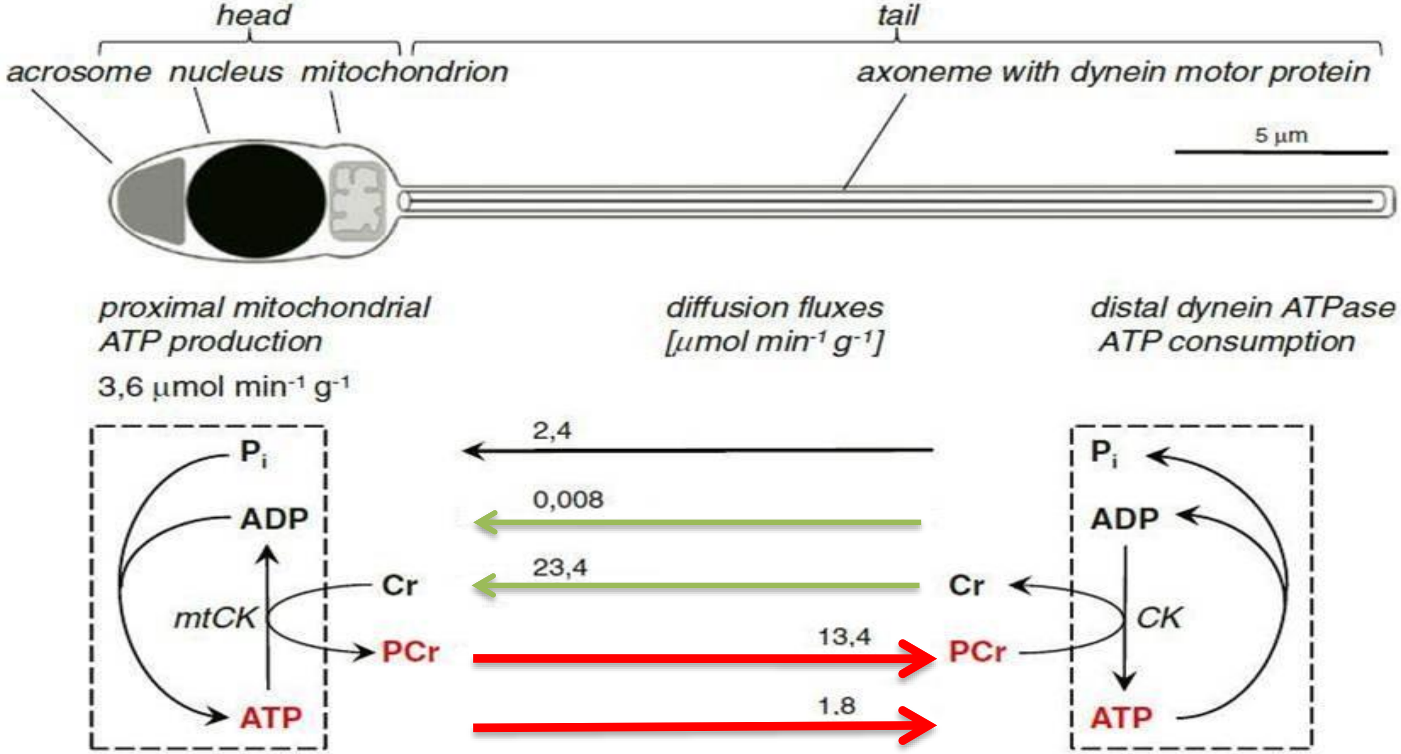
10.0 um



x
50
z
y
50
100
50
(A)
(B)
Cross-section diameter [µm]
40
30
20
10
0
50
100
150
Distance from orifice [µm]


a
E
T
T
T
E
T
E
50 µm
b
L
5 µm




Wallimann et.al, 2011

## Embryo Mortalities , Vitamins and Minerals Deficiencies

| Vitamin/Mineral | Stage of Incubation | | | |
|---|---|---|---|---|
| | Early | Mid-term | Mid to late | Late |
| A | × | | | |
| D | | | | × |
| E | × | | | × |
| K | | | | × |
| B1 | × | | | × |
| B2 | | × | × | × |
| B3 | × | | × | |
| B5 | × | | × | × |
| B6 | | | × | |
| H | × | | | × |
| B9 | | | | × |
| B12 | | × | × | × |
| Ca | | | | × |
| P | | × | | × |
| Mg | | | | × |
| Cu | × | | | |
| I | | | | × |
| Mn | | | | × |
| Se | × | | | × |
| Zn | | × | | × |


B9
A
D
B1
K
C
B2
B3
B6
B7
B5
B12
E

# ROSS 308 PARENT STOCK: Nutrition Specifications

## Female Parent Stock Nutrient Specifications

| ADDED TRACE MINERALS PER KG | | | | | |
|---|---|---|---|---|---|
| Copper | mg | 16 | | 10 | |
| Iodine | mg | 1.25 | | 2.00 | |
| Iron | mg | 40 | | 50 | |
| Manganese | mg | 120 | | 120 | |
| Selenium | mg | 0.30 | | 0.30 | |
| Zinc | mg | 110 | | 110 | |
| | | | | | |
| **ADDED VITAMINS PER KG** | | **Wheat based feed** | **Maize based feed** | **Wheat based feed** | **Maize based feed** |
| Vitamin A | IU | 11000 | 10000 | 12000 | 11000 |
| Vitamin D3 | IU | 3500 | 3500 | 3500 | 3500 |
| Vitamin E | IU | 100 | 100 | 100 | 100 |
| Vitamin K (Menadione) | mg | 3 | 3 | 5 | 5 |
| Thiamin (B1) | mg | 3 | 3 | 3 | 3 |
| Riboflavin (B2) | mg | 6 | 6 | 12 | 12 |
| Nicotinic Acid | mg | 30 | 35 | 50 | 55 |
| Pantothenic Acid | mg | 13 | 15 | 13 | 15 |
| Pyridoxine (B6) | mg | 4 | 3 | 5 | 4 |
| Biotin | mg | 0.20 | 0.15 | 0.30 | 0.25 |
| Folic Acid | mg | 1.50 | 1.50 | 2.00 | 2.00 |
| Vitamin B12 | mg | 0.02 | 0.02 | 0.03 | 0.03 |

Lee Russell McDowell

# VITAMINS IN ANIMAL AND HUMAN NUTRITION

SECOND EDITION

Iowa State University Press / Ames

Fig. 10.6 Pantothenic acid deficiency in a turkey with dermatitis on lower beak and at angle of mouth (lower turkey). Sticky exudate that formed on the eyelid resulted in encrustation and caused swollen eyelids to remain stuck together. Normal turkey above is the control. (Courtesy of T.M. Ferguson [deceased] and J.R. Couch, Texas A&M University.)

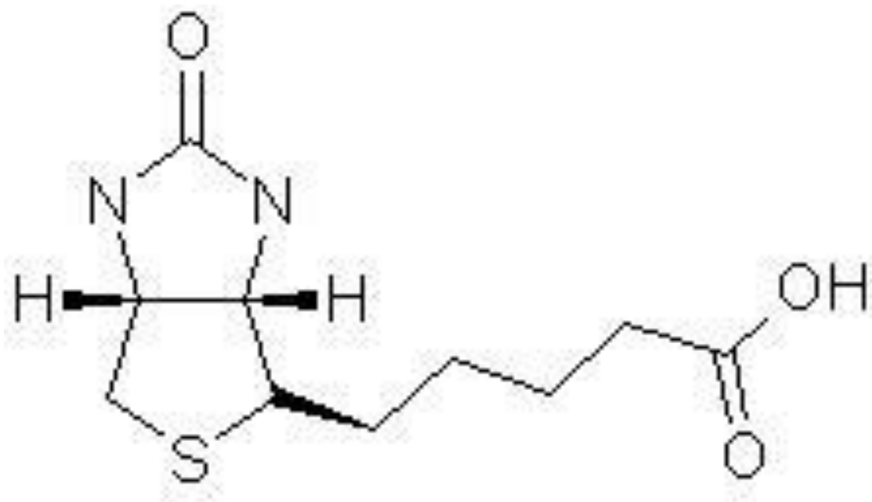
feet is evident over the toes, in contrast to biotin defic
marily affects the foot pads and is often
acid deficiency.

Signs of

They found that the hens required addition of 1.0 mg/kg for optimum egg production, at least 4.0 mg/kg for maximum hatchability, and 8.0 mg/kg for optimum hatchability and viability of offspring.

...rmally affect egg production ...ability, and chicks that hatch may be too ... Embryonic mortality in pantothenic acid deficiency oc-...s usually during the last few days of incubation. A direct linear relationship exists between diet pantothenic acid and hatchability. Beer et al. (1963) fed a purified diet to White Leghorn hens that contained 0.9 mg of pantothenic acid per kilogram of diet. They found that the hens required addition of 1.0 mg/kg for optimum egg production, at least 4.0 mg/kg for maximum hatchability, and 8.0 mg/kg for optimum hatchability and viability of offspring. Dawson et al. (1962) reported that turkey breeder hens fed a diet deficient in pantothenic acid demonstrated a high embryonic mortality during the first week of development. After 17 days, the surviving embryos were small and poorly feathered, and showed signs of edema, hemorrhaging, fatty livers, and pale dilated hearts.

# Biotin




Imidazole ring with valeric acid side chain

$C_{10}H_{16}N_2O_3S_1$

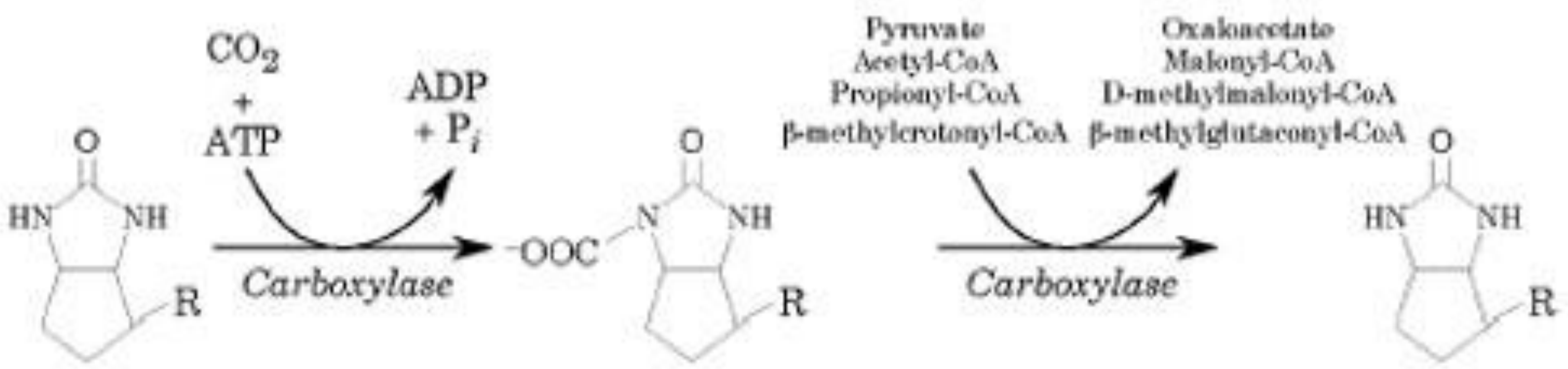
MW: 224.31 g/mol

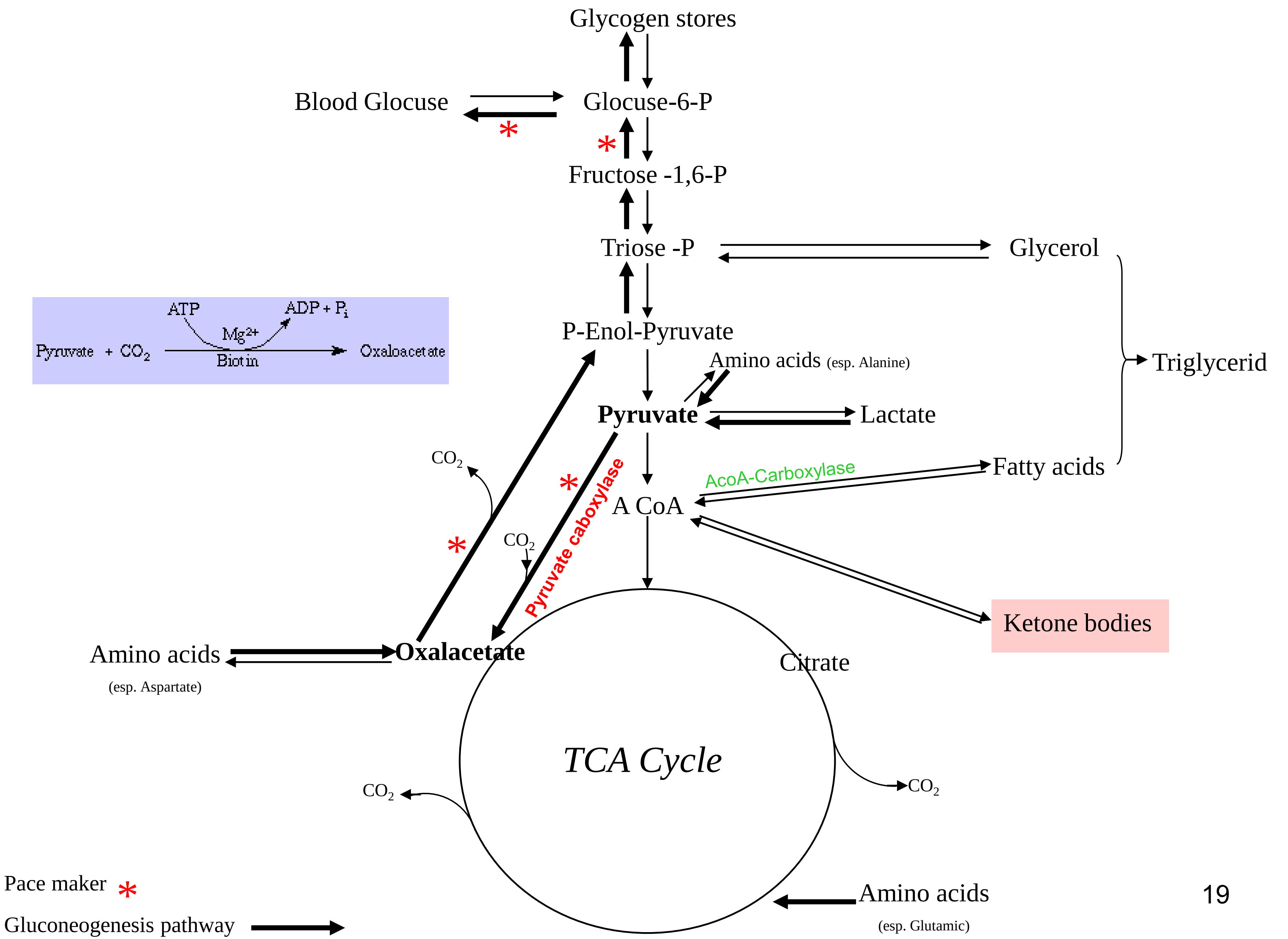
8 optically isomers

**Deficiency: Anorexia, Nausea, Vomiting, Dermatitis**

**Biochemical function**

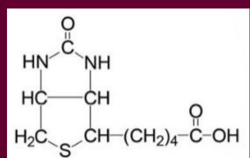
- **Pyruvate carboxylase**
- **Acetyl CoA carboxylase**
- **Propinyl coA carboxylase**
- **Methyl crotonyl coenzyme A carboxylase**





Glycogen stores
Blood Glocuse
Glocuse-6-P
Fructose -1,6-P
Triose -P
Glycerol
P-Enol-Pyruvate
Amino acids (esp. Alanine)
Triglycerid
ATP
ADP + $P_i$
$Mg^{2+}$
Pyruvate + $CO_2$
Biotin
Oxaloacetate
Pyruvate
Lactate
$CO_2$
Pyruvate caboxylase
AcoA-Carboxylase
Fatty acids
A CoA
$CO_2$
Ketone bodies
Amino acids
(esp. Aspartate)
Oxalacetate
Citrate
TCA Cycle
$CO_2$
$CO_2$
Amino acids
(esp. Glutamic)
Pace maker *
Gluconeogenesis pathway

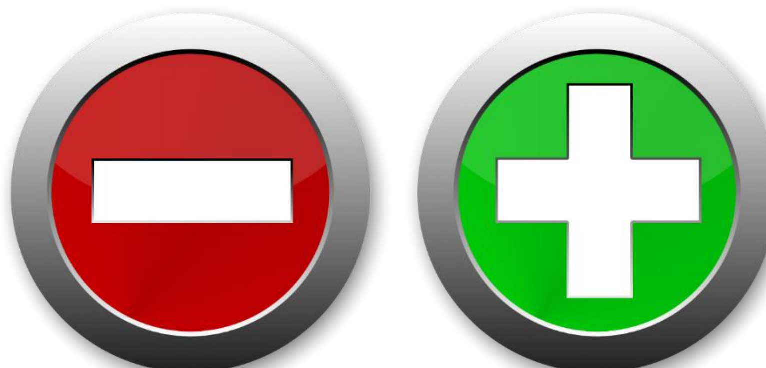
# New biochemical function




Carboxylases

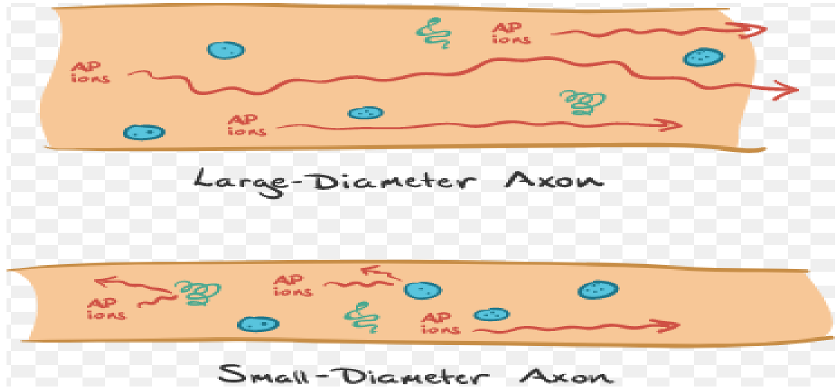
**Gene expression**

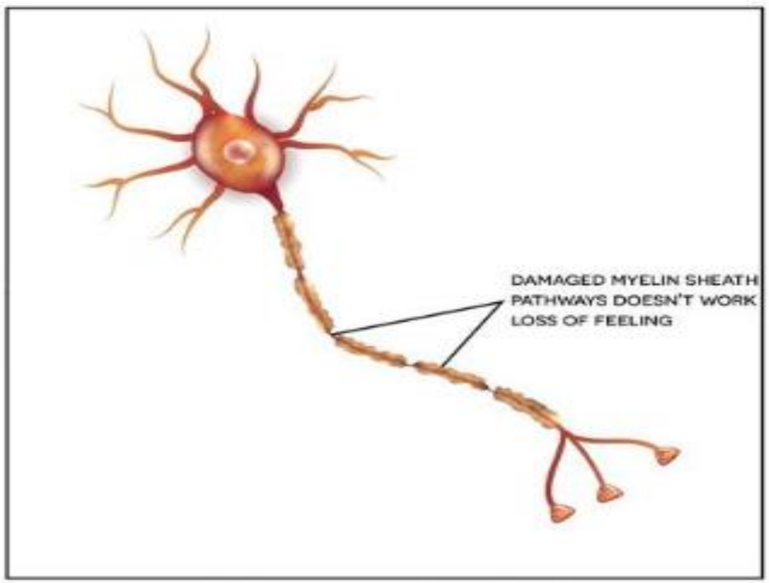
- Development
- Immunity
- Growth
- Metabolism
- Reproduction



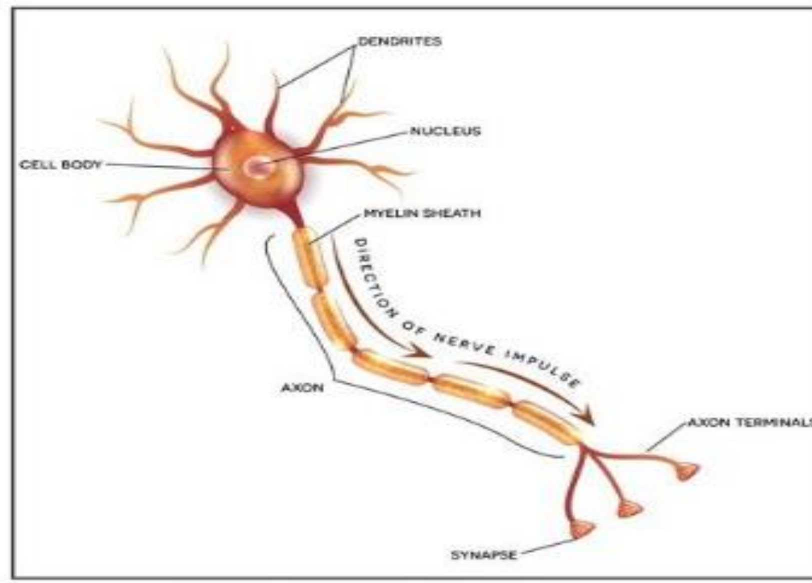
*Neuroscience* 289 (2015) 233–241

# TERATOGENIC EFFECTS OF PYRIDOXINE ON THE SPINAL CORD AND DORSAL ROOT GANGLIA OF EMBRYONIC CHICKENS

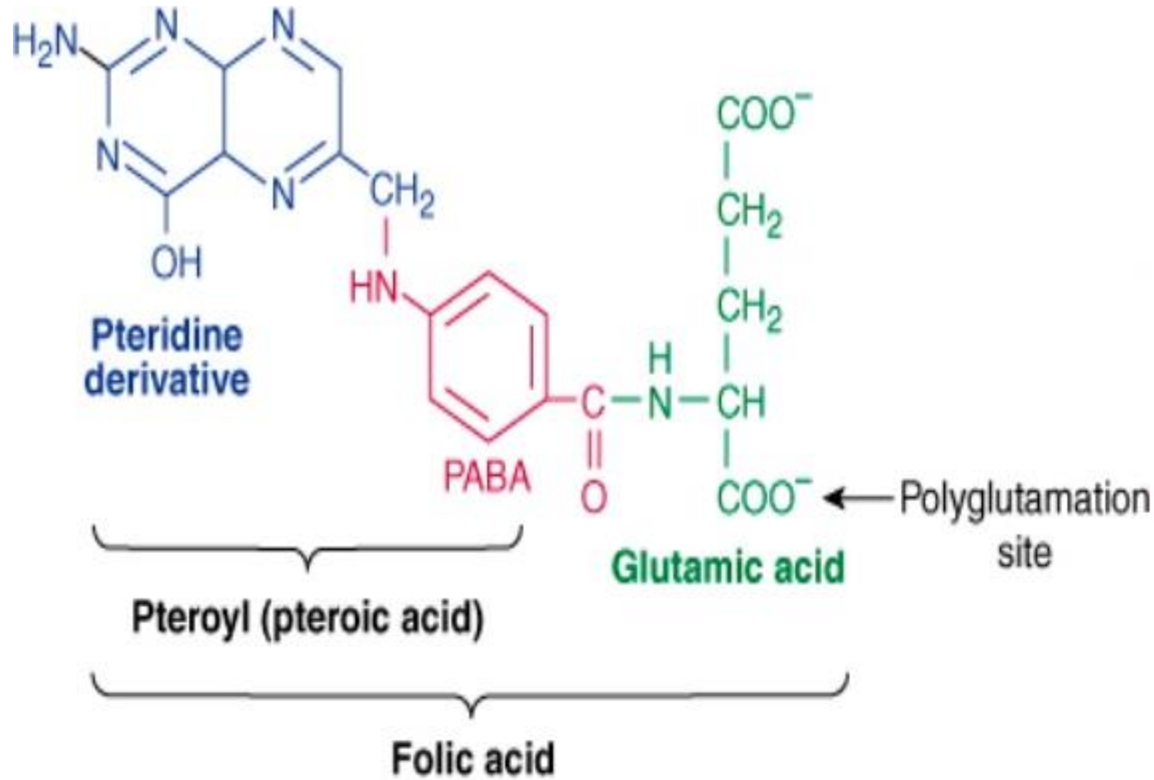



UNHEALTHY NERVE CELL




HEALTHY NERVE CELL


H2N
N
N
N
N
OH
CH2
HN
COO⁻
CH2
CH2
H
C—N—CH
O
COO⁻
Polyglutamation site
Pteridine derivative
PABA
Glutamic acid
Pteroyl (pteroic acid)
Folic acid

# METABOLISM

## Digestion, Absorption, and Transport

Polyglutamate forms are digested via hydrolysis to pteroylmonoglutamate prior to transport across the intestinal mucosa. Intraluminal polyglutamate hydrolysis is catalyzed by a conjugase intestinal enzyme found in the brush border. This brush border pteroylpolyglutamate hydrolase (γ-carboxy peptidase) is an exopeptidase that cleaves the polyglutamyl chain one residue at a time starting from the carboxyl end. It has a pH optimum near neutrality and is activated by zinc (Chandler et al., 1986). In humans, a zinc deficiency resulted in a decreased intestinal hydrolysis of pteroylpolyglutamate (Tamura et al., 1978). Conjugase activity is widely distributed in the mucosa of the proximal small intestine, both intracellularly and in association with the brush border. Conjugase activities have also been found in bile, pancreatic juice, kidney, and liver. Conjugase activity is reduced by nutritional zinc deficiency, chronic consumption of alcohol, and exposure to naturally occurring inhibitors in foods.

Pteroylmonoglutamate is absorbed predominantly in the jejunum, with lesser amounts in the duodenum, by a $Na^+$-coupled carrier-mediated process. Folacin is also absorbed passively, presumably by diffusion; this mechanism accounts for 20 to 30% of folacin absorption, regardless of folate concentration.

Dietary folates, after hydrolysis and absorption from the intestine, are transported in plasma as monoglutamate derivatives, with only limited methylation (5-methyltetrahydrofolate). Folacin taken up by the liver is converted primarily to 5-methyltetrahydrofolate and 10-formyltetrahydrofolate and then transported to the peripheral tissues. The monoglutamate derivatives are then taken up by cells in tissues by specific transport systems. There, the pteroylpolyglutamates—the major folacin form in cells—are built up again in stepwise fashion by the enzyme folate polyglutamate synthetase. Polyglutamation traps folates inside cells at concentrations one to two orders of magnitude greater than those of extracellular fluids. Polyglutamates serve to keep folacin within the cells since only the monoglutamate forms are transported across membranes, and only the monoglutamates are found in plasma and urine (Wagner, 1995). Folacin enzymes are compartmentalized between the cytosol and the mitochondria. Almost all the folate in the cell is distributed equally between the two compartments. There are also mitohave been produced in chicks fed corn-soybean meal diets (Pesti et al., 1991).

Self-synthesis of folacin is dependent on dietary composition. For poultry, some research has indicated higher folacin requirements for very high protein diets, or when sucrose was the only source of carbohydrates (Scott et al., 1982). Keagy and Oace (1984) reported that dietary fiber had an effect on folacin utilization; xylan, wheat bran, and beans stimulated folacin synthesis in the rat, reflected as higher fecal and liver folacin. For humans it was concluded that milk type differentially affects intestinal folacin biosynthesis and the superior folacin availability from human (versus cow and goat) milk-containing diets is due in part to enhanced intestinal biosynthesis of folacin (Semchuk et al., 1994).

The levels of antibacterials added to the feed will affect microbial synthesis of folacin. Sulfa drugs, which are commonly added to livestock diets, are folacin antagonists (see Deficiency). In the chicken, sulfa drugs have been shown to increase the requirement (Scott et al., 1982). Moldy feeds (e.g., aflatoxins) have also been shown to contain antagonists that inhibit microbial intestinal synthesis in swine (Purser, 1981).

Folacin requirements are dependent on the form in which it is fed and concentrations and interrelationships of other nutrients. Deficiencies of choline, vitamin $B_{12}$, iron, and vitamin C all have an effect on folacin needs. Although most folacin in poultry feedstuffs is present in conjugated form, the young chick is fully capable of utilizing it. On the contrary, Baker et al. (1978) reported that human patients over 60 years of age utilized conjugated forms of folacin much less efficiently than monoglutamates.

Folacin requirements are related to type and level of production. Growth rate, age, and pregnancy influence folacin requirements. The requirement decreases with age because diminished growth rate reduces the need for DNA synthesis. Increased catabolism of folacin is a feature of pregnancy. Studies with both rats (McNulty et al., 1993) and humans (McPartlin et al., 1993) demonstrated an enhanced folacin catabolism that was a feature of pregnancy per se and not simply due to increased weight. In poultry the folacin requirement for egg hatchability is higher than that for production (NRC, 1994). Taylor (1947) reported that 0.12 mg of folacin per kilogram of diet was satisfactory for egg production, but higher levels were required for good hatchability. Table 12.1 summarizes the folacin requirements for various livestock species and humans; a more complete listing is given in the appendix, Table A1.

The current Recommended Dietary Allowances (RDAs) for folates pharmaceutical companies in the preparation of capsules, tablets, and ampoules. The tablets used for prophylactic purposes usually contain 2 mg per daily dose. For therapeutic purposes, 10- to 150-mg tablets are taken one to three times daily.

The recovery of vitamin $B_6$ as pyridoxine hydrochloride in a multivitamin premix not containing trace minerals was 100%, even after 3 months in storage at 37°C. However, stability in a premix containing trace minerals was poor, with only 45% recovery after 3 months at 37°C (Adams, 1982). Verbeeck (1975) found vitamin $B_6$ to be stable in premixes with minerals as sulfates. However, if minerals in the form of carbonates and oxides are used, 25% of the vitamin can be lost over a 3-month period. Stress agents such as choline chloride help catalyze this destruction. Gadient (1986) considers pyridoxine to be very sensitive to heat, slightly sensitive to moisture and light, and insensitive to oxygen. Retention of $B_6$ activity in pelleted feeds after 3 months at room temperature should be 80 to 100% as a general rule. The retention of pyridoxine in an extruded fish meal fed after 1 month at room temperature was found to be 56%.

Data have accumulated for the need of vitamin $B_6$ supplementation for humans, especially for young and pregnant or lactating women. Requirements for $B_6$ are higher for individuals during pregnancy, use of oral contraceptives, certain drug therapy, radiation, ... of alcohol, hyperthyroidism, uremia, urinary calculi, and in errors of metabolism (see Deficiency). Vitamin $B_6$ supplements are commonly given when isoniazid is used in tuberculosis treatment and when penicillamine is used in the treatment of Wilson's disease. Vitamin $B_6$ supplements are also frequently given along with most anticonvulsant drugs. Reports indicate that mothers unsupplemented with vitamin $B_6$ produce milk low in the vitamin (Guilarte, 1993). Based on these studies, it is apparent that some degree of vitamin $B_6$ deficiency may be present in infants whose sole source of nutrients is breast milk and whose
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اعجبني القلب



# Preface

Vitamin products began to be developed several decades ago. Nevertheless, there is still much that is obscure in the pharmaceutical technology of vitamins. This derives from the specific problems associated with this class of substances. The multivitamin products are unique in combining such a large number of active substances with entirely different chemical structures and physical properties. This is compounded by the fact that virtually all the vitamins are more or less unstable when formulated and some of them interact to result in decomposition.

There has been a large number of publications on the pharmaceutical technology of vitamin formulations. The intention of this text is not merely to review the literature. Although a wide selection of publications has been quoted in order to give an overview, our own work represents a large proportion of the text and this is reflected by the many formulations which are specified, almost all of which were developed in the food products/pharmaceuticals applications laboratories of BASF AG, Ludwigshafen, FRG. However, not all of them have been examined for chemical stability.

On this basis, the present text aims to make the process of development of vitamin products intelligible and thus to aid pharmacists engaged in this work.

The entries have been arranged alphabetically to provide rapid access to the information, and this is facilitated by cross-references and the *key words* which are *printed in italics*.

*Spring 1988* *Volker Bühler*

In the second edition of this book some amendements and actualizations were introduced. This concerns e. g. the situation of the Pharmacopoeias and other legal conditions. Furthermore several new formulations of vitamin combinations (e. g. multivitamin syrup, vitamin C + E tablets, vitamin B complex injectable, multivitamin effervescent tablets, multivitamin tablets with minerals) and a great chapter of multivitamin solutions were added to impart an even better knowledge about the pharmaceutical technology of vitamins.

Since this book has the structure of a dictionary and many crosslinks between the individual sections are included it was decided to offer it also in an electronic form of the attached CD-ROM.

An alphabetical index of all formulations listed in the book was added.

*September 2000* *Volker Bühler*

| | |
|---|---|
| Pro date: | Oct/18 |
| Exp date: | Oct/19 |

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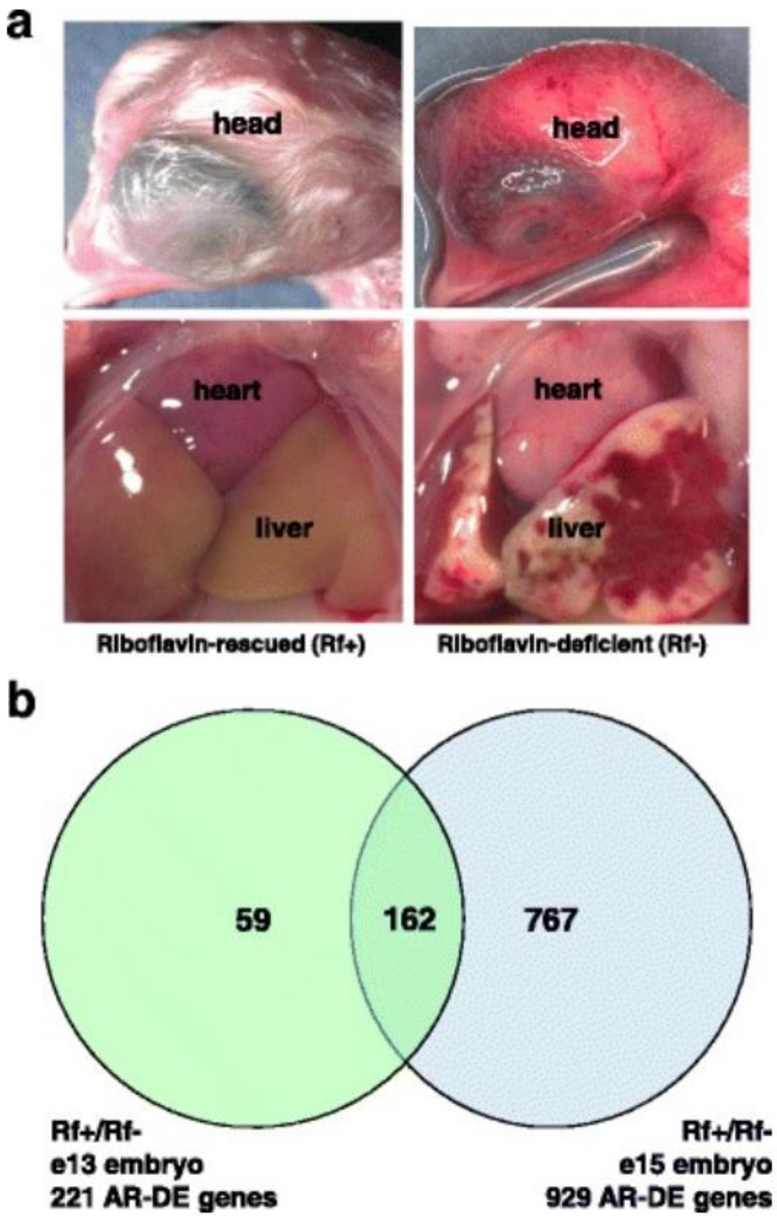
**Pro date:** Oct/18

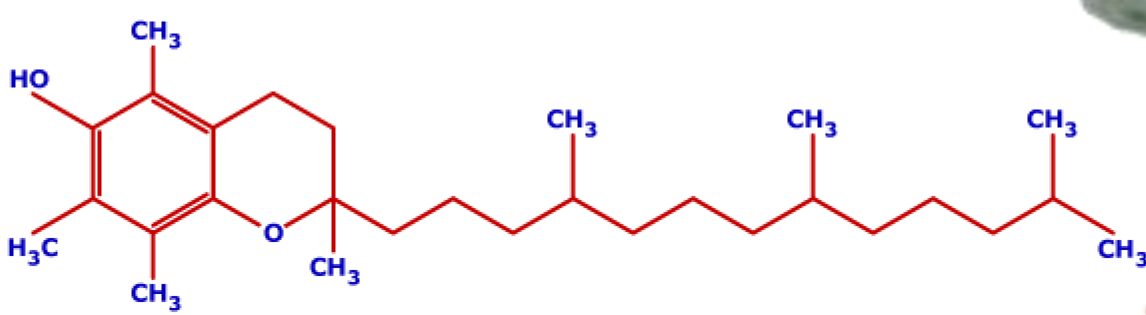
**Exp date:** Oct/19

**Transcriptional profiling of liver in riboflavin-deficient chicken embryos explains impaired lipid utilization, energy depletion, massive hemorrhaging, and delayed feathering.**

doi: 10.1186/s12864-018-4568-2.



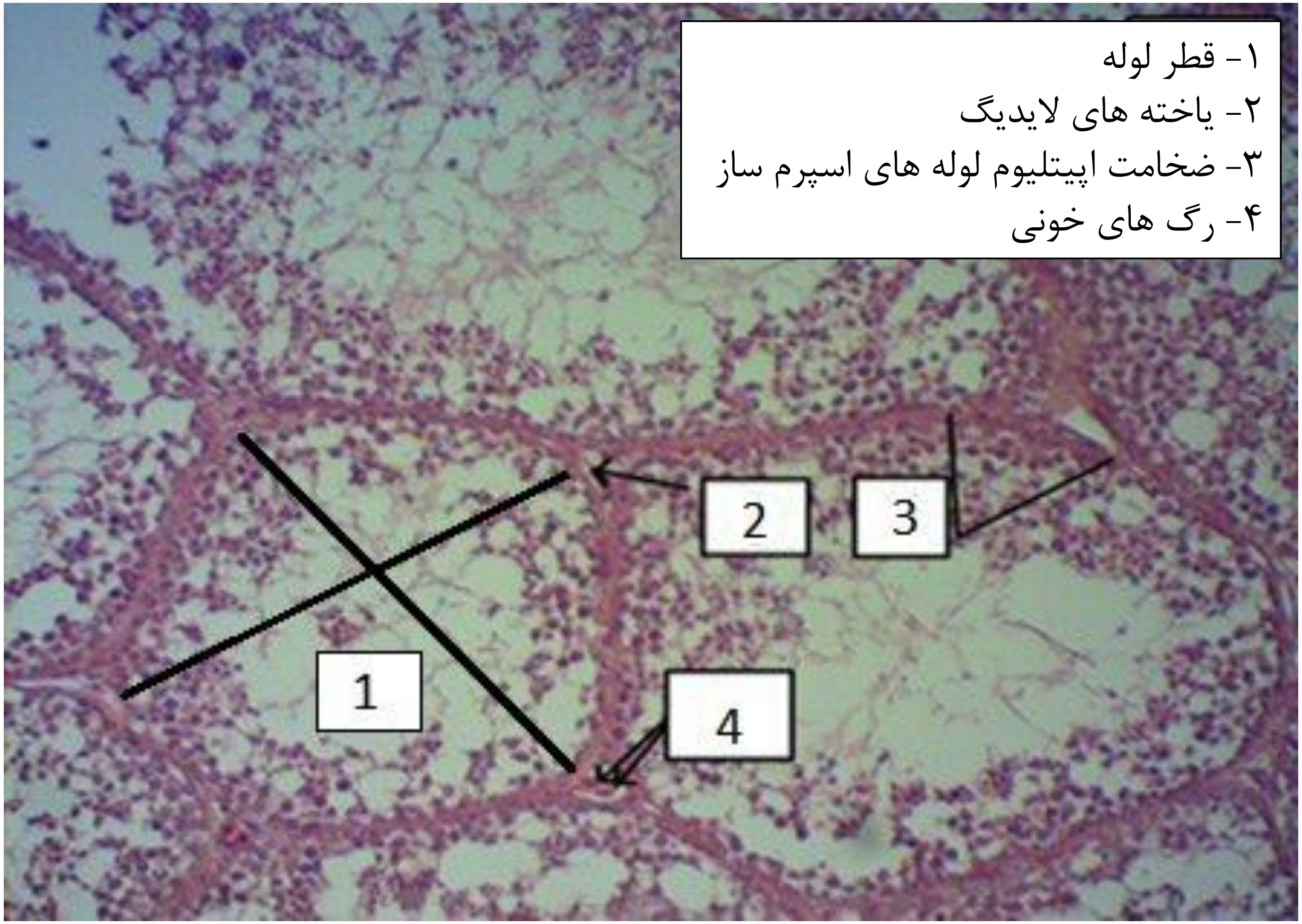
# تاثیر ویتامین E بر باروری خروس های گله مادر گوشتی



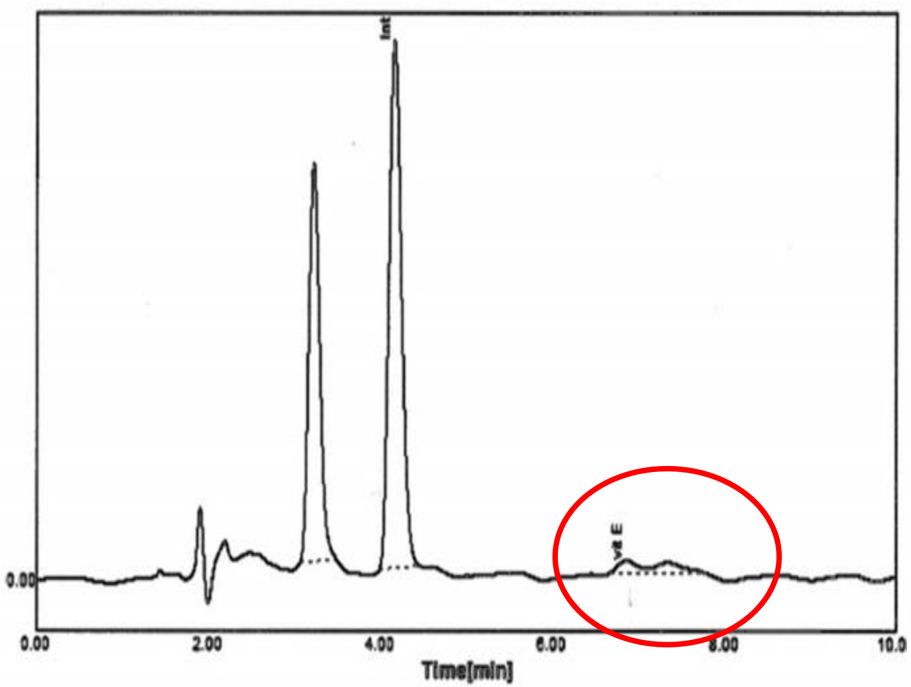
# Materials and Methods

| α-Tocopherol acetate | | | | | × | Body Weight | |
|---|---|---|---|---|---|---|---|
| 0 | 100 | 200 | 300 | 400 | | Standard<br>3100 | Obese<br>3500 |

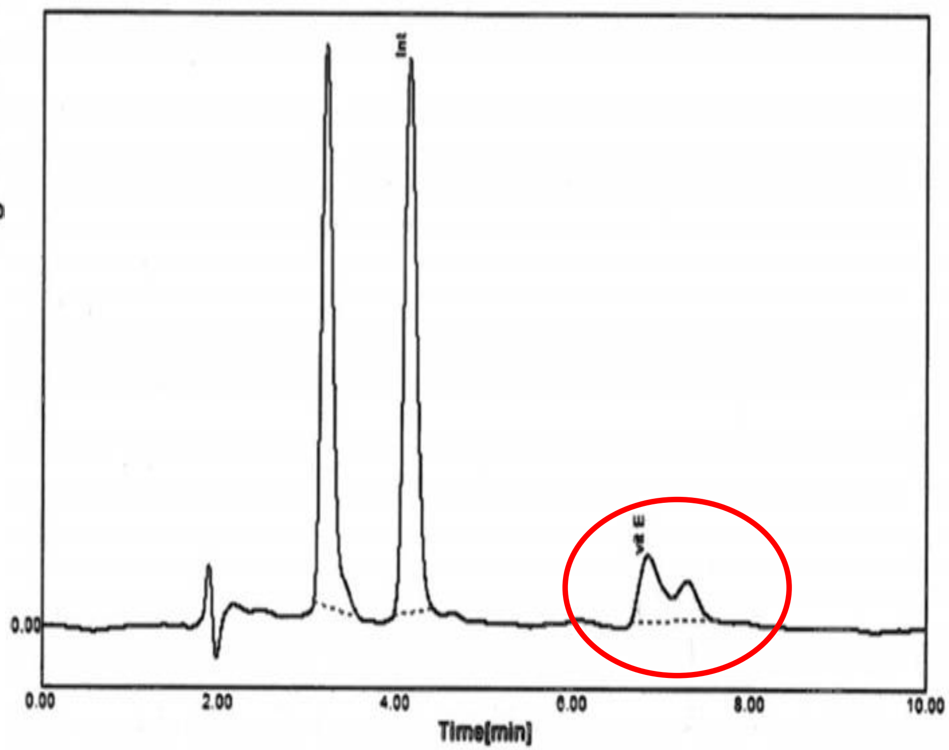

SW
5
SW
4
AZI


۱- قطر لوله
۲- یاخته های لایدیگ
۳- ضخامت اپیتلیوم لوله های اسپرم ساز
۴- رگ های خونی
2
3
1
4

# Results

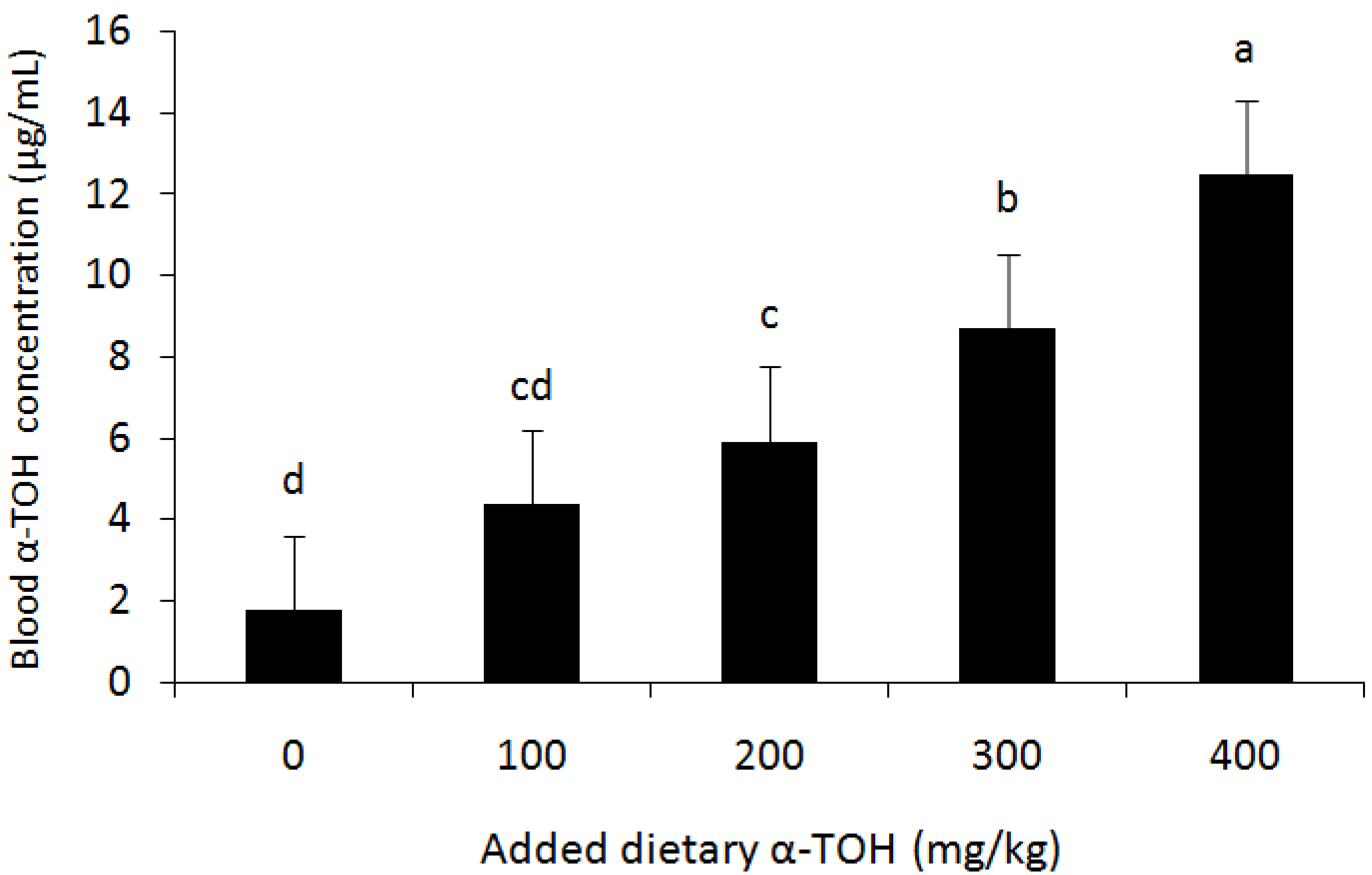


Int
vit E
0.00
0.00
2.00
4.00
6.00
8.00
10.0
Time[min]

Int
vit E
0.00
0.00
2.00
4.00
6.00
8.00
10.00
Time[min]

# Results




Influence of dietary α-TOH on blood concentration of α-tocopherol

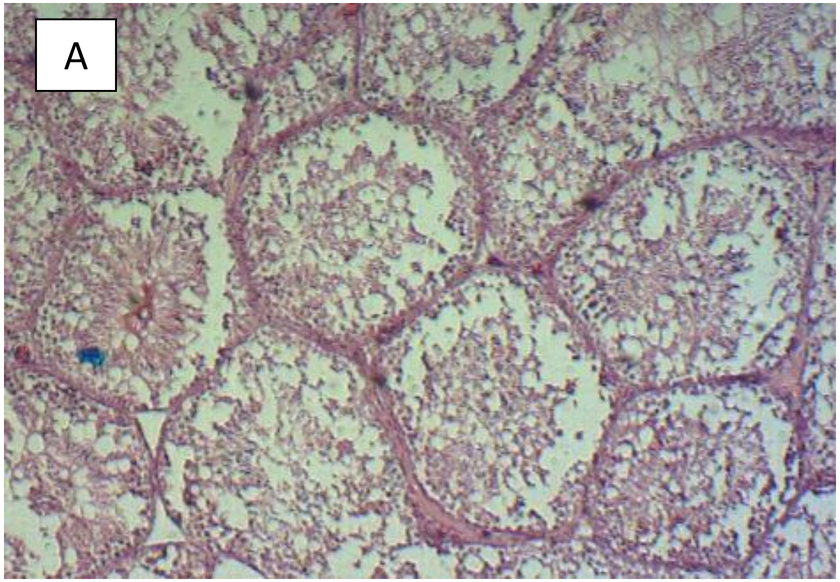
# Results

| Weight category | Vitamin E doses | Parameters | | | | | |
|---|---|---|---|---|---|---|---|
| | | W. testis R (g) | W. testis L (g) | S. testis R (mm) | S. testis L (mm) | D. testis R (mm) | D. testis L (mm) |
| **S** | | 24.03 ± 1.06 | 24.90 ± 1.04 | 47.04 ±0.90 | 46.73[b] ± 0.84 | 25.42[b] ± 0.37 | 25.29[b] ± 0.46 |
| **H** | | 24.43 ± 1.10 | 26.10 ±1.29 | 49.41 ± 1.00 | 49.66[a] ± 0.89 | 27.60 [a] ± 0.59 | 28.06[a] ± 0.53 |
| | 0 | 19.75[c] ± 1.74 | 19.45[c] ± 1.72 | 42.87[b] ±1.79 | 43.20[b] ± 1.40 | 24.15[c] ± 0.89 | 24.36[b] ± 0.83 |
| | 100 | 22.01[bc] ±1.66 | 23.66[bc] ± 1.87 | 48.16[a] ±1.48 | 47.41[a] ±1.28 | 25.57[bc] ±0.54 | 26.39[ab] ± 0.92 |
| | 200 | 24.81[ab] ±1.61 | 27.45[ab] ± 2.17 | 49.86[a] ± 1.16 | 50.25[a] ± 0.96 | 26.91[ab] ±0.90 | 26.79[a] ± 1.08 |
| | 300 | 27.08[a] ± 1.59 | 27.166[ab] ±1.19 | 49.91[a] ± 1.01 | 49.58[a] ± 1.07 | 28.10[a] ±0.77 | 27.58[a] ±0.62 |
| | 400 | 27.58[a] ±0.66 | 29.33[a] ± 0.59 | 50.35[a] ± 1.07 | 50.63[a] ± 1.35 | 27.75[a] ±0.55 | 28.16[a] ± 0.67 |
| P- Value | BW | 0.8012 | 0.4616 | 0.0507 | 0.0058 | 0.0009 | 0.0001 |
| | VE | 0.0028 | 0.0011 | 0.0010 | 0.0002 | 0.0007 | 0.0066 |
| | BW×VE | 0.8319 | 0.9865 | 0.8605 | 0.7937 | 0.7644 | 0.9226 |

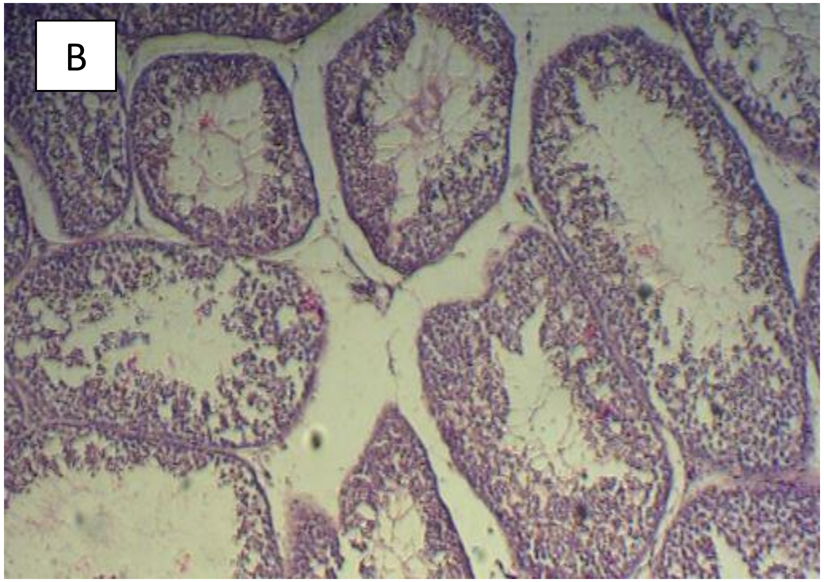
# Results

| Weight category | Vitamin E doses | Parameters | | | |
|---|---|---|---|---|---|
| | | Seminiferous tubules diameter (µm) | Seminiferous epithelium thickness (µm) | Leydig cells (n) | Blood vessels (n) |
| **S** | | 231.75 ±11.12 | 59.89 ±2.45 | 28.49 ± 1.09 | 1.94 ± 0.05 |
| **H** | | 243.94 ±12.97 | 61.47 ± 3.25 | 29.50 ± 1.27 | 1.90 ± 0.06 |
| | 0 | $179.50^{c}$ ±9.92 | $47.722^{d}$ ±1.22 | $24.080^{d}$ ±0.87 | $1.758^{c}$ ±0.058 |
| | 100 | $224.40^{b}$ ±11.88 | $53.756^{cd}$ ±1.60 | $25.333^{d}$ ±0.48 | $1.770^{c}$ ± 0.047 |
| | 200 | $233.88^{b}$ ±12.95 | $60.733^{bc}$ ±3.30 | $28.042^{c}$ ±0.64 | $1.866^{bc}$ ±0.069 |
| | 300 | $255.39^{b}$ ± 7.55 | $67.724^{ab}$ ±3.54 | $32.042^{b}$ ±0.956 | $2.033^{ab}$ ±0.033 |
| | 400 | $297.54^{a}$ ±10.90 | $72.160^{a}$ ±3.90 | $35.133^{a}$ ±1.203 | $2.200^{a}$ ±0.079 |
| P- Value | BW | 0.1919 | 0.5746 | 0.1438 | 0.4704 |
| | VE | <.0001 | 0.0003 | .0001 | 0.0001 |
| | BW×VE | 0.2935 | 0.3296 | 0.0550 | 0.5423 |

# Results

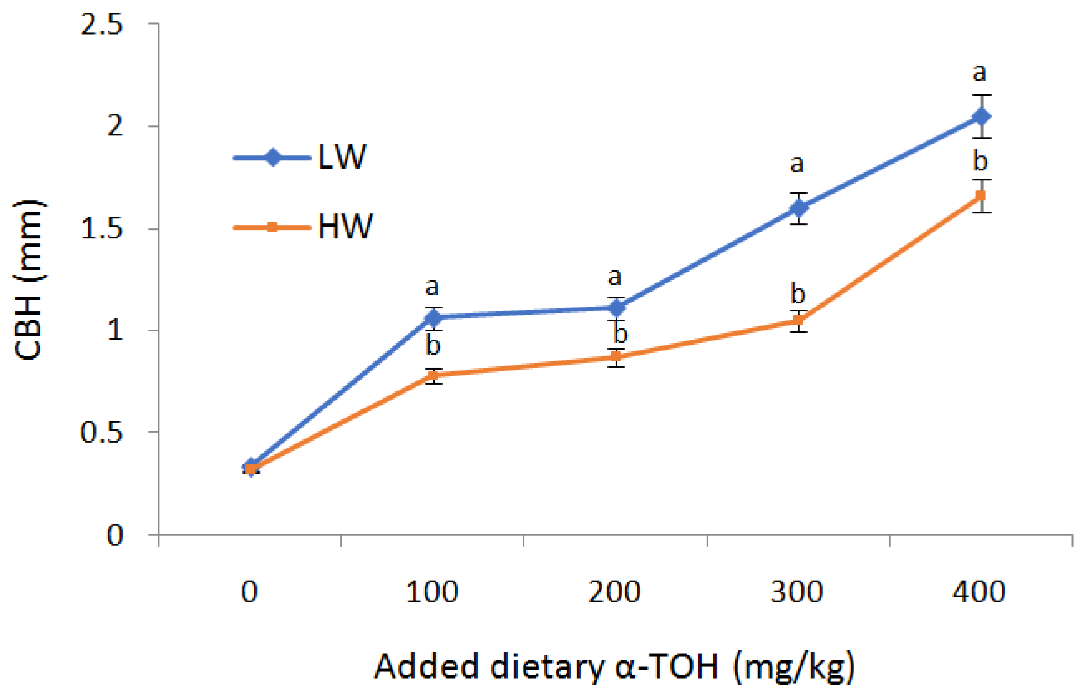



مقطع بیضه خروس سنگین تیمار ۴۰۰ میلی‌گرم در
کیلوگرم ویتامین E



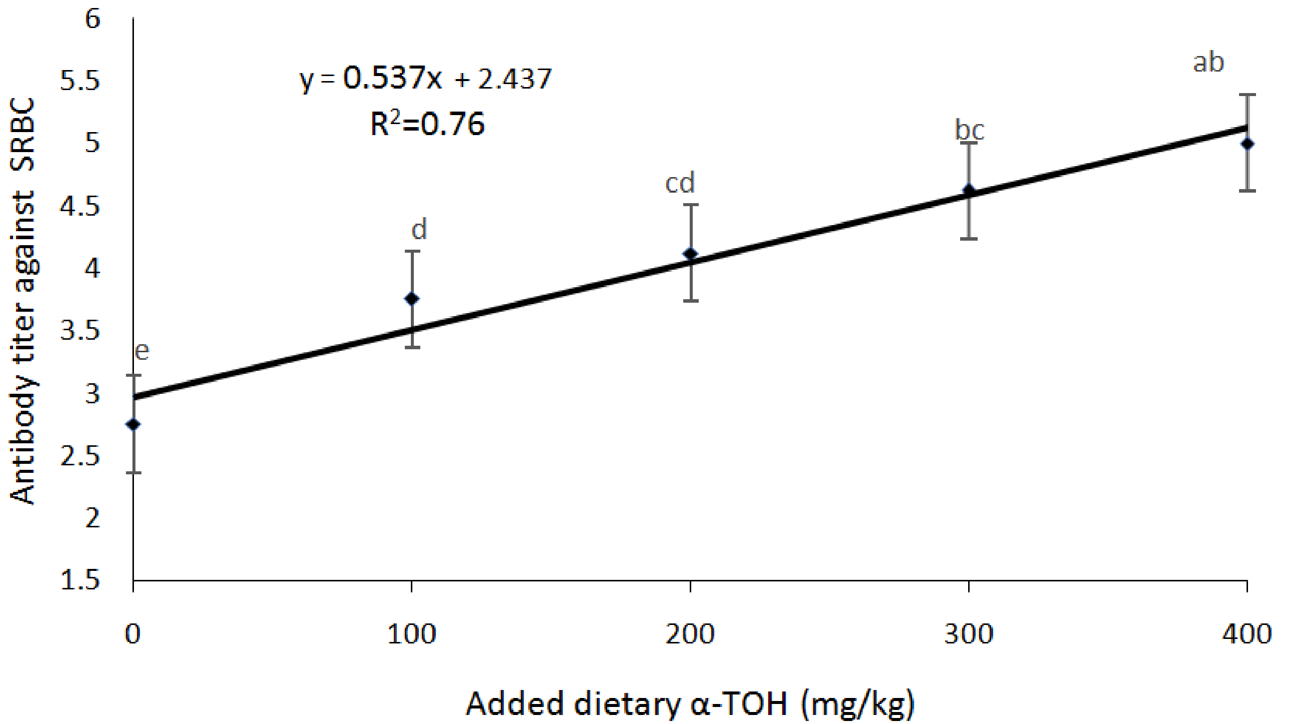

مقطع بیضه خروس سنگین گروه کنترل
کاهش تعداد اسپرماتوگونی و واکوئل‌ها در اپیتلیوم

# Results




Effect of dietary graded levels of α-TOH and body weight of rosters on cell mediated immunity (CBH)

# Results




The relationship between graded levels of α-TOH and humoral immunity (SRBC)

# Results

Analysis of the relationship between dependent (CBH, AIV, NDV and SRBC) and independent variable α-TOH. The main effect of two BW type (LW and HW) and 5 different levels of α-TOH (0, 100, 200, 300, 400 mg/kg diet) on rooster's immune parameters (Means± SE).

| Factors | | Parameters | | | | | |
|---|---|---|---|---|---|---|---|
| | | CBH (mm) | $AIV^2W5$ | $AIV^2W10$ | $NDV^2$ W5 | $NDV^2W10$ | $SRBC^2$ |
| BW | SW | $1.23^a$± 0.15 | 4.46± 0.16 | 5.93 ± 0.20 | 4.67 ± 0.12 | 6.40 ±0.21 | 4.10 ±0.20 |
| | HW | $0.93^b$ ±0.10 | 4.57 ±0.15 | 6.13 ± 0.29 | 4.58 ± 0.15 | 6.46 ±0.32 | 4.00 ±0.20 |
| α-TOH | 0 | $0.33^d$ ±0.05 | $4.91^d$ ±0.23 | $5.00^c$ ± 0.32 | $4.08^b$ ± 0.08 | $5.16^c$ ±0.30 | $2.75^e$ ±0.17 |
| | 100 | $0.92^c$ ±0.15 | $5.33^c$ ±0.22 | $5.50^{bc}$ ± 0.34 | $4.53^{ab}$ ± 0.20 | $5.83^c$ ± 0.30 | $3.75^d$ ±0.16 |
| | 200 | $0.99^c$ ±0.11 | $5.33^c$ ±0.14 | $6.33^{ab}$ ± 0.21 | $4.66^{ab}$ ± 0.18 | $6.50^{bc}$ ±0.22 | $4.12^{cd}$ ±0.22 |
| | 300 | $1.33^b$ ±0.10 | $5.85^{ab}$ ±0.29 | $6.50^a$ ± 0.22 | $4.75^a$ ± 0.14 | $7.16^{ab}$ ± 0.16 | $4.62^{bc}$ ±0.18 |
| | 400 | $1.85^a$ ±0.21 | $6.16^a$ ±0.16 | $6.83^a$ ± 0.47 | $5.08^a$ ± 0.25 | $7.50^a$ ±0.22 | $5.00^{ab}$ ±0.17 |
| P- Value | BW | 0.0175 | 0.5804 | 0.4992 | 0.6418 | 0.7661 | 0.5319 |
| | α-TOH | 0.0001 | 0.0013 | 0.0039 | 0.0222 | 0.0001 | 0.0001 |
| | BW× α-T | 0.6907 | 0.2593 | 0.9897 | 0.8532 | 0.2532 | 0.9615 |
| | Linear BW | 0.0175 | NS | NS | NS | NS | NS |
| | Linear α-TOH | 0.0001 | 0.0001 | 0.0002 | 0.0023 | 0.0001 | 0.0001 |
| | R-Square | 0.6618 | 0.3504 | 0.5302 | 0.2231 | 0.7662 | 0.7648 |
| | Quadratic α-TOH | NS | NS | NS | NS | NS | NS |
| | Exponential α-TOH | NS | NS | NS | NS | NS | NS |

AIVW5: Avian influenza virus week5, AIVW10: Avian influenza virus week10 CBH: Cutaneous basophil hypersensitivity, NDVw5: Avian Newcastle virus week5.NDVw10: Avian Newcastle virus week10 SRBC: sheep red blood cell. Different superscripts (A and B) for BW, (a-e) for VE levels within the same line differ significantly.

# Results

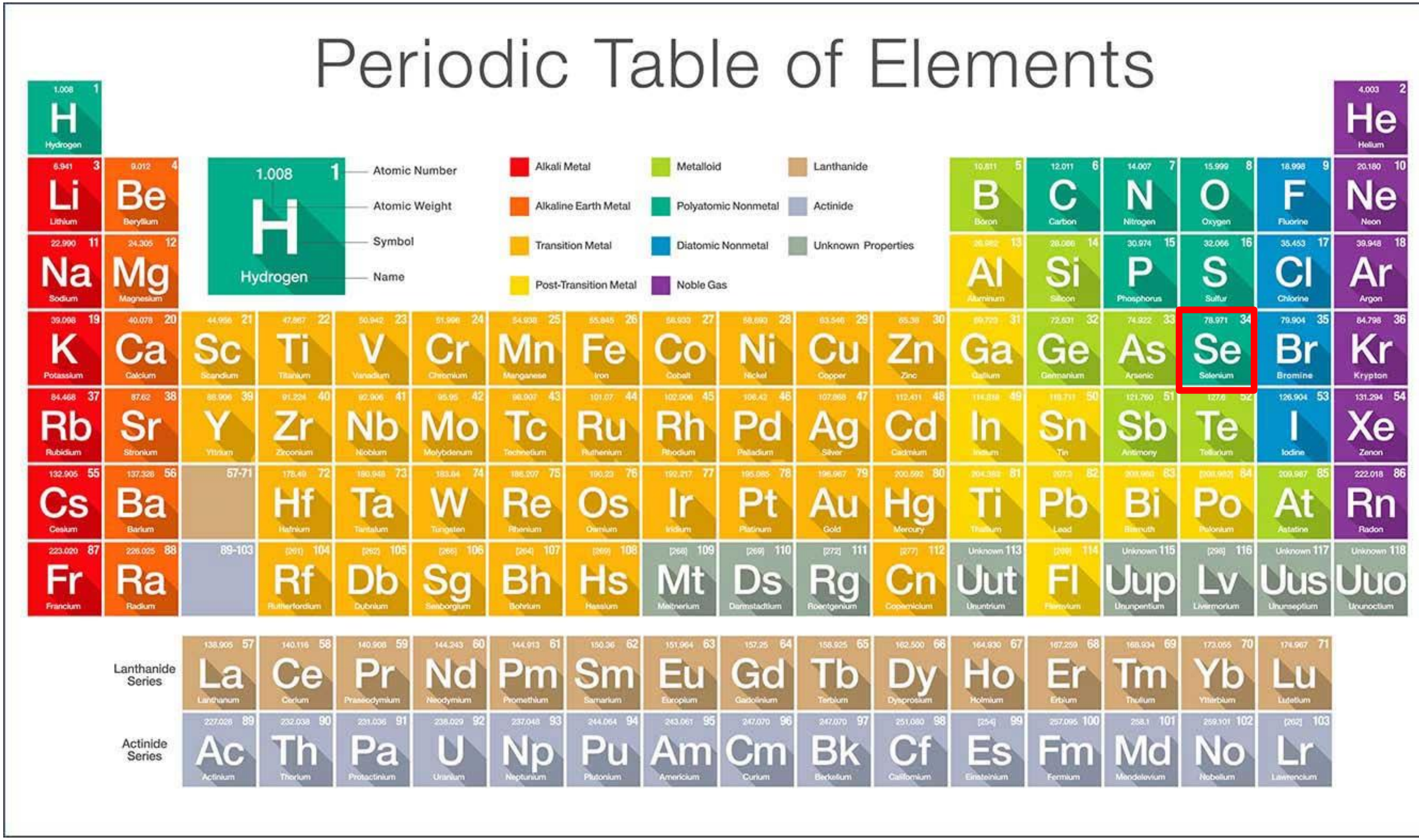
| Weight category | Type/Levels | Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Cholesterol (mg/dl) | AST (mg/dl) | TG(mg/dl) | HDL(mg/dl) | LDL(mg/dl) | α-TOH.con. (μg/mL) | Liver Weight (g) |
| BW | S | 131.60± 5.64 | 288.33±15.81 | $60.13^{B} \pm 2.96$ | 89.13 ± 3.31 | 31.53 ±1.88 | 7.39 ±1.17 | $42.53^{B} \pm 0.97$ |
| | H | 134.93 ±6.70 | 306.13±23.47 | $68.60^{A} \pm 2.66$ | 92.06 ± 2.61 | 40.40 ±3.62 | 5.93 ±1.02 | $45.66^{A} \pm 1.04$ |
| α-TOH | 0 | $146.00^{a} \pm 9.07$ | $383.50^{a} \pm 18.85$ | $78.66^{a} \pm 1.94$ | $79.66^{b} \pm 6.26$ | 39.83 ±7.99 | $1.77^{d} \pm 0.31$ | $41.08^{b} \pm 0.97$ |
| | 100 | $134.50^{b} \pm 7.74$ | $297.16^{b} \pm 36.99$ | $68.50^{bc} \pm 2.24$ | $88.33^{ab} \pm 3.32$ | 36.50 ±4.08 | $4.38^{cd} \pm 0.69$ | $43.00a^{b} \pm 1.49$ |
| | 200 | $123.83^{b} \pm 5.64$ | $289.16^{b} \pm 17.50$ | $60.50^{cd} \pm 3.89$ | $91.83^{ab} \pm 5.08$ | 36.16 ±6.20 | $5.92^{c} \pm 0.56$ | $43.15^{ab} \pm 1.74$ |
| | 300 | $122.33^{b} \pm 7.24$ | $287.83^{b} \pm 22.42$ | $58.00^{d} \pm 3.41$ | 93.16a ± 1.70 | 35.66 ± 2.87 | $8.69^{b} \pm 0.92$ | $46.50^{a} \pm 1.71$ |
| | 400 | $121.66^{b} \pm 7.47$ | $228.50^{b} \pm 26.24$ | $56.16^{d} \pm 4.96$ | $100.00^{a} \pm 1.93$ | 31.66 ± 1.54 | $12.50^{a} \pm 1.49$ | $46.75^{a} \pm 1.82$ |
| P- Value | BW | 0.6562 | 0.4632 | 0.0042 | 0.4599 | 0.0649 | 0.0913 | 0.0298 |
| | α-TOH | 0.0075 | 0.0108 | 0.0001 | 0.0472 | 0.8553 | 0.0001 | 0.0544 |
| | BW× α-TOH | 0.9652 | 0.7005 | 0.3527 | 0.8617 | 0.8402 | 0.9253 | 0.9569 |


Co
58.933195
Mn
54.938045
Zn
65.38
Ca
40.078
P
30.973762
Fe
55.845

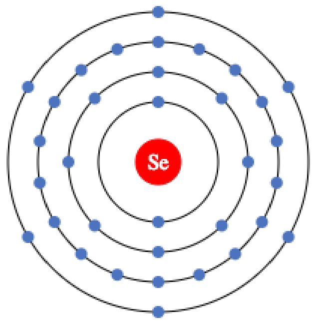
# Trace-Minerals Requirements / Recommendations for Broiler Breeders

- Lack of research, especially involved with impacts in the progeny
- Some published recommendations has no basis in research

| Mineral (ppm) | Rostagno 2017 | Aviagen 2016 | Cobb-Vantress 2013 | NRC 1994 |
|---|---|---|---|---|
| Cu | 9.94 | 10 | 15 | - |
| Fe | 45.8 | 50 | 55 | 60 |
| Zn | 65.1 | 110 | 110 | 45 |
| Mn | 70.0 | 120 | 120 | 20 |
| Se | 0.30 | 0.30 | 0.30 | 0.06 |
| I | 1.01 | 2.00 | 2.00 | 0.10 |

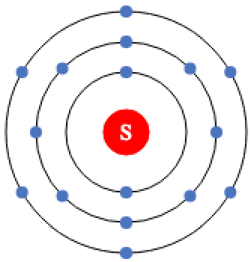

Periodic Table of Elements
1.008 1 H Hydrogen
Atomic Number
Atomic Weight
Symbol
Name
Alkali Metal
Alkaline Earth Metal
Transition Metal
Post-Transition Metal
Metalloid
Polyatomic Nonmetal
Diatomic Nonmetal
Noble Gas
Lanthanide
Actinide
Unknown Properties
H He
Li Be B C N O F Ne
Na Mg Al Si P S Cl Ar
K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
Cs Ba 57-71 Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn
Fr Ra 89-103 Rf Db Sg Bh Hs Mt Ds Rg Cn Uut Fl Uup Lv Uus Uuo
Lanthanide Series
La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Actinide Series
Ac Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr

34: Selenium



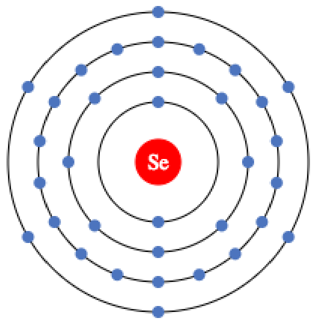

[Ar] 3d10 4s2 4p4 [2, 8, 18, 6]

16: Sulfur



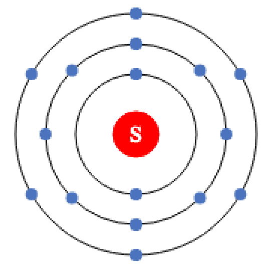

[Ne] 3s2 3p4 [2, 8, 6]

34: Selenium



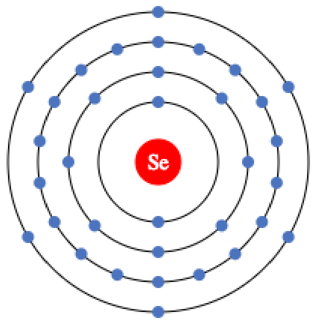

[Ar] 3d10 4s2 4p4 [2, 8, 18, 6]

16: Sulfur



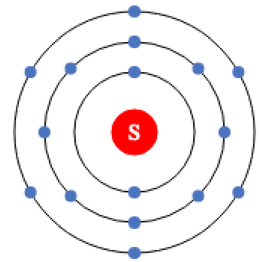

[Ne] 3s2 3p4 [2, 8, 6]

34: Selenium




[Ar] 3d10 4s2 4p4 [2, 8, 18, 6]

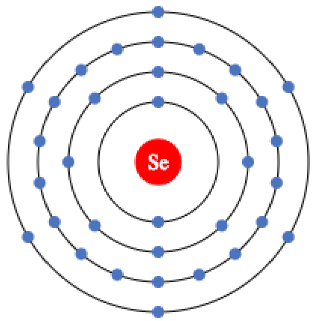
16: Sulfur

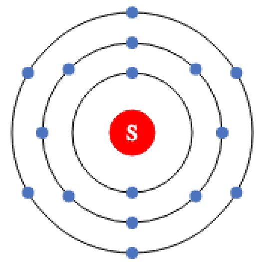



[Ne] 3s2 3p4 [2, 8, 6]

34: Selenium

16: Sulfur



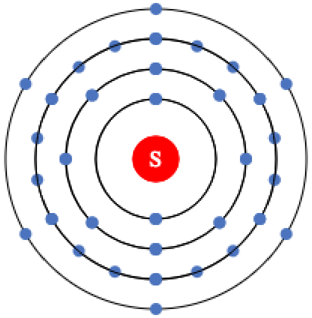




[Ne] 3s2 3p4 [2, 8, 6]

[Ar] 3d10 4s2 4p4 [2, 8, 18, 6]

34: Selenium

16: Sulfur




[Ne] 3s2 3p4 [2, 8, 6]

[Ar] 3d10 4s2 4p4 [2, 8, 18, 6]

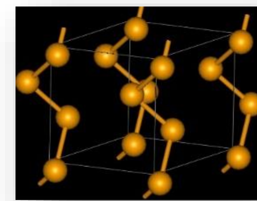
- The discovery of Se essentiality in early 1960s.
- The discovery in 1973 that glutathione peroxidase is a selenoprotein.
- Characterisation of main selenoproteins in nutrition and health in 2003.

## New insight

The role of free radicals as signalling molecules, understanding the role of nutrients in gene expression and maternal programming, tremendous progress in human and animal genome.

- Elemental selenium

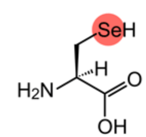
$Se^0$



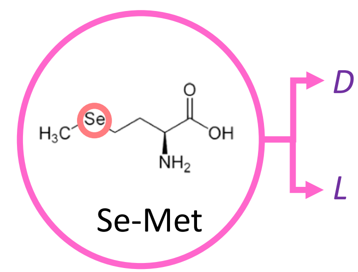
- Inorganic selenium compounds

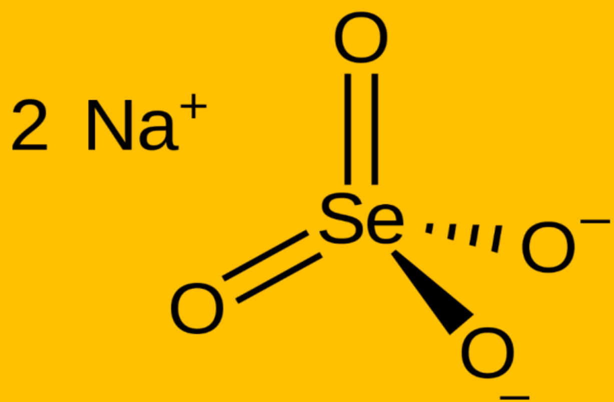
Selenite ($SeO_3^{--}$), Selenate ($SeO_4^{--}$), Selenide ($Se^{--}$)

- Organic selenium compounds

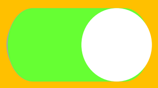


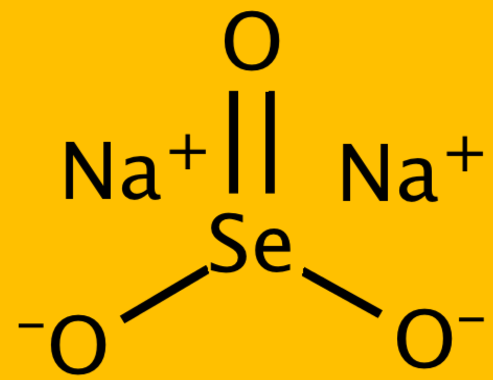

Se-Cys





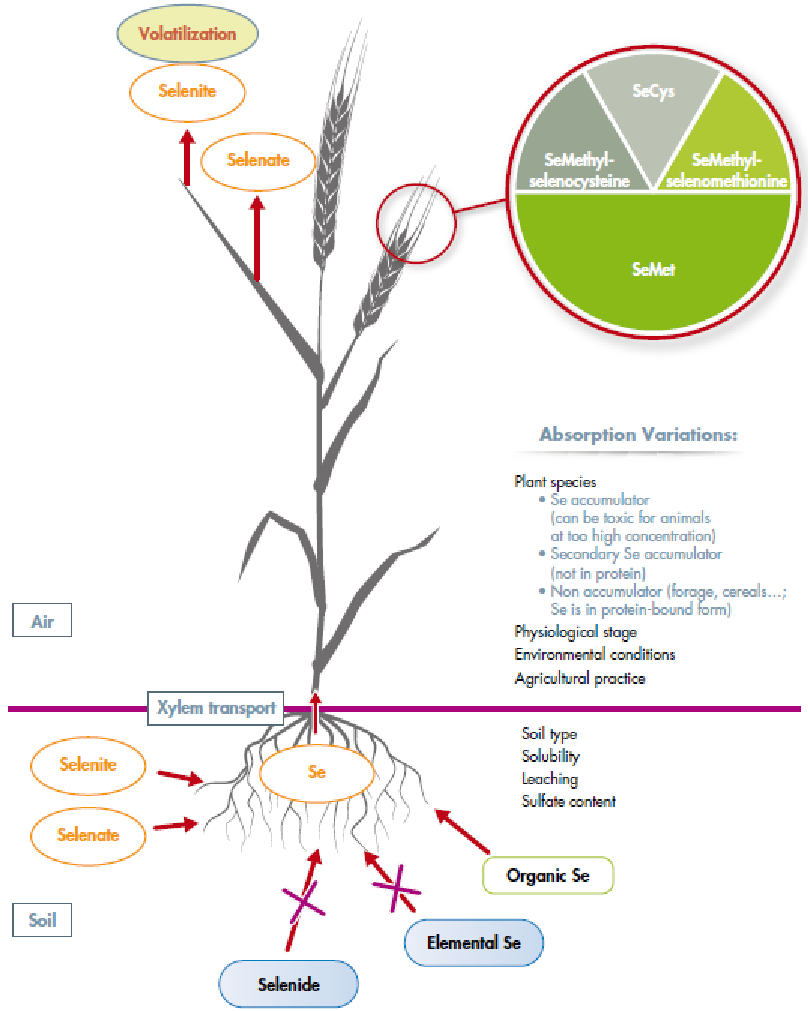

Sodium Selenate






Sodium Selenite

pH↓ absorption↓



# Functions


- Acute
- Sub-acute
- Chronic poisoning (alkali disease)
    - Ataxia
    - Diarrhoea
    - Death
    - Garlic odour
    - Hair loss
    - Growth retardation

Selenium acid > selenite > selenate > selenocysteine > methylated selenium compounds

# Functions

- Selenium dependent enzymes
  - Glutathione peroxidase
  - Deiodinases
- Other functions
  - Immune response
  - Complex with heavy metals (Cd, Hg & Ag)

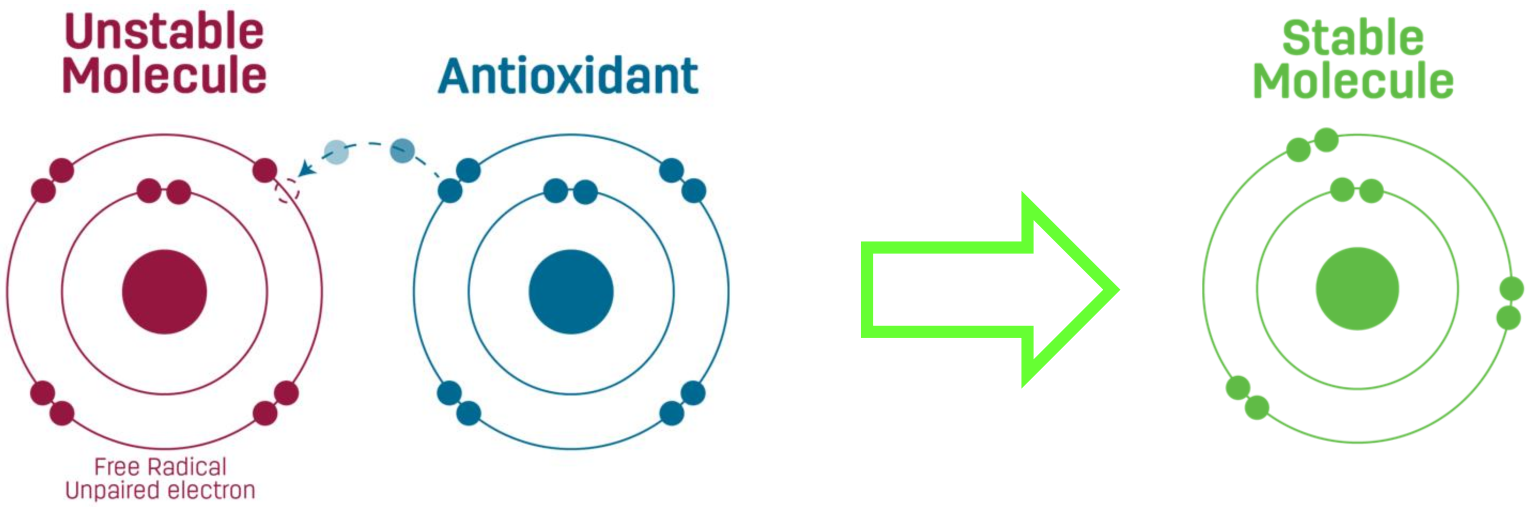
# Functions

*Self-preservation is the first law of nature*

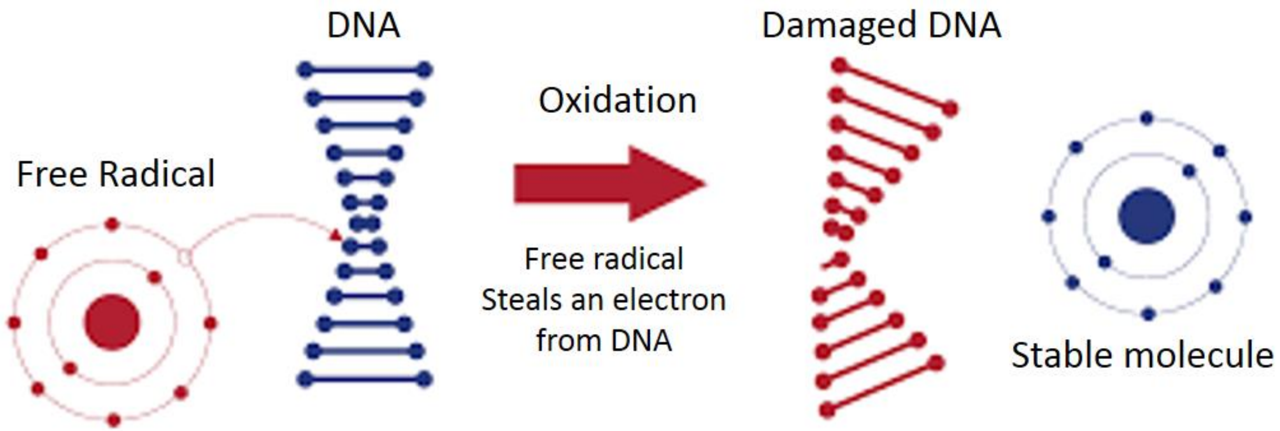
$$LH \xrightarrow{\text{Initiator}} L\bullet$$

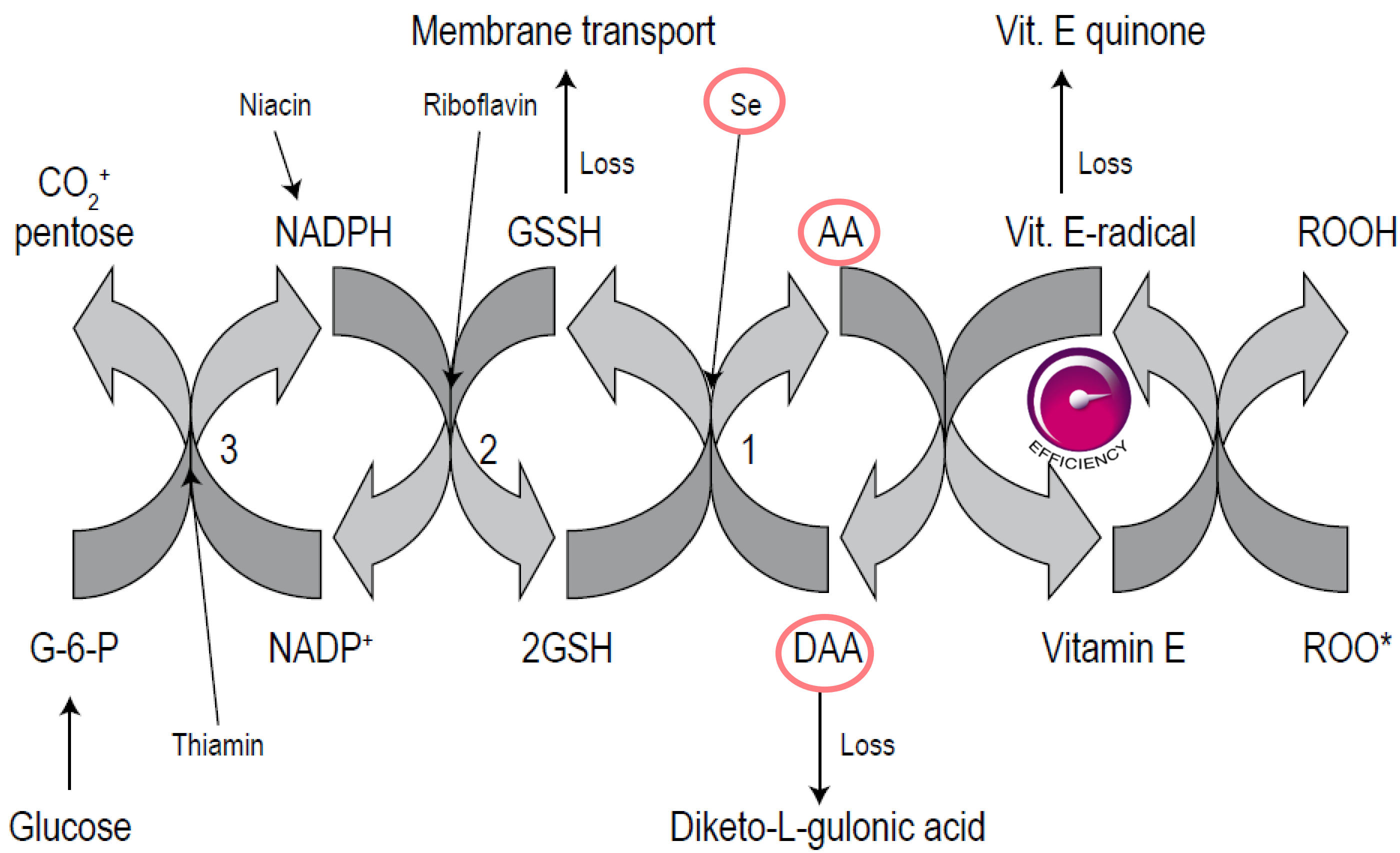
$$L\bullet + O_2 \longrightarrow LOO\bullet$$

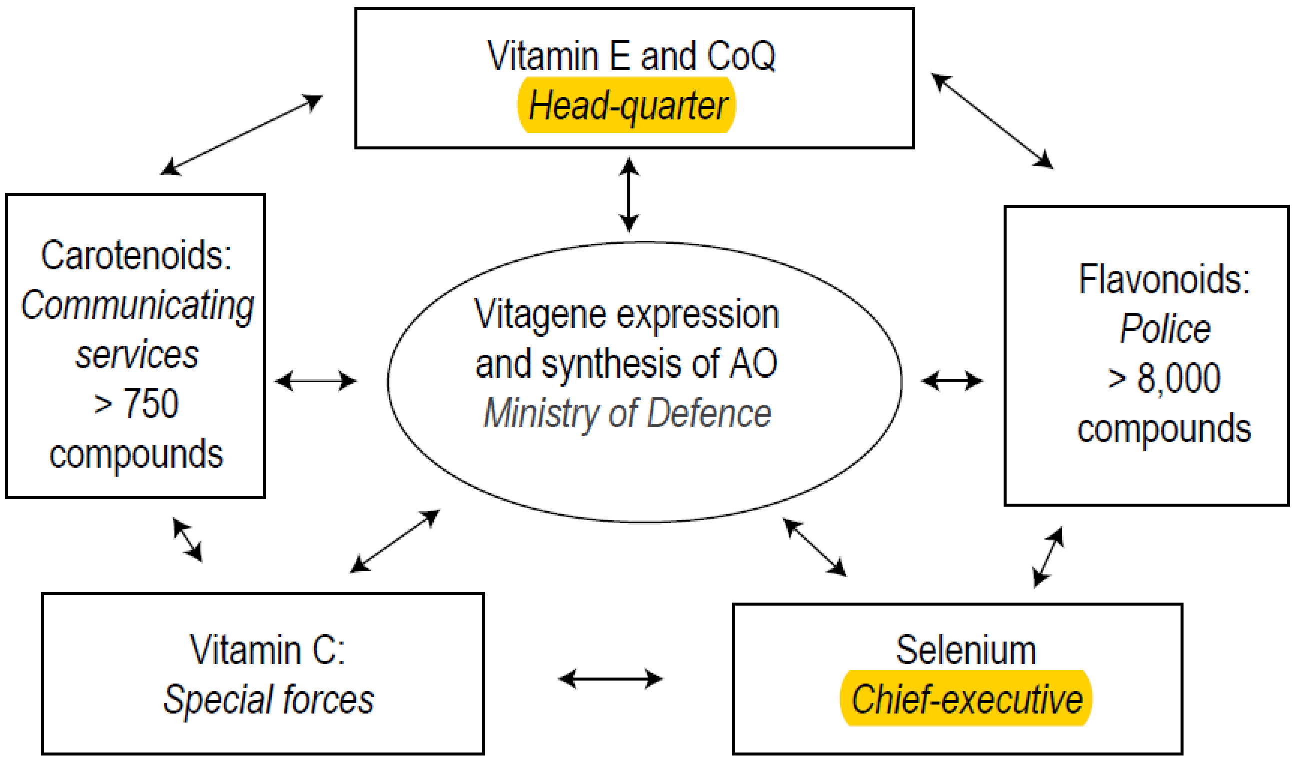
$$LOO\bullet + LH \longrightarrow LOOH + L\bullet$$

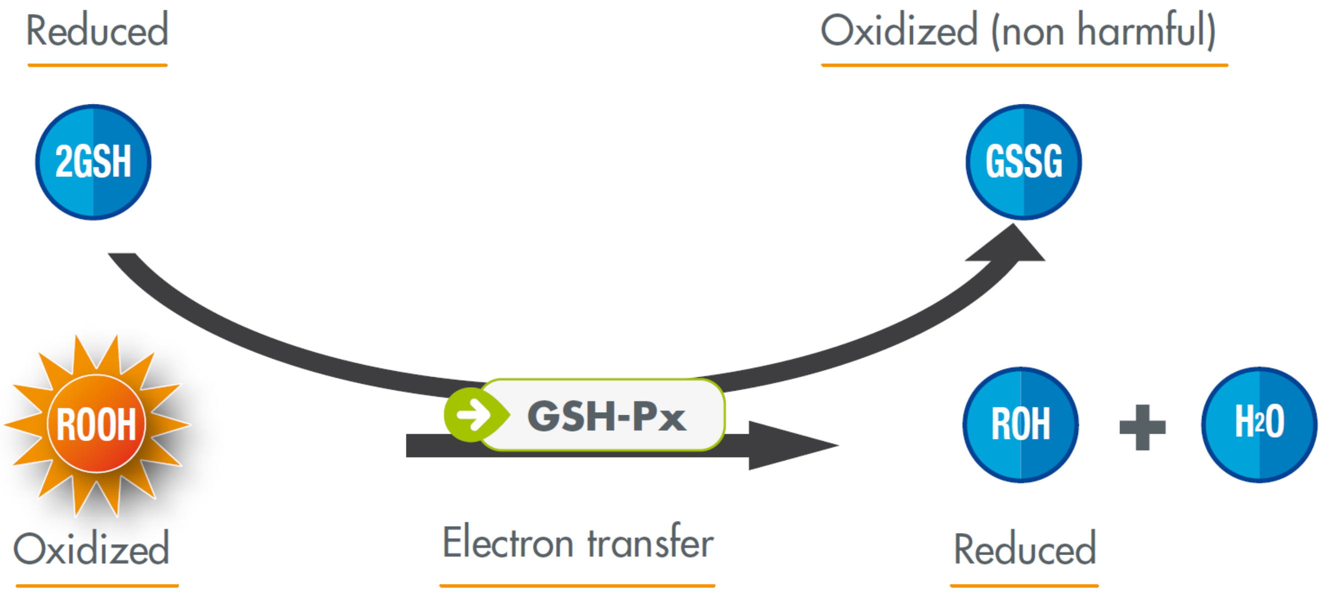


Unstable Molecule
Antioxidant
Free Radical
Unpaired electron
Stable Molecule


DNA
Damaged DNA
Oxidation
Free Radical
Free radical
Steals an electron
from DNA
Stable molecule


Membrane transport
Vit. E quinone
Niacin
Riboflavin
Se
Loss
Loss
$CO_2$ +
pentose
NADPH
GSSH
AA
Vit. E-radical
ROOH
3
2
1
EFFICIENCY
G-6-P
NADP+
2GSH
DAA
Vitamin E
ROO*
Thiamin
Loss
Glucose
Diketo-L-gulonic acid


Vitamin E and CoQ
Head-quarter
Carotenoids:
Communicating services
> 750 compounds
Vitagene expression and synthesis of AO
Ministry of Defence
Flavonoids:
Police
> 8,000 compounds
Vitamin C:
Special forces
Selenium
Chief-executive

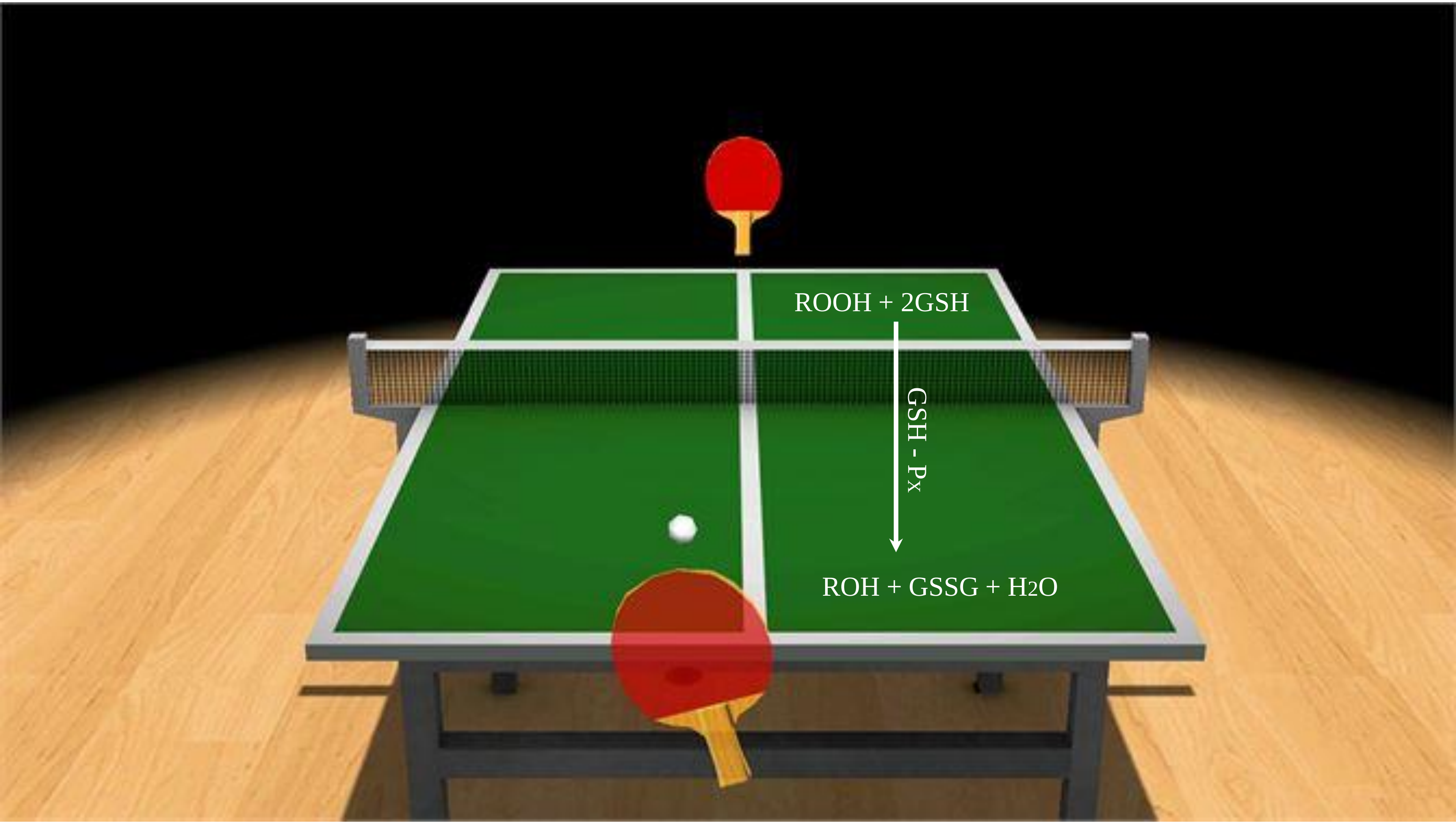


Reduced
Oxidized (non harmful)
2GSH
GSSG
ROOH
GSH-Px
ROH
+
H2O
Oxidized
Electron transfer
Reduced

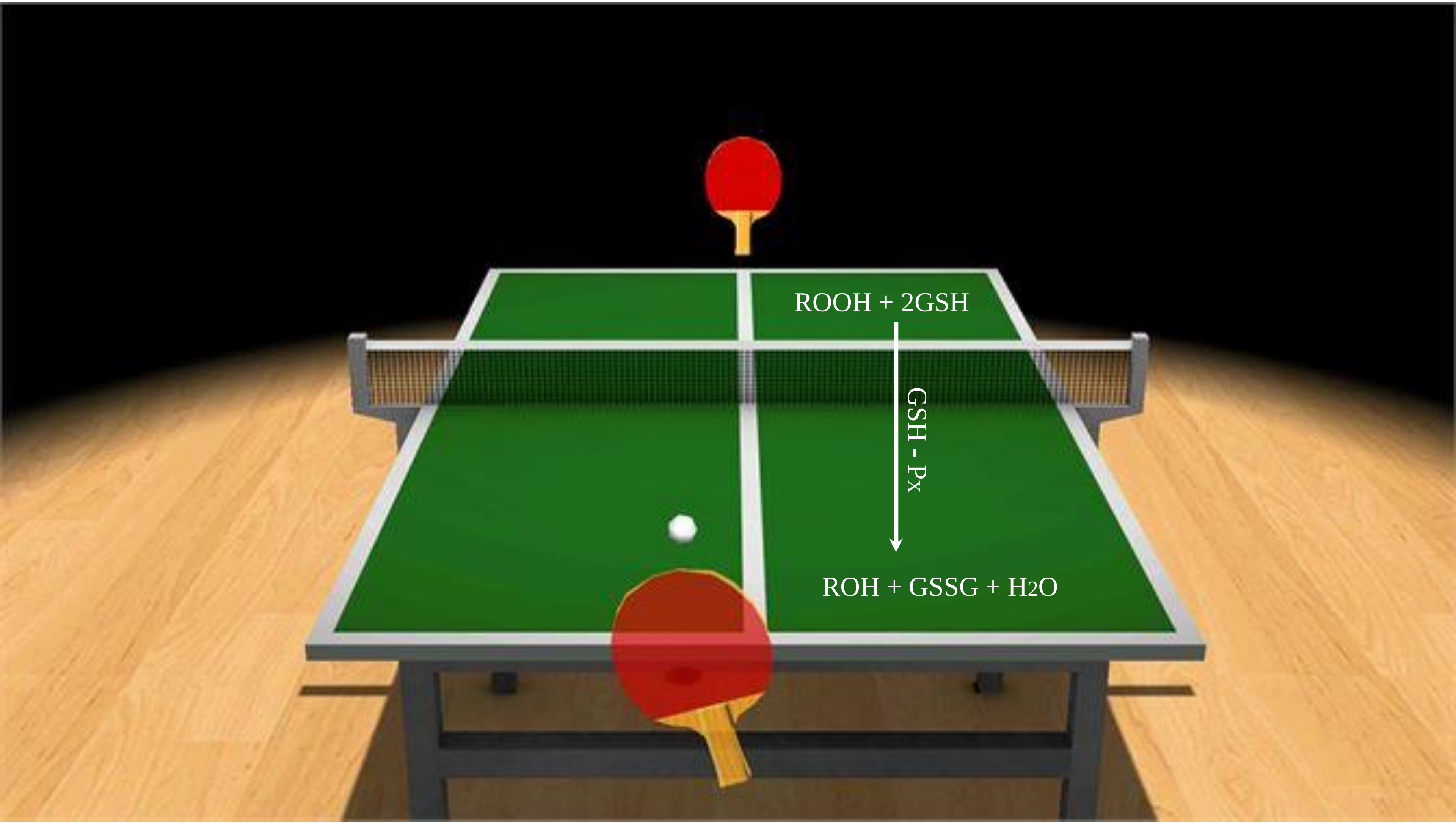
- 4 different GSH-Px in avian species
- Selenium feed supplementation ↗ GSH-Px activity

**Different biological roles:**

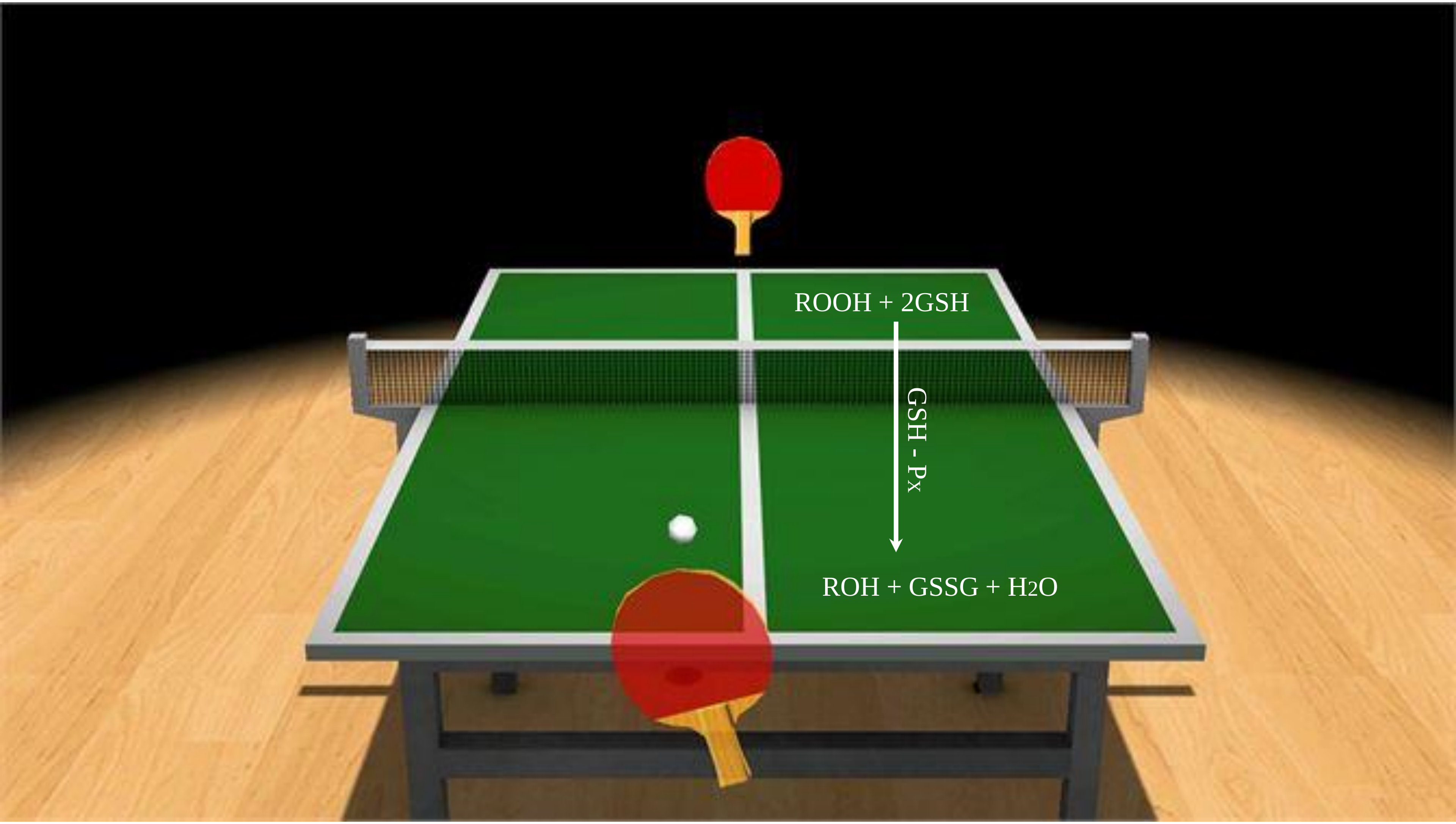
- Prevention of lipid peroxidation
- ROS detoxification
- Specific role of GSH-Px 4 in male fertility


ROOH + 2GSH
GSH - Px
ROH + GSSG + H2O

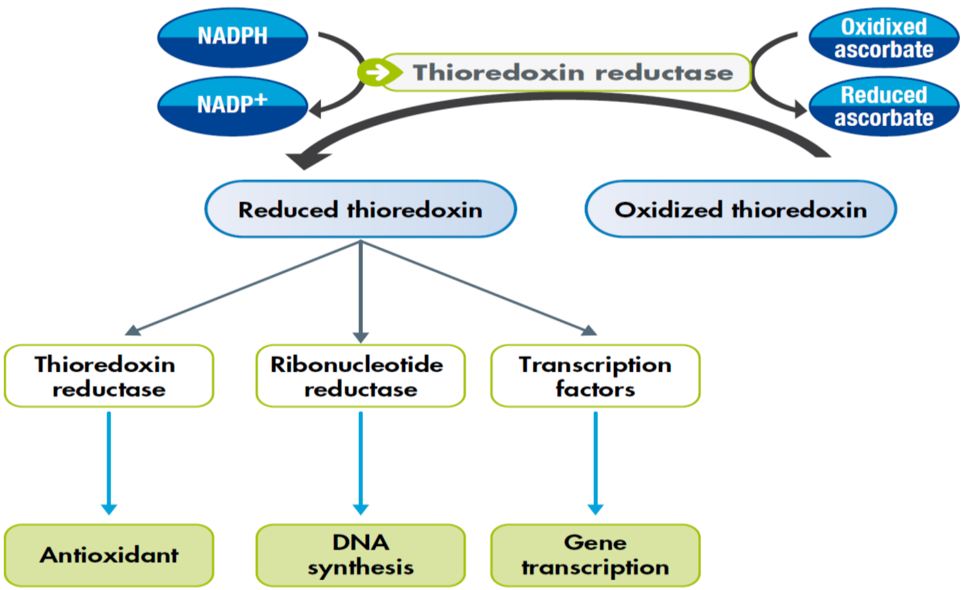
2GSH + NADP+
GR
GSSG + NADPH + H+


ROOH + 2GSH
GSH - Px
ROH + GSSG + H2O


2GSH + NADP+
GR
GSSG + NADPH + H+


ROOH + 2GSH
GSH - Px
ROH + GSSG + H2O


2GSH + NADP+
GR
GSSG + NADPH + H+




**TrxR plays a role in:**

- Cell growth
- Inhibition of apoptosis
- Cellular sensitivity to glucocorticoids
- Immunomodulation
- Pregnancy and birth
- Neuronal survival

# Other selenoproteins

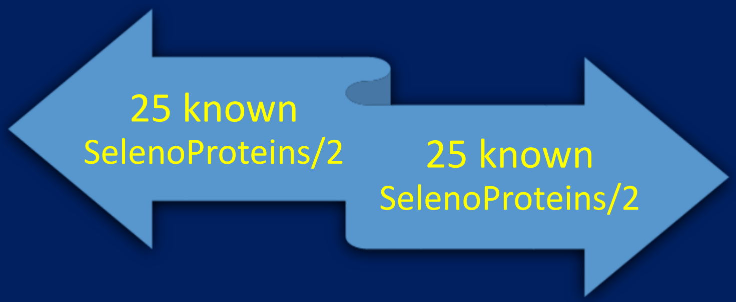
I. Iodothyronine deiodinases
II. Selenophosphate synthetase-2
III. 15-kDa selenoprotein
IV. Selenoprotein H
V. Selenoprotein I
VI. Selenoprotein K
VII. Selenoprotein M
VIII. Selenoprotein N
IX. Selenoprotein O
X. Selenoprotein P
XI. Selenoprotein Pb
XII. Selenoprotein R
XIII. Selenoprotein S
XIV. Selenoprotein T
XV. Selenoprotein U
XVI. Selenoprotein W

## Selenoprotein location in chicken

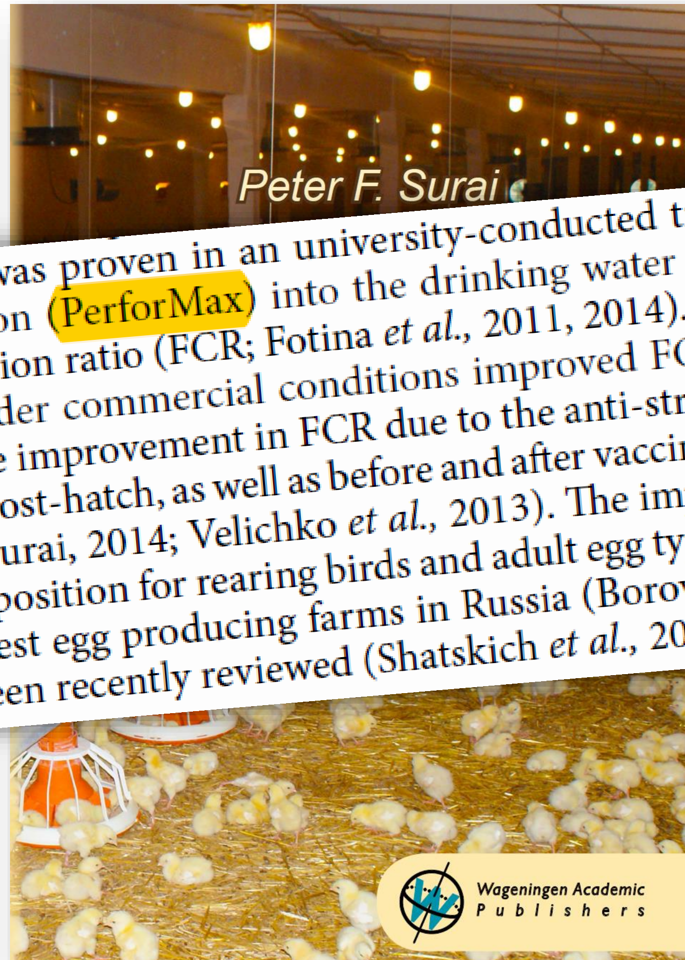
| Location/feature | Selenoproteins |
|---|---|
| Inside the cell | GSH-Px1, GSH-Px2, GSH-Px4, DIO1, DIO2, DIO3, TrxR1, TrxR2, TrxR3, Sep15, SelH, SelI, SelK, SelM, SelN, SelO, SelT, SelU, SelW, MsrB1, SPS2 |
| Outside the cell/secreted | SelPa, SelPb and GSH-Px3 |
| Endoplasmic reticulum | DIO1, DIO2, DIO3, Sep15, SelI, SelK, SelM, SelN SelS and SelT |
| Mitochondria | GSH-Px1, GSH-Px2, GSH-Px4, TrxR1, TrxR2, TrxR3, SelM, SelO and SelU |
| Cytoplasm | GSH-Px1, GSH-Px2, GSH-Px4, TrxR1, TrxR2, TrxR3 and SelW |
| Nucleus | GSH-Px4, MsrB1 and SelH |
| Golgi apparatus | SelT |
| Membrane | SelI |
| Membrane-bound | SelI, SelK, SelS, SelT, DIO1 and DIO3 |
| Zn-containing | Sep15, MsrB1, SelW and SelM |
| POP-containing | GSH-Px1, GSH-Px2, GSH-Px3 and GSH-Px4 |
| Thioredoxin-like fold-containing | GSH-Px1, GSH-Px2, GSH-Px3, GSH-Px4, DIO1, DIO2, DIO3, TrxR3, SelT, SelH, SelW, Sep15, SelM, SelU and SelO |
| Flavin adenine dinucleotide-interacting | TrxR1, TrxR2 and TrxR |

# Vitagene Concept

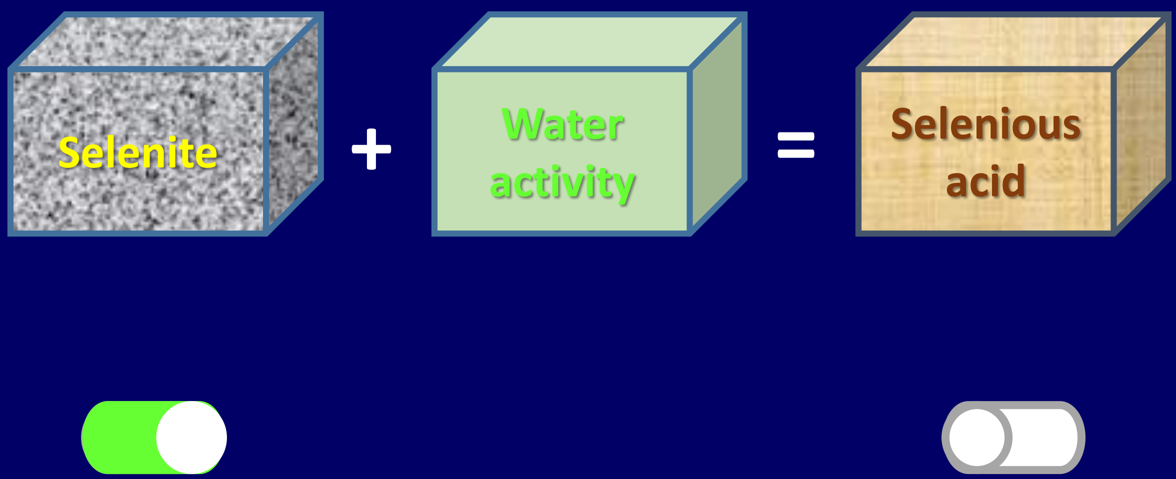
Antioxidant Defences

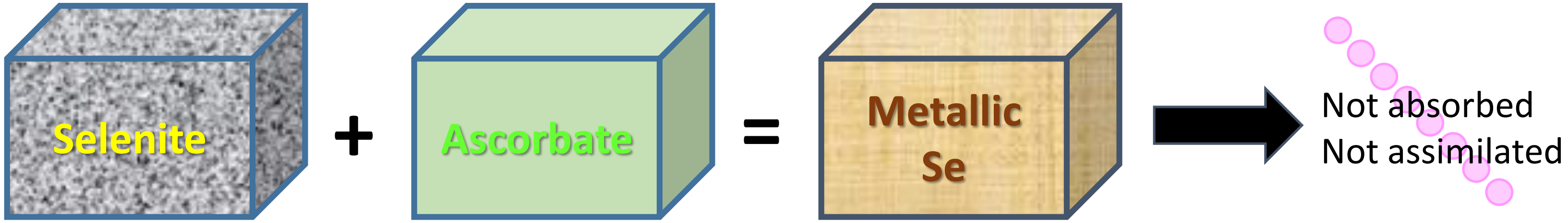



- AO defence Cell proliferation
- DNA-repair systems Cell differentiation
- Transfer of genetic information Stability of cell membrane
- Stress protein synthesis Stability of intracellular milieu
- Proteosomal function Macromolecular turnover
- Neutralisation and removing toxic chemicals Stress response
- Tissue regeneration and wound healing Hormonal response
- Tumour suppression Immune response
- Cell death and cell replacement Thermoregulation
- Neuronal response




In particular, it was proven in an university-conducted trial that inclusion of anti-stress composition (PerforMax) into the drinking water improved chicken growth and feed conversion ratio (FCR; Fotina *et al.*, 2011, 2014). Using the same anti-stress composition under commercial conditions improved FCR during a 39 day broiler growth trial. The improvement in FCR due to the anti-stress composition during the first three days post-hatch, as well as before and after vaccination was highly significant (Velichko and Surai, 2014; Velichko *et al.*, 2013). The importance and efficacy of the anti-stress composition for rearing birds and adult egg type parent stock (Hy-Line) at one of the biggest egg producing farms in Russia (Borovskaya poultry farm, Tumen region) have been recently reviewed (Shatskich *et al.*, 2015).


Selenite
+
Water activity
=
Selenious acid

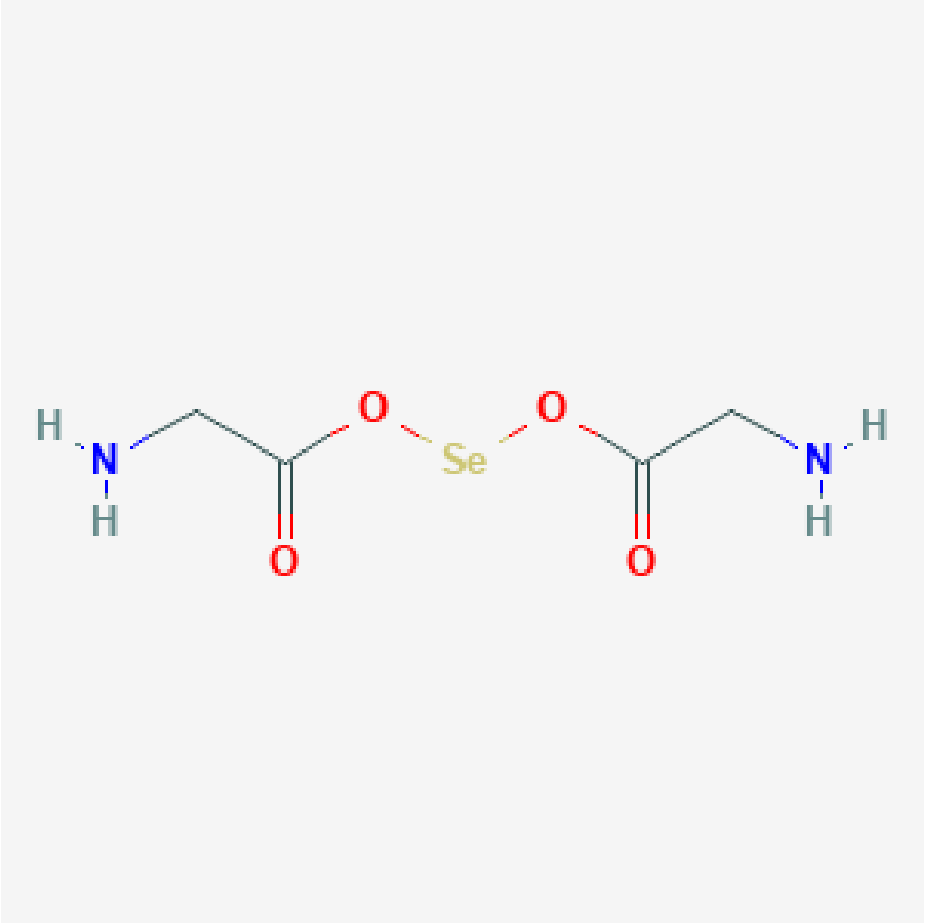

Selenite
+
Ascorbate
=
Metallic
Se
Not absorbed
Not assimilated

# Chelated Selenium products

Se-glycinates
Se-proteinates
Se-amino acids complexes

The chemical position of Se in the periodic table of elements indicates that Se is not a true metal, and therefore its chelating ability is in question.

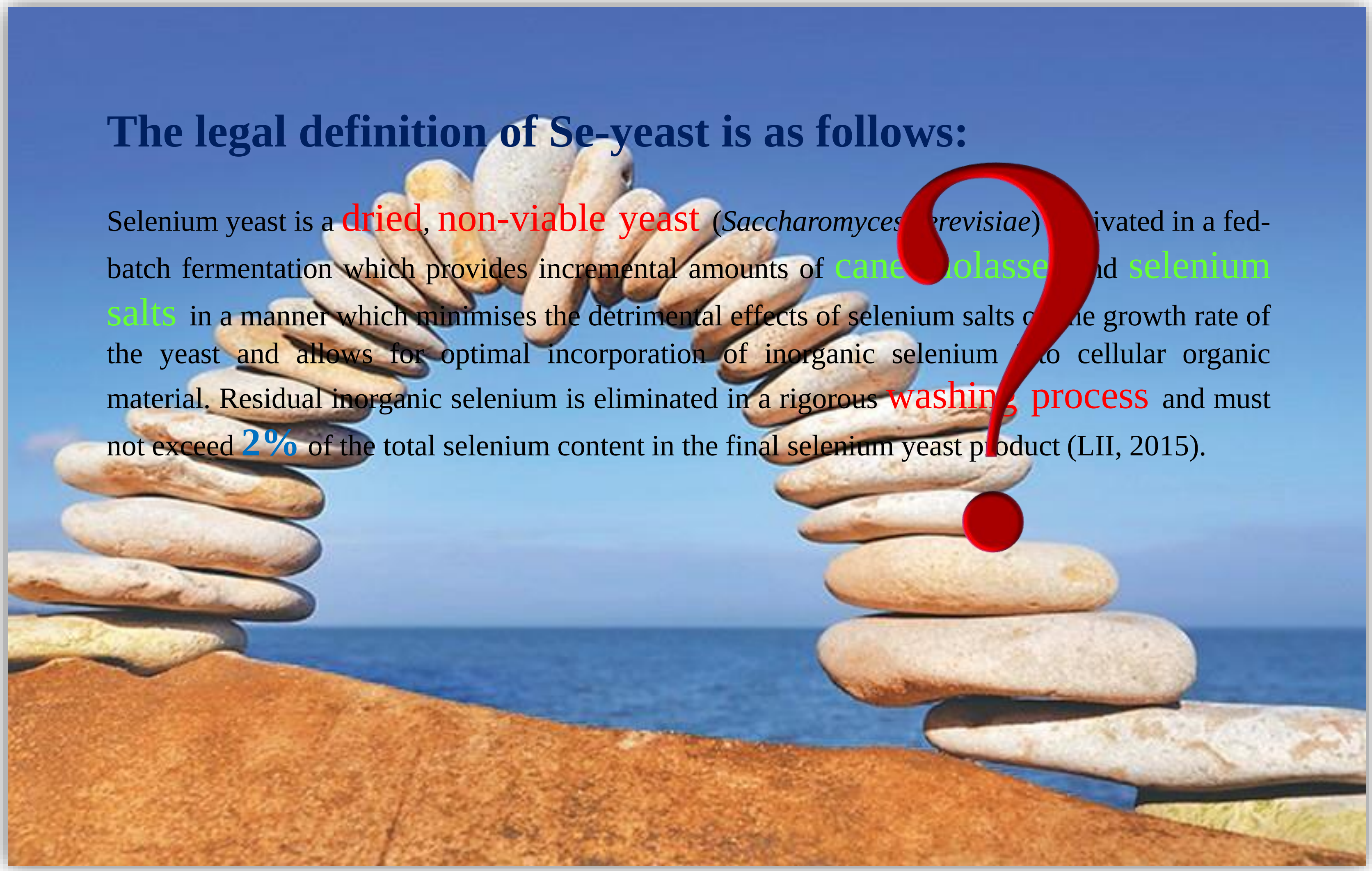
Chelated Se products are not related to SeMet or SeCys and, probably, should not be included into the organic Se category.

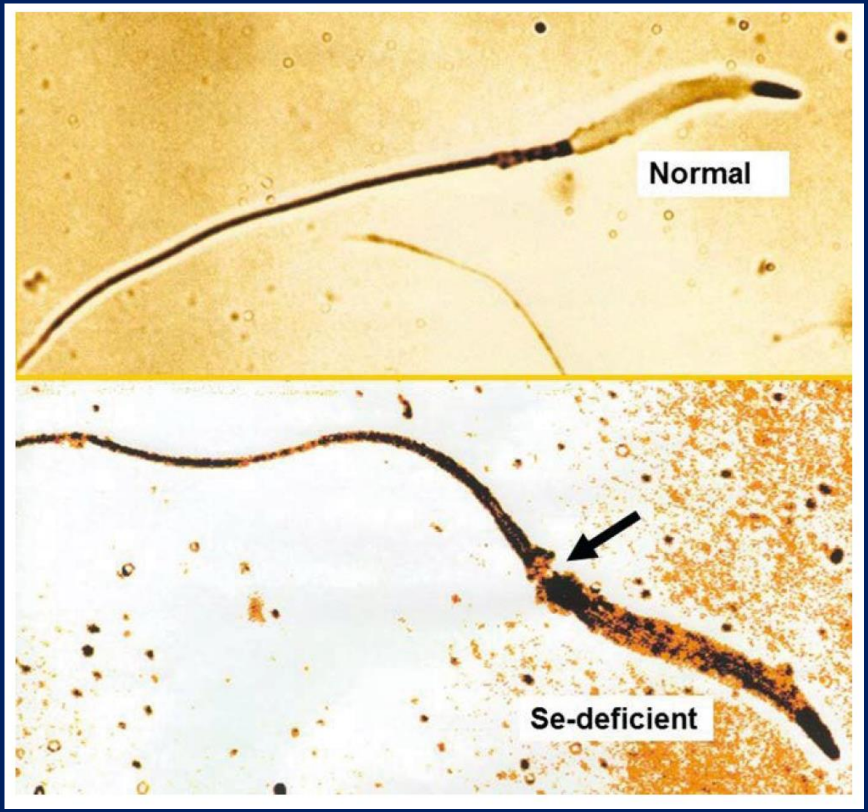

H
N
H
O
Se
O
O
O
N
H
H

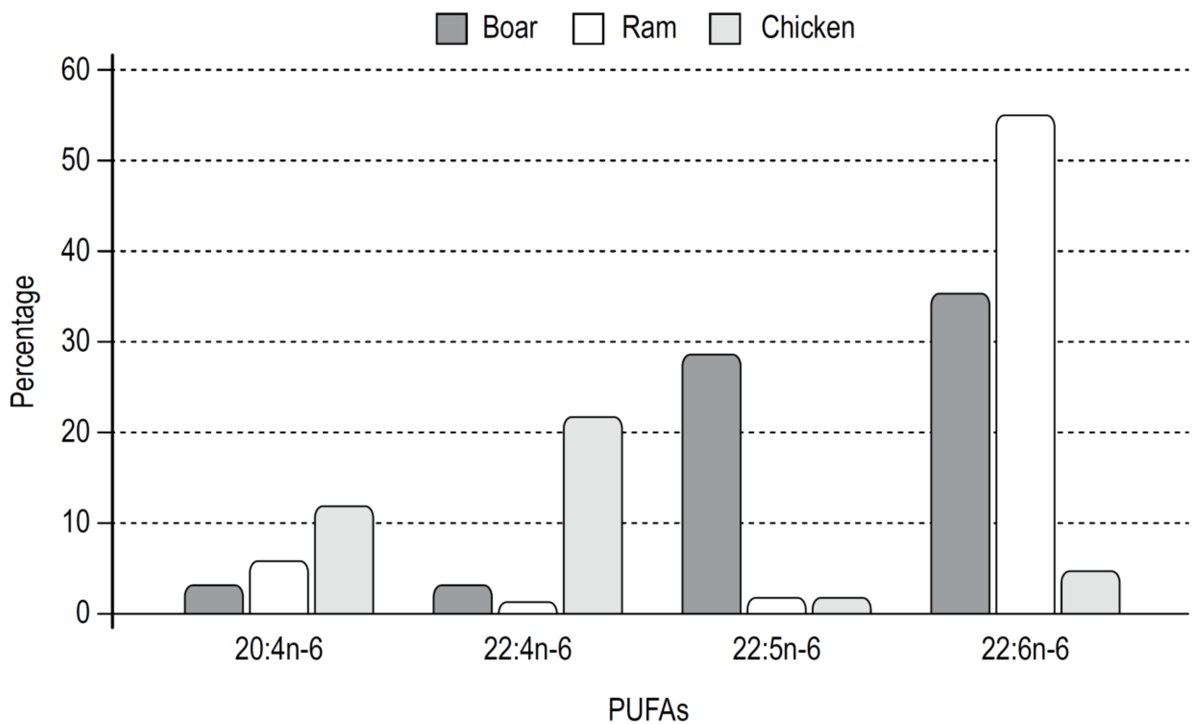
# Selenium-enriched yeast

**Saccharomyces Cerevisiae**
inactivated yeast

- **50-70%** of Se as SeMet
- **10-15%** of Se as SeCy
- Fermentation process, Se composition depends on growing conditions
- **11.5%** to **28%** of water soluble Se
- **>50** Selenium species
- Variation of SeMet proportion from batch to batch


The legal definition of Se-yeast is as follows:
Selenium yeast is a dried, non-viable yeast (*Saccharomyces cerevisiae*) cultivated in a fed-batch fermentation which provides incremental amounts of cane molasses and selenium salts in a manner which minimises the detrimental effects of selenium salts on the growth rate of the yeast and allows for optimal incorporation of inorganic selenium into cellular organic material. Residual inorganic selenium is eliminated in a rigorous washing process and must not exceed 2% of the total selenium content in the final selenium yeast product (LII, 2015).


Normal
Se-deficient




Polyunsaturated fatty acids (PUFAs) in spermatozoa phospholipids, % (adapted from Surai, 2002).
20:4n-6 = arachidonic acid; 22:4n-6 = docosatetraenoic acid; 22:5n-6 = docosapentaenoic acid; 22:6n = 3 docosahexaenoic acid.


GSH-Px

GSH-Px

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# An improvement in productive and reproductive performance of aged broiler breeder hens by dietary supplementation of organic selenium

Mojtaba Emamverdi [a], Ahmad Zare-Shahneh [a, *], Mahdi Zhandi [a, **], Mojtaba Zaghari [a], Dariush Minai-Tehrani [b], Mahdi Khodaei-Motlagh [c]

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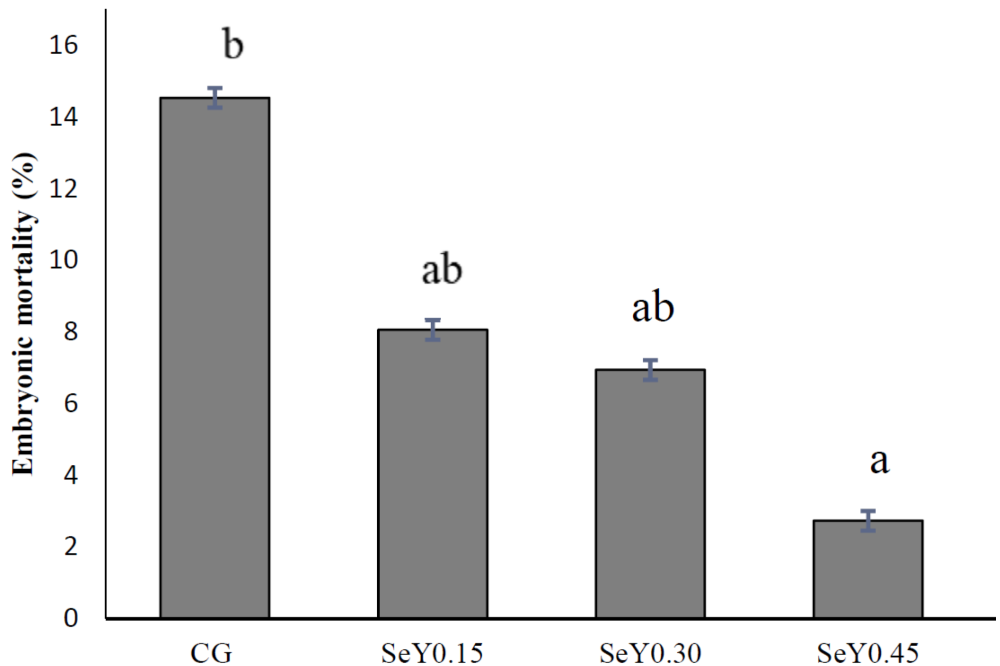
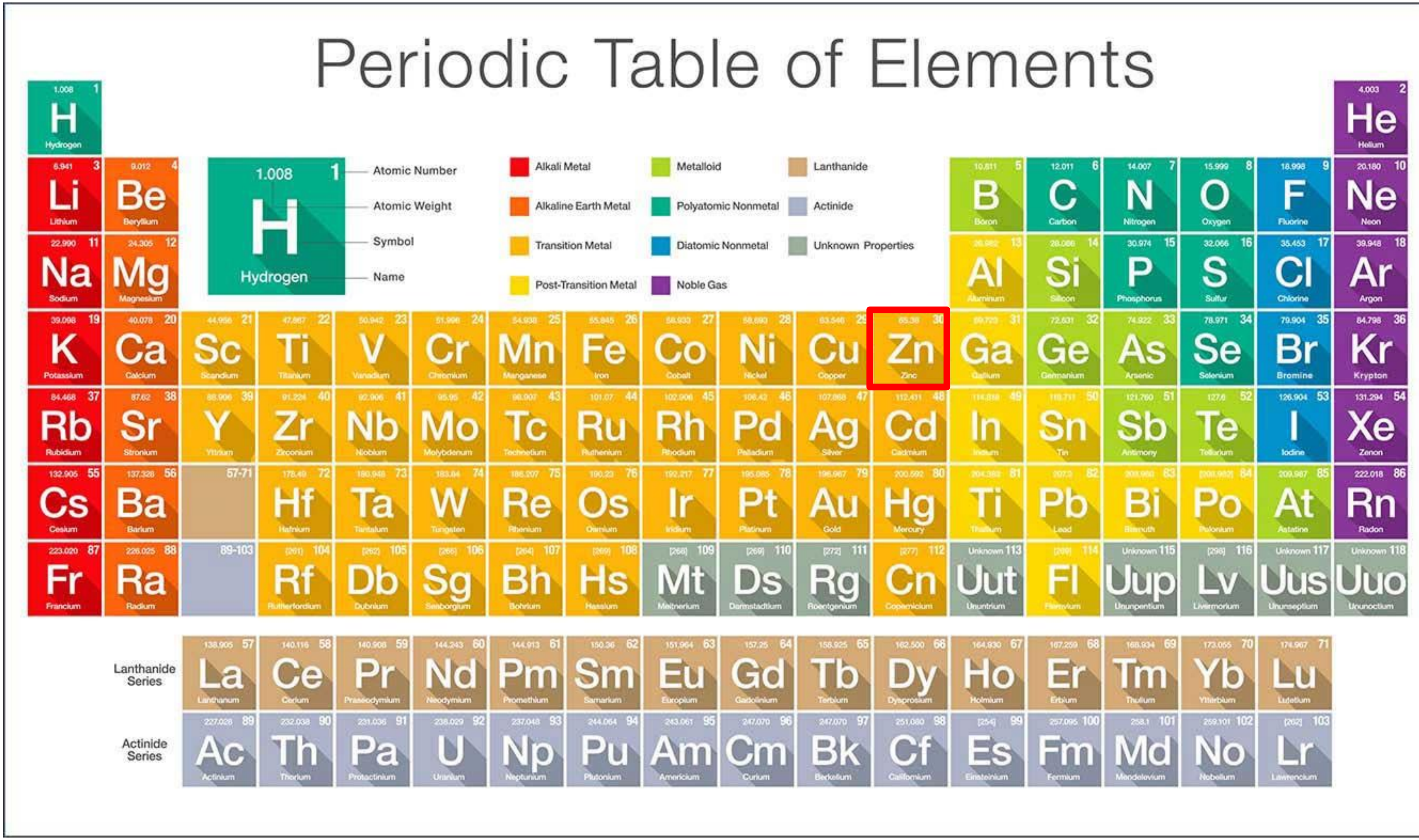
[b] Faculty of Life Science and Biotechnology, Shahid Beheshti University, Tehran, 16589-53571, Iran
[c] Department of Animal Science, Faculty of Agricultural and Natural Science, University of Arak, Arak, 38156-88349, Iran


b
ab
ab
a
16
14
12
10
8
6
4
2
0
Embryonic mortality (%)
CG
SeY0.15
SeY0.30
SeY0.45


Periodic Table of Elements
1.008 1
H
Hydrogen
Atomic Number
Atomic Weight
Symbol
Name
Alkali Metal
Alkaline Earth Metal
Transition Metal
Post-Transition Metal
Metalloid
Polyatomic Nonmetal
Diatomic Nonmetal
Noble Gas
Lanthanide
Actinide
Unknown Properties
H He
Li Be B C N O F Ne
Na Mg Al Si P S Cl Ar
K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
Cs Ba 57-71 Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn
Fr Ra 89-103 Rf Db Sg Bh Hs Mt Ds Rg Cn Uut Fl Uup Lv Uus Uuo
Lanthanide Series
La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Actinide Series
Ac Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr

- Essential trace element
- Cofactor in more than 300 enzymes
- Required for the structural and functional integrity of over 2000 transcription factors and almost every signaling and metabolic pathway is dependent on one or more zinc-requiring proteins
- Cell growth and proliferation is strictly depend on zinc (immune system, skin, reproductive system)
- Gene expression
- Appetite control
- Protein, carbohydrate and fat metabolism
- Antioxidant defense
- No storage system for zinc

# Some studies showing the zinc requirement of broiler chickens

| References | Year | Sex | Age (Day) | Diet type | Traits evaluated | Estimated requirement (mg kg$^{-1}$) |
|---|---|---|---|---|---|---|
| Rossi, *et al.* | 2007 | M [a] | 0-42 | Corn-soy | Skin tearing | 105 |
| Vieira *et al.* | 2013 | M | 0-42 | Corn-soy | Footpad integrity | 100 |
| Gomez | 2008 | M and F | 8-21 | Practical | Tibia Zn | 86 |
| Huang *et al.* | 2007 | M | 0-21 | Corn-soy | Weight gain | 84 |
| Mohanna and Nys | 1999 | - | 5-21 | Corn-soy | Tibia and plasma Zn | 75 |
| Bao *et al.* | 2009 | - | 14-35 | - | Weight gain | 68 |
| Xiudong Liao *et al.* | 2013 | - | 22-42 | Corn-soy | Tibia Zn | 62 |
| Ao *et al.* | 2007 | M | 0-21 | Corn-soy | Weight gain | 37 |
| Wedekind and Baker | 1990 | M | 8-12 | Semi purified | Weight gain | 33 |
| Ao *et al.* | 2006 | M | 0-21 | Corn-soy | Weight gain | 32.8 |
| Steinruck and Kirchgessner | 1993 | - | 72-107 | Semi purified | Weight gain | 32 |
| Zeigler *et al.* | 1961 | - | - | Semi purified | Weight gain | 28 |
| Batal *et al.* | 2001 | F [b] | 1-3 | Semi purified | Weight gain | 27.1 |
| Dewar and Downie | 1984 | M and F | 0-3 | Purified | Live weight | 18 |
| Emmert and Baker | 1995 | - | 8-22 | Purified | Weight gain | 10.6 |

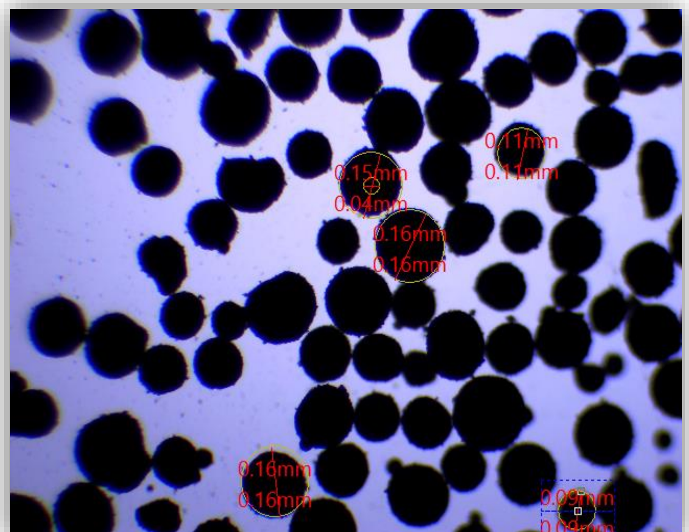
[a] Male, [b] Female.

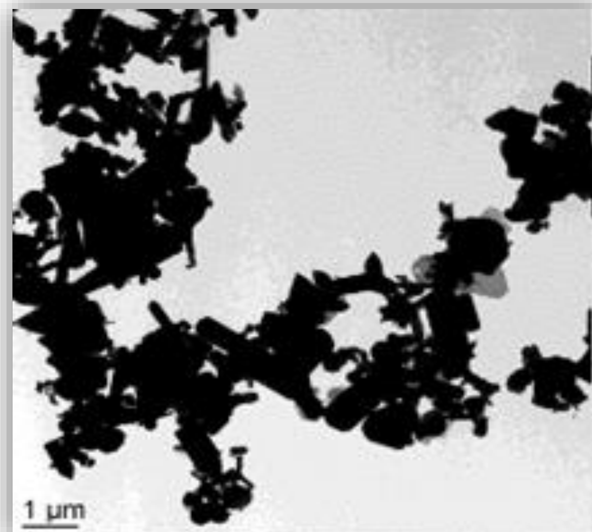
| Feed Ingredients | Zinc content (mg/kg) |
|---|---|
| Corn | 18 |
| Soybean meal | 40 |
| Wheat | 34 |
| Wheat bran | 100 |
| Barley | 30 |
| Canola meal | 71 |
| Corn gluten | 33 |

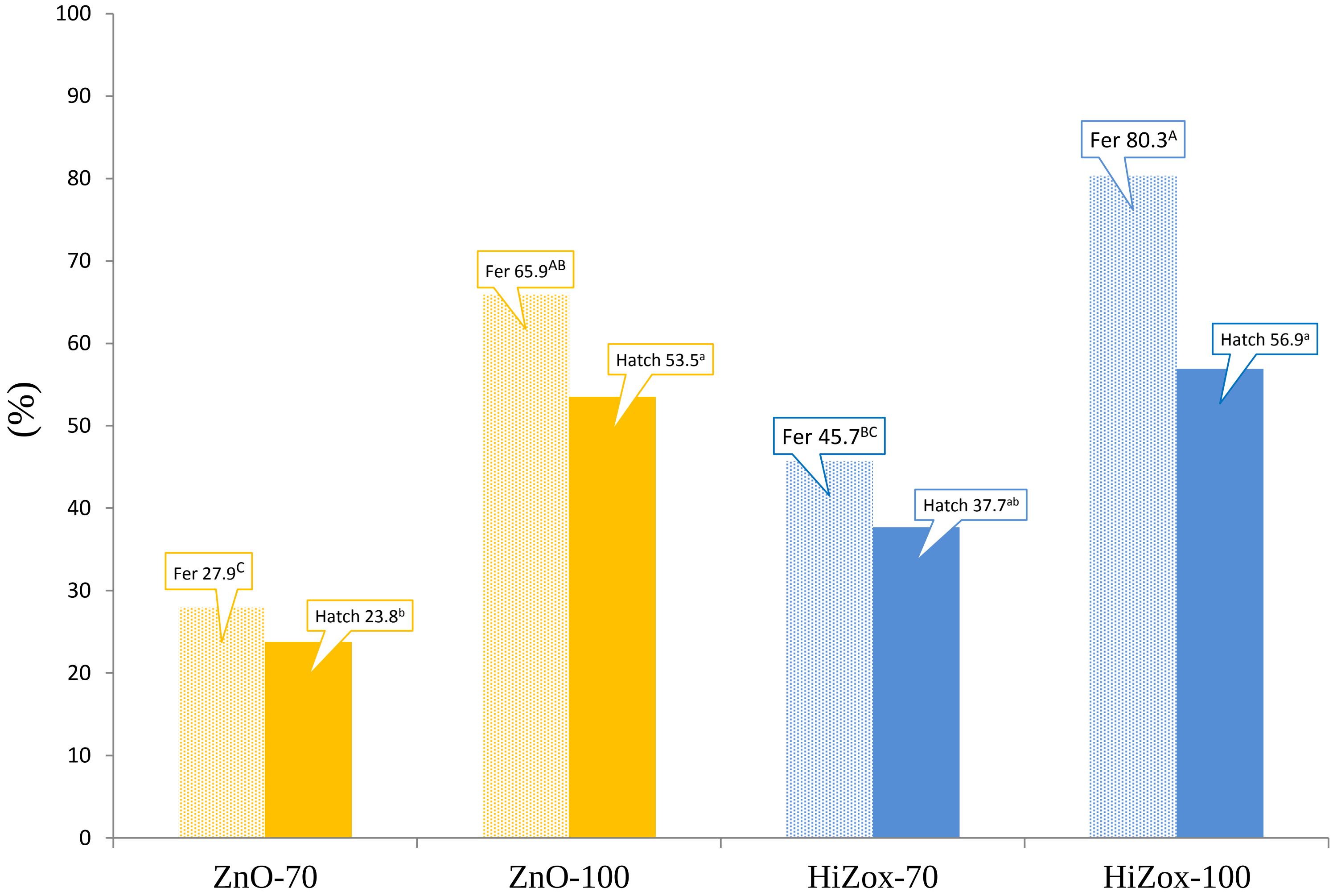
**What does it means?**

Natural Zn concentrations in feedstuffs are generally lower than the daily Zn requirement for broiler chickens leading to the necessity of dietary Zn supplementation.

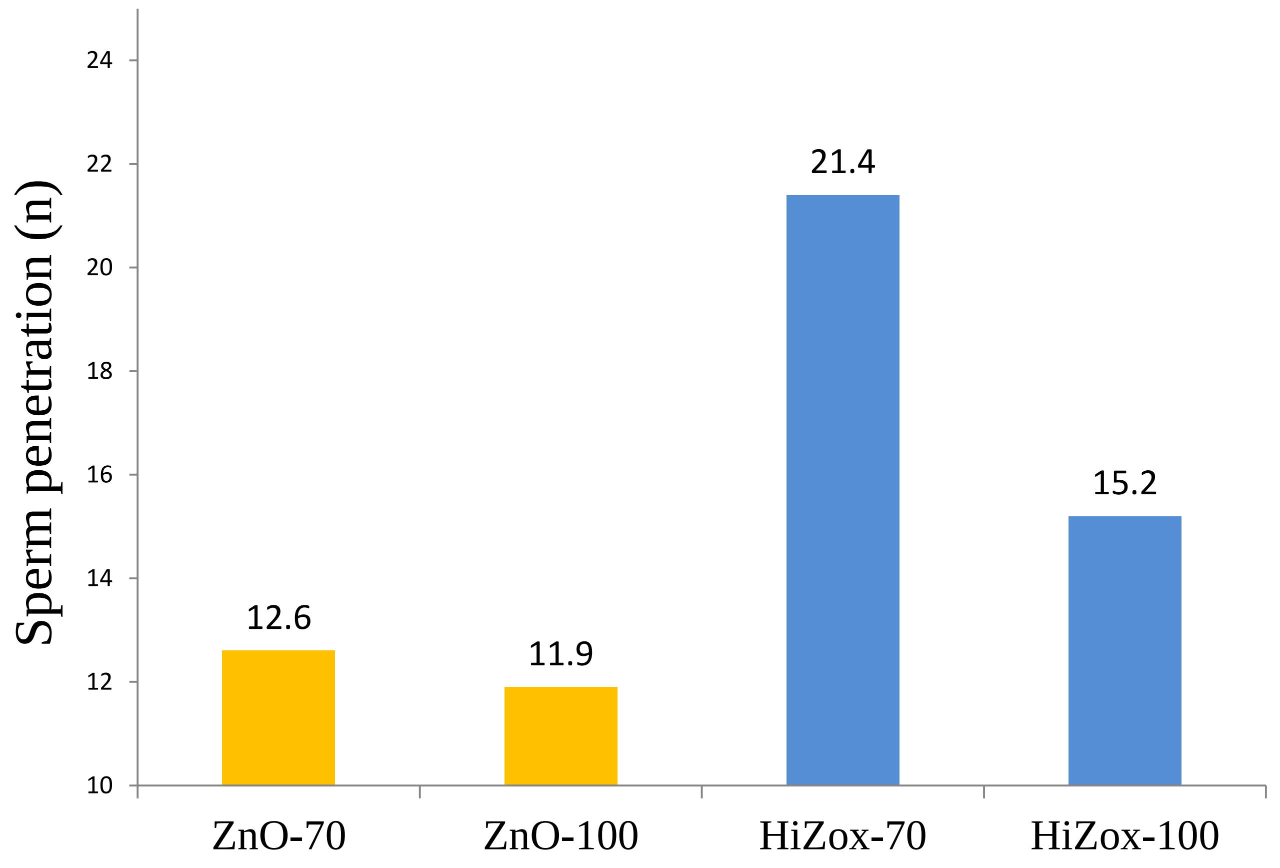
| مقایسه خصوصیات فیزیکی انواع اکسید روی | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| منبع اکسید روی | اندازه ذرات (µm) | شکل | زاویه ریزش (درجه) | قابلیت میکس شدن | رنگ | نسبت سطح به وزن ($m2/g$) | آلودگی به عناصر سنگین | | | |
| | | | | | | | آرسنیک (*ppm*) | کادمیوم (*ppm*) | سرب (*ppm*) | دی اکسین (*ng*) |
| اکسید روی فعال شده | کمتر از ۱۰۰ | صفحه‌ای | ۲۸ | خوب | کرم | ۴۲ | ۵ | ۲ | ۲۰ | ۱/۵ |
| اکسید روی معمولی | ۱۰۰ تا ۱۰۰۰ | میله‌ای | ۳۵ | ضعیف | سفید | ۴/۲ | ۱۰ | ۱۱ | ۸۰ | ۱/۵ |

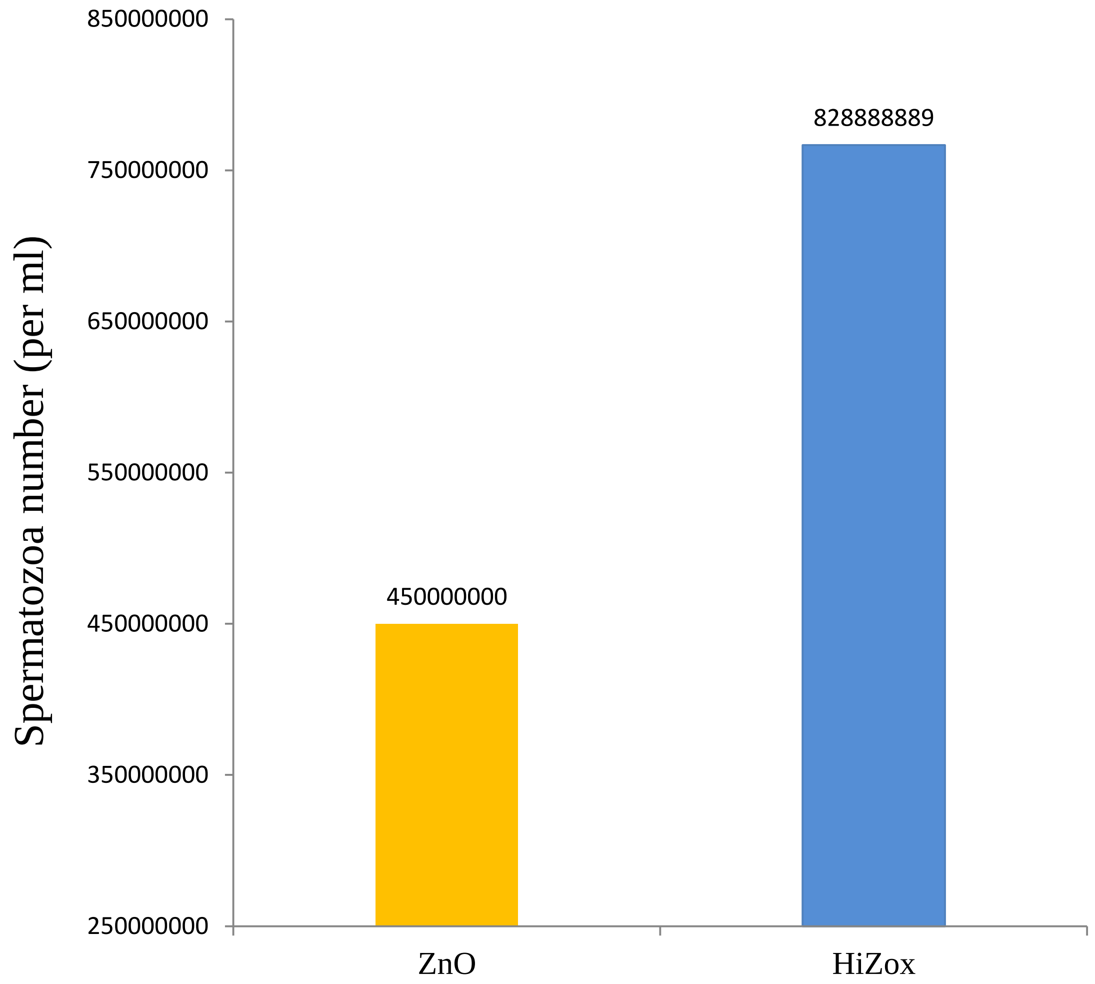


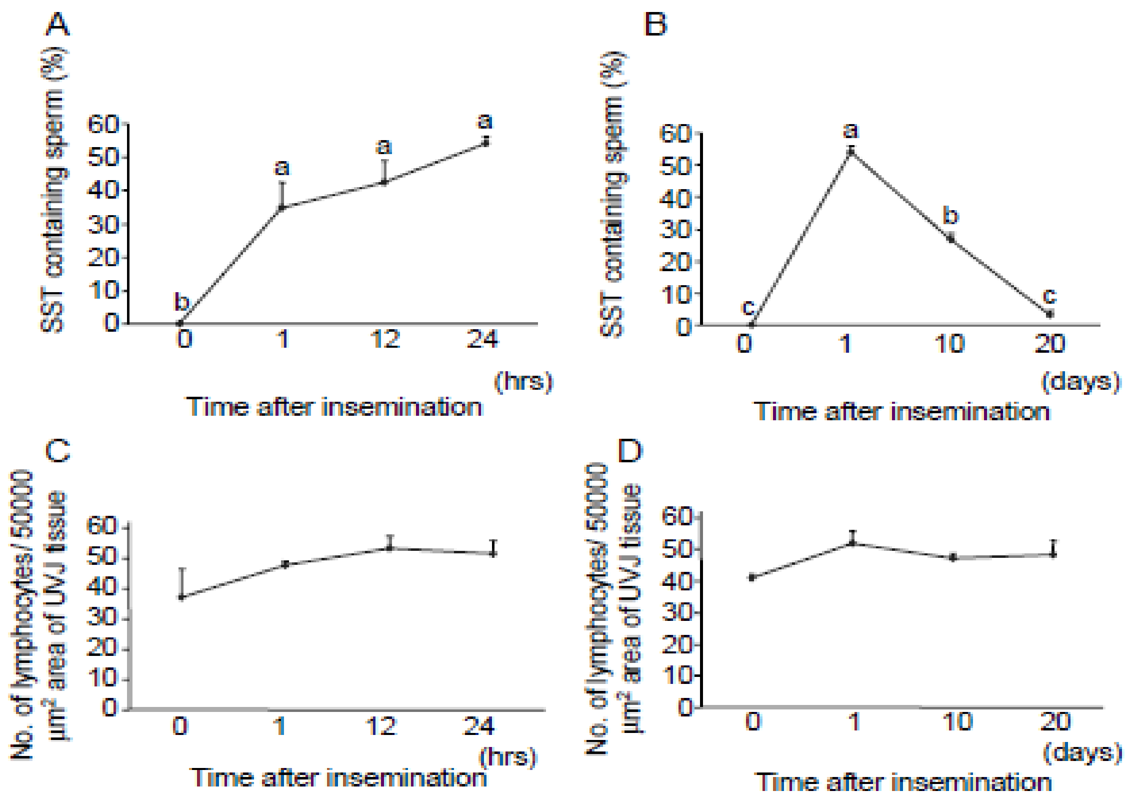


(%)
100
90
80
70
60
50
40
30
20
10
0
Fer 27.9C
Hatch 23.8b
Fer 65.9AB
Hatch 53.5a
Fer 45.7BC
Hatch 37.7ab
Fer 80.3A
Hatch 56.9a
ZnO-70
ZnO-100
HiZox-70
HiZox-100


Sperm penetration (n)
24
22
20
18
16
14
12
10
12.6
11.9
21.4
15.2
ZnO-70
ZnO-100
HiZox-70
HiZox-100




Effect of zinc sources on concentration of spermatozoa (cell number per ml of semen) at week 65 (P<0.06, SE 113955511).


A
SST containing sperm (%)
60
50
40
30
20
10
0
b
a
a
a
0
1
12
24
(hrs)
Time after insemination
B
SST containing sperm (%)
a
b
c
c
0
1
10
20
(days)
Time after insemination
C
No. of lymphocytes/ 50000 μm² area of UVJ tissue
0
1
12
24
(hrs)
Time after insemination
D
No. of lymphocytes/ 50000 μm² area of UVJ tissue
0
1
10
20
(days)
Time after insemination

## عوامل موثر بر زنده‌مانی اسپرم در SST

| تاثیر | عامل |
| --- | --- |
| | |
| | |
| | |
| | |
| | |
| | |

| عوامل موثر بر زنده‌مانی اسپرم در SST | |
|---|---|
| **عامل** | **تاثیر** |
| کربنیک آنهیدراز | کاهش pH و کاهش تحرک اسپرم |
| | |
| | |
| | |
| | |
| | |

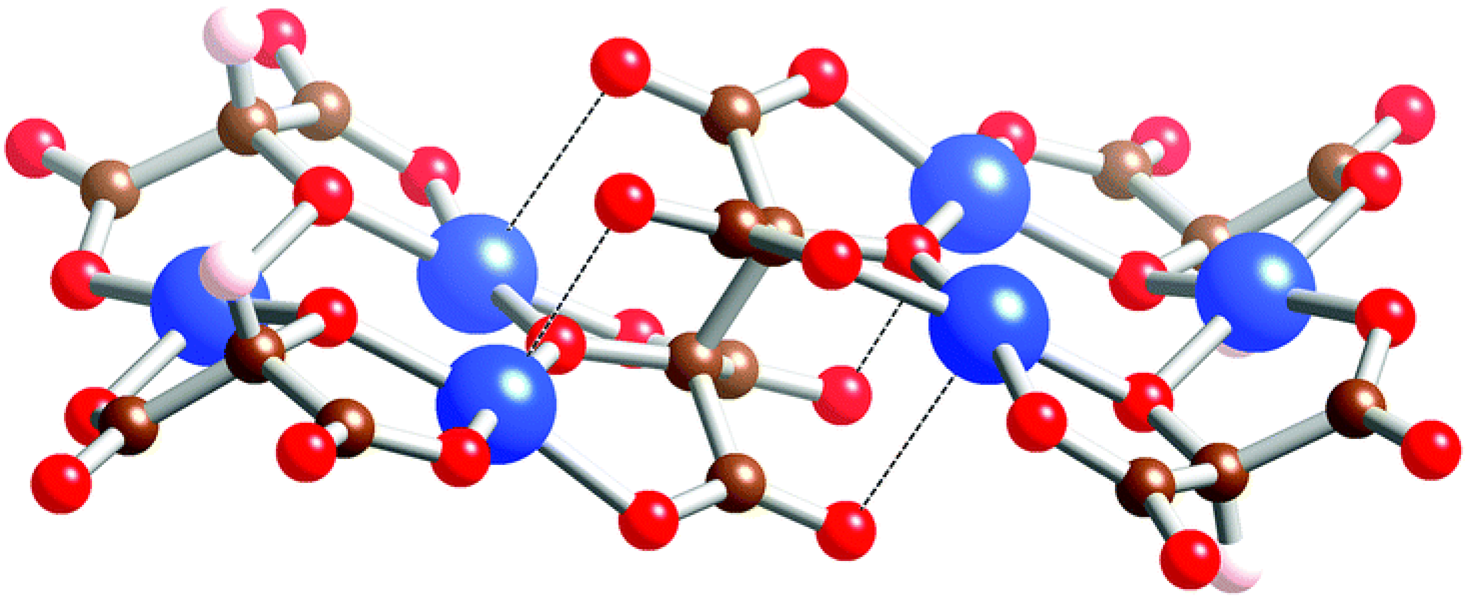
| عوامل موثر بر زنده‌مانی اسپرم در SST | |
|---|---|
| عامل | تاثیر |
| کربنیک آنهیدراز | کاهش pH و کاهش تحرک اسپرم |
| آلکالین فسفاتاز | انتقال لیپید ها از غشاء ریز پرزهای SST |
| | |
| | |
| | |
| | |

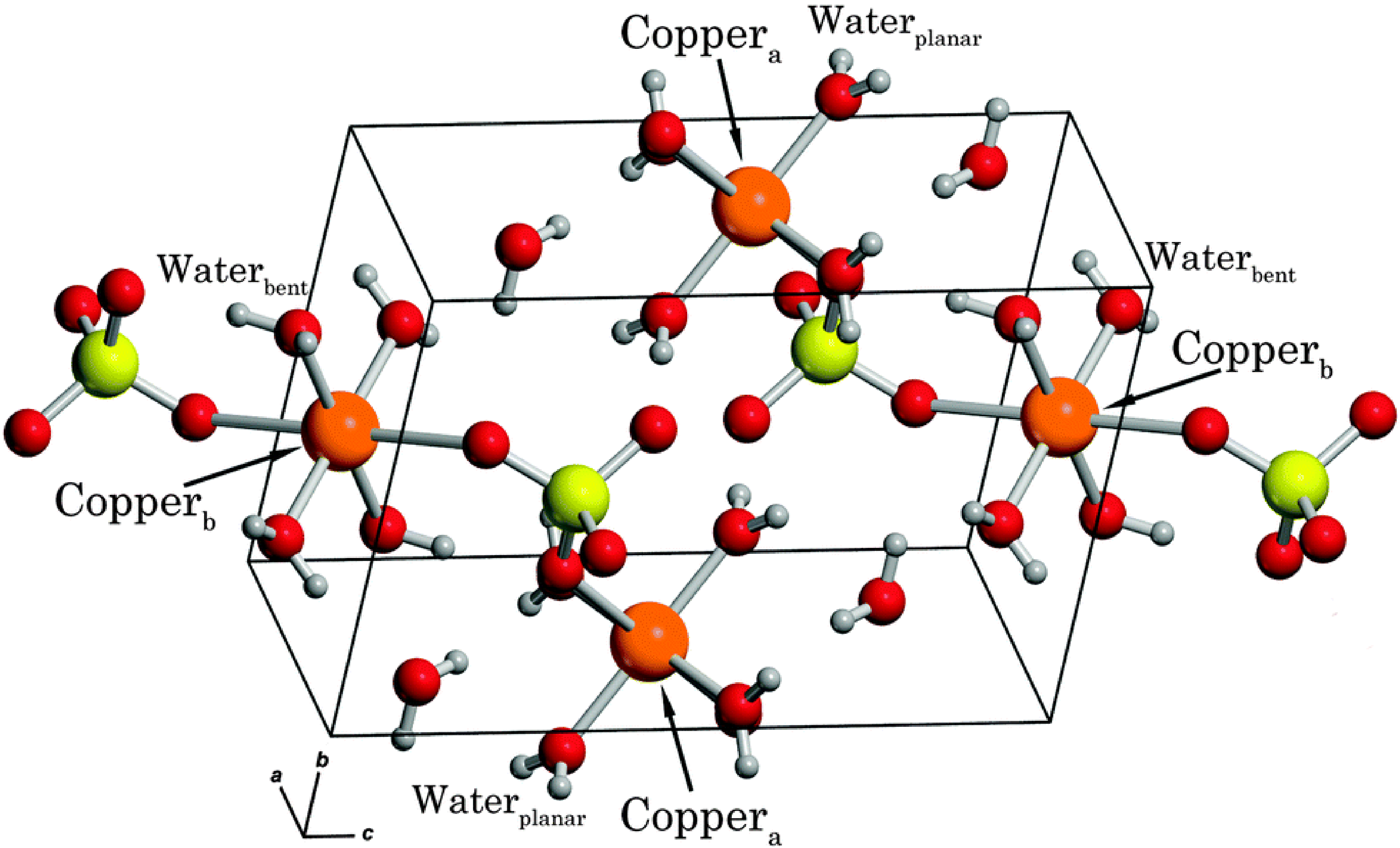
| عوامل موثر بر زنده‌مانی اسپرم در SST | |
|---|---|
| عامل | تاثیر |
| کربنیک آنهیدراز | کاهش pH و کاهش تحرک اسپرم |
| آلکالین فسفاتاز | انتقال لیپید ها از غشاء ریز پرزهای SST |
| آکواپورین‌ها | حذف کاتابولیت‌های اسپرم که طی دوره ذخیره اسپرم در لوله‌ها تجمع یافته‌اند |
| | |
| | |
| | |

| عوامل موثر بر زنده‌مانی اسپرم در SST | |
| --- | --- |
| **عامل** | **تاثیر** |
| کربنیک آنهیدراز | کاهش pH و کاهش تحرک اسپرم |
| آلکالین فسفاتاز | انتقال لیپید ها از غشاء ریز پرزهای SST |
| آکواپورین‌ها | حذف کاتابولیت‌های اسپرم که طی دوره ذخیره اسپرم در لوله‌ها تجمع یافته‌اند |
| آویدین | منشاء مواد مغذی بیوتین و ویتامین‌های مشابه است. نشان‌دهنده فعالیت پروژسترون و ارتباط آن با ذخیره طولانی مدت اسپرم |
| | |
| | |

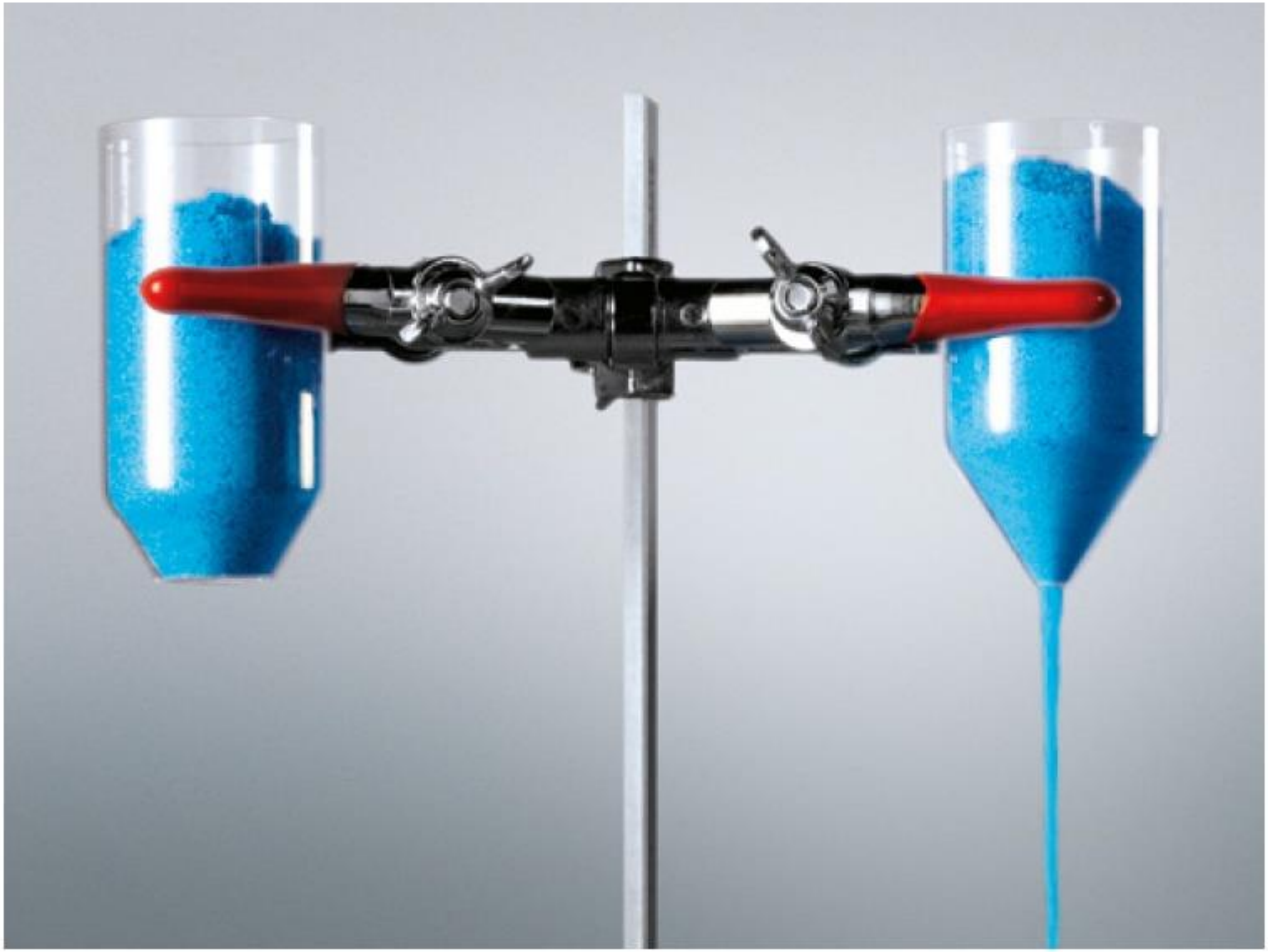
| عوامل موثر بر زنده‌مانی اسپرم در SST | |
|---|---|
| **عامل** | **تاثیر** |
| کربنیک آنهیدراز | کاهش pH و کاهش تحرک اسپرم |
| آلکالین فسفاتاز | انتقال لیپید ها از غشاء ریز پرزهای SST |
| آکواپورین‌ها | حذف کاتابولیت‌های اسپرم که طی دوره ذخیره اسپرم در لوله‌ها تجمع یافته‌اند |
| آویدین | منشاء مواد مغذی بیوتین و ویتامین‌های مشابه است. نشان‌دهنده فعالیت پروژسترون و ارتباط آن با ذخیره طولانی مدت اسپرم |
| آنتی‌اکسیدان‌ها | حفاظت از غشاء اسپرم در برابر اکسیداسیون در SST |
| | |

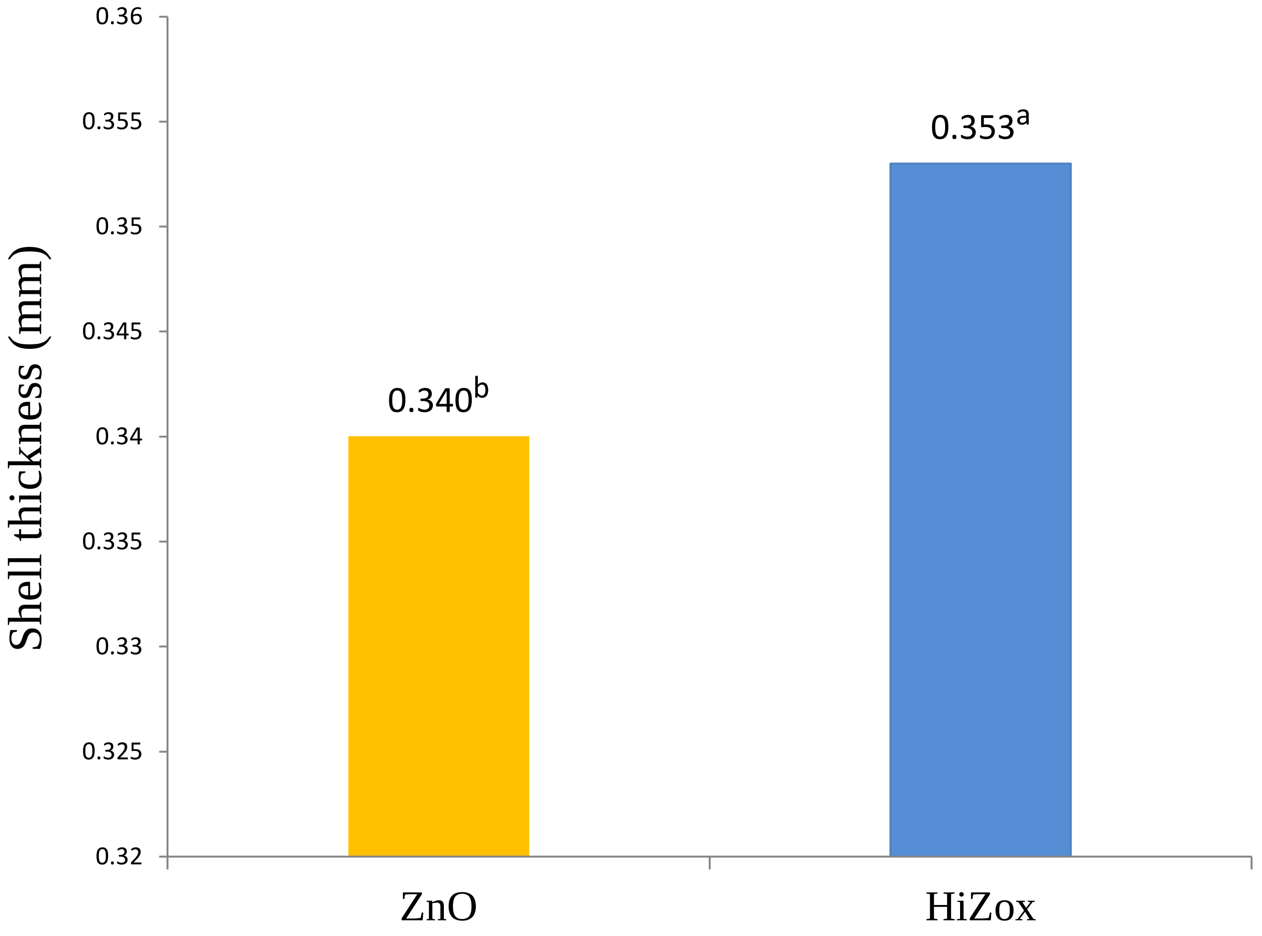
| عوامل موثر بر زنده‌مانی اسپرم در SST | |
|---|---|
| **عامل** | **تاثیر** |
| کربنیک آنهیدراز | کاهش pH و کاهش تحرک اسپرم |
| آلکالین فسفاتاز | انتقال لیپید ها از غشاء ریز پرزهای SST |
| آکواپورین‌ها | حذف کاتابولیت‌های اسپرم که طی دوره ذخیره اسپرم در لوله‌ها تجمع یافته‌اند |
| آویدین | منشاء مواد مغذی بیوتین و ویتامین‌های مشابه است. نشان‌دهنده فعالیت پروژسترون و ارتباط آن با ذخیره طولانی مدت اسپرم |
| آنتی‌اکسیدان‌ها | حفاظت از غشاء اسپرم در برابر اکسیداسیون در SST |
| TFGβ | کاهش پاسخ ایمنی و جلوگیری از التهاب |



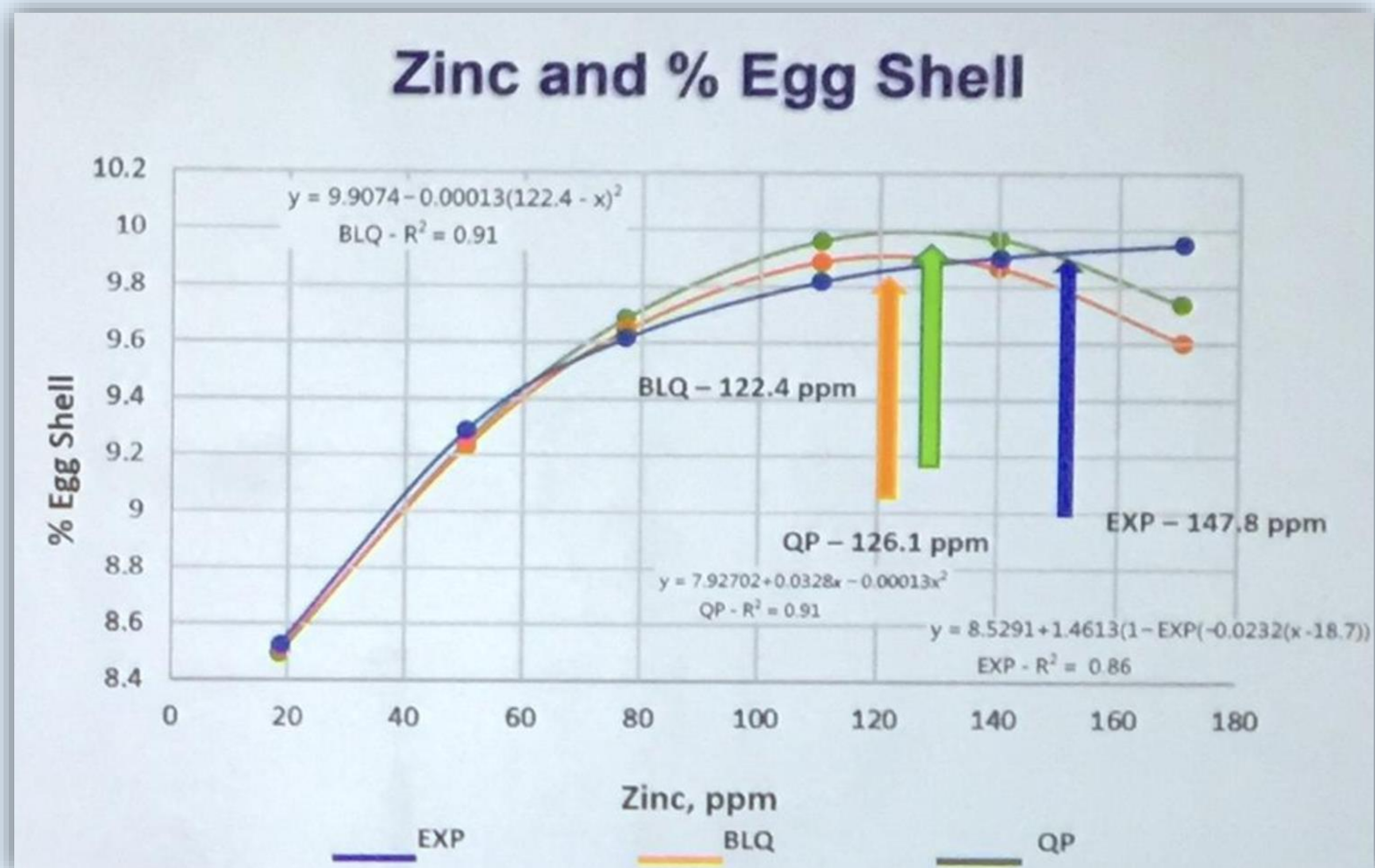


Copper$_a$
Water$_{planar}$
Water$_{bent}$
Water$_{bent}$
Copper$_b$
Copper$_b$
Water$_{planar}$
Copper$_a$
a
b
c

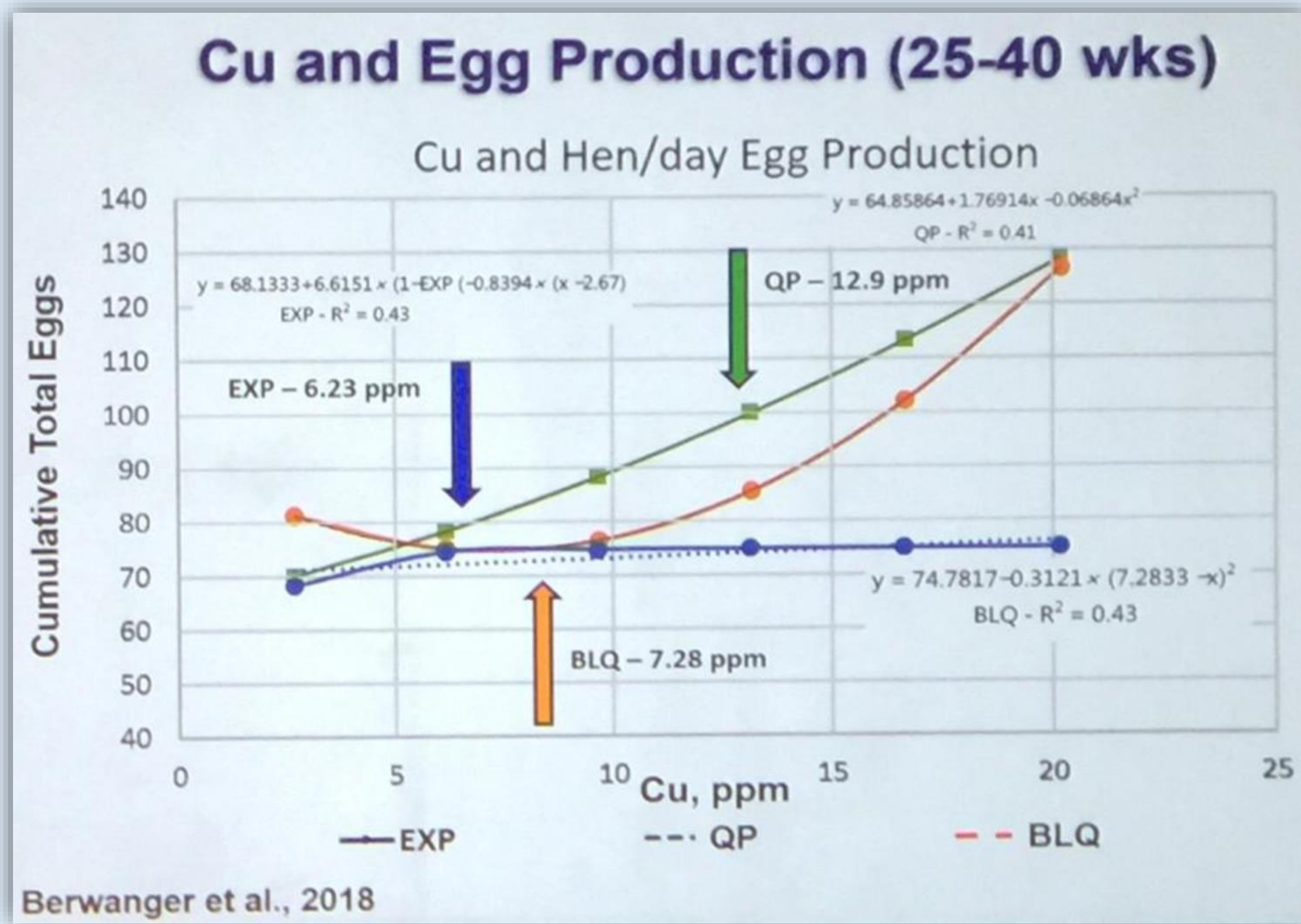




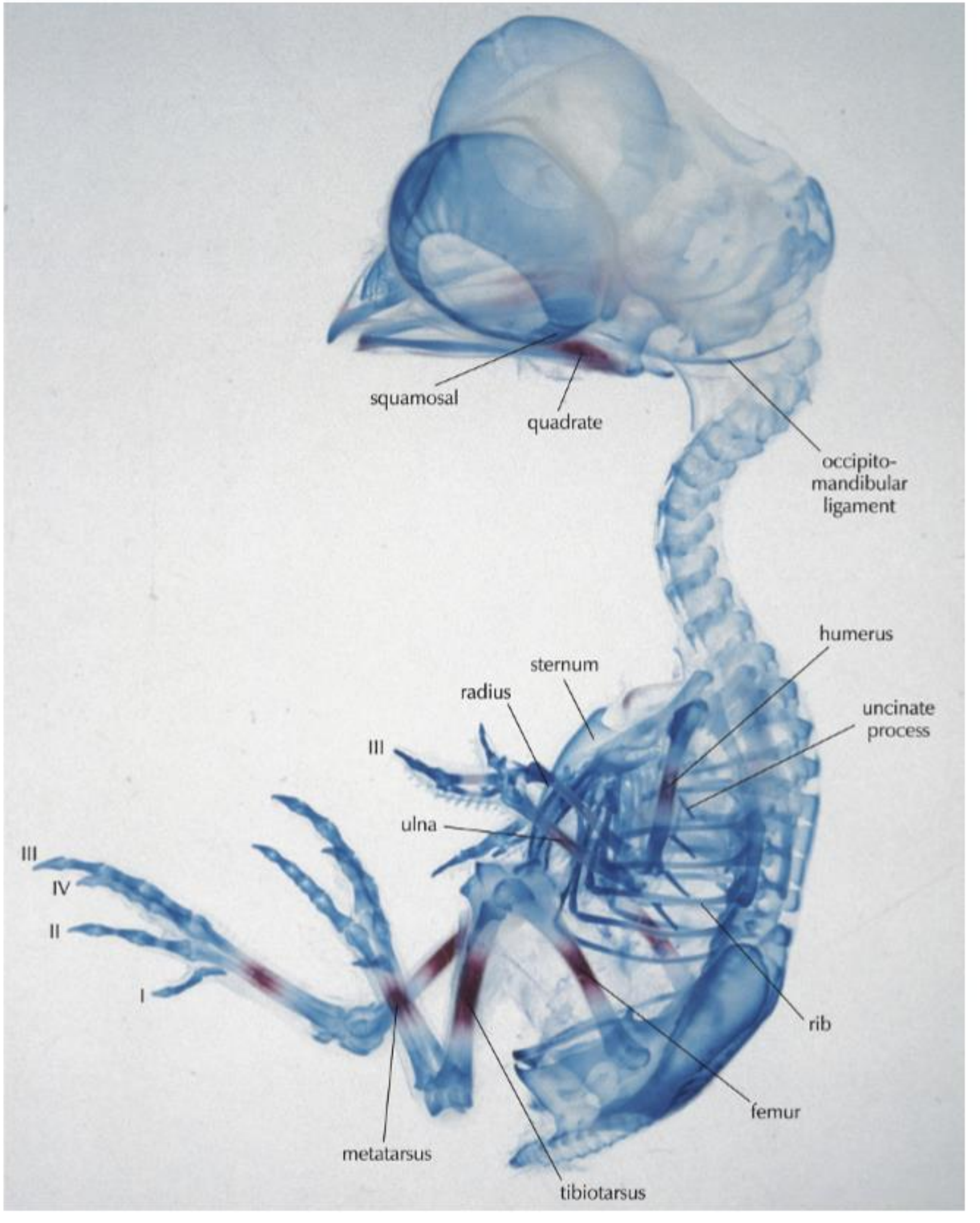
Shell thickness (mm)
0.36
0.355
0.35
0.345
0.34
0.335
0.33
0.325
0.32
0.340[b]
0.353[a]
ZnO
HiZox



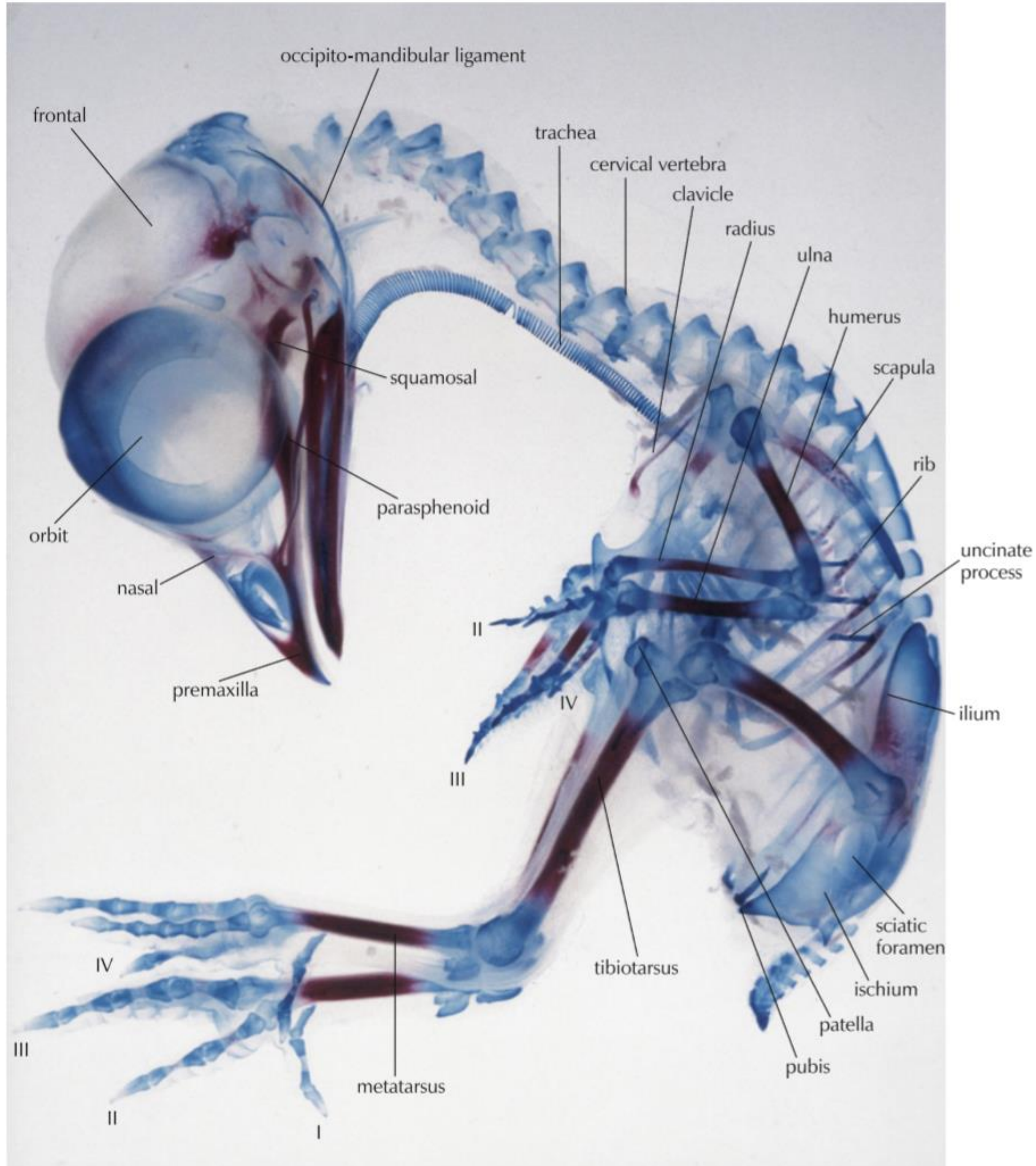

Mayer et al 2018


Cu and Egg Production (25-40 wks)
Cu and Hen/day Egg Production
y = 64.85864+1.76914x -0.06864x²
QP - R² = 0.41
y = 68.1333+6.6151 × (1-EXP (-0.8394 × (x -2.67)
EXP - R² = 0.43
QP – 12.9 ppm
EXP – 6.23 ppm
y = 74.7817-0.3121 × (7.2833 -x)²
BLQ - R² = 0.43
BLQ – 7.28 ppm
Cumulative Total Eggs
140
130
120
110
100
90
80
70
60
50
40
0
5
10
15
20
25
Cu, ppm
EXP
QP
BLQ
Berwanger et al., 2018

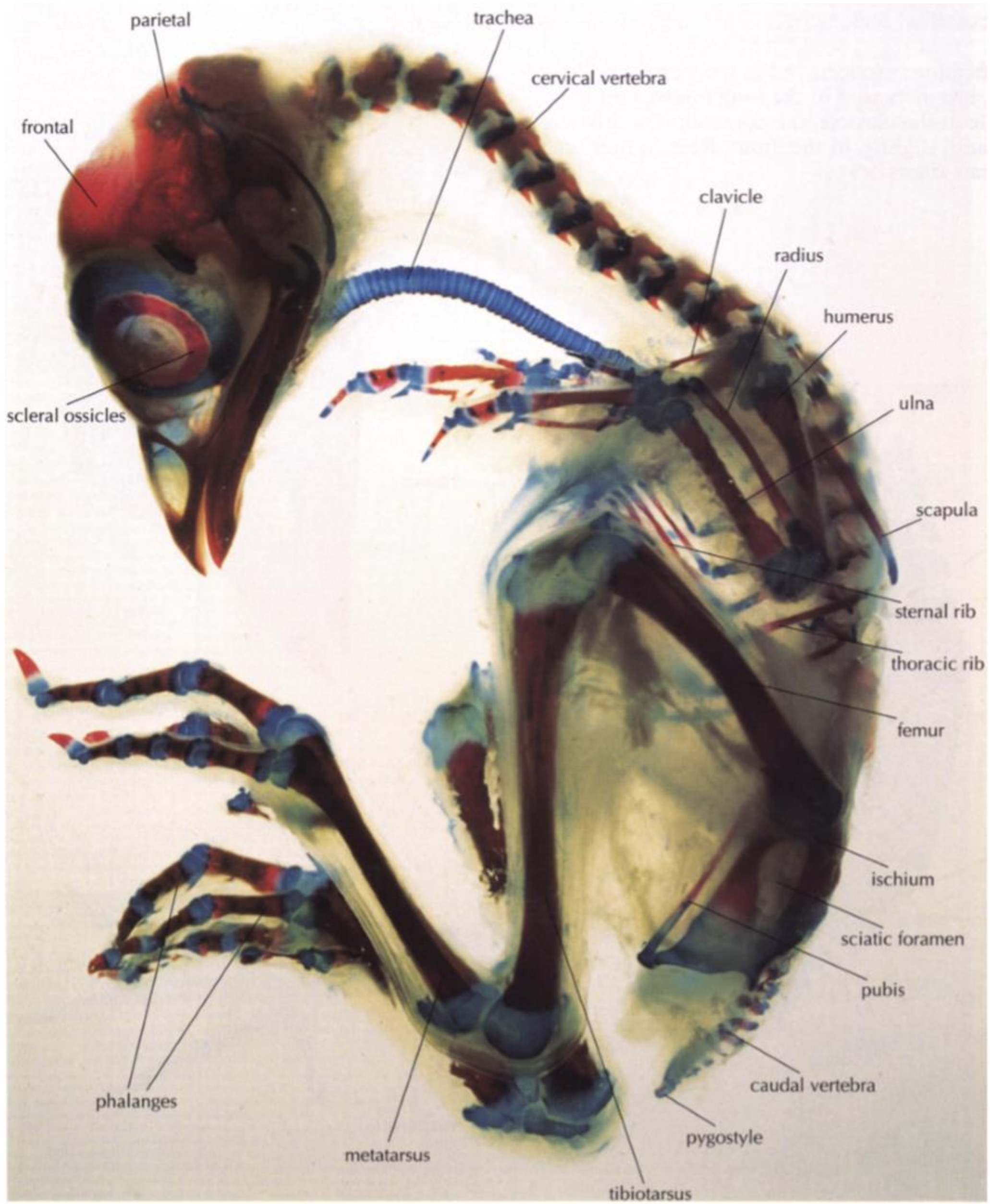

11
days

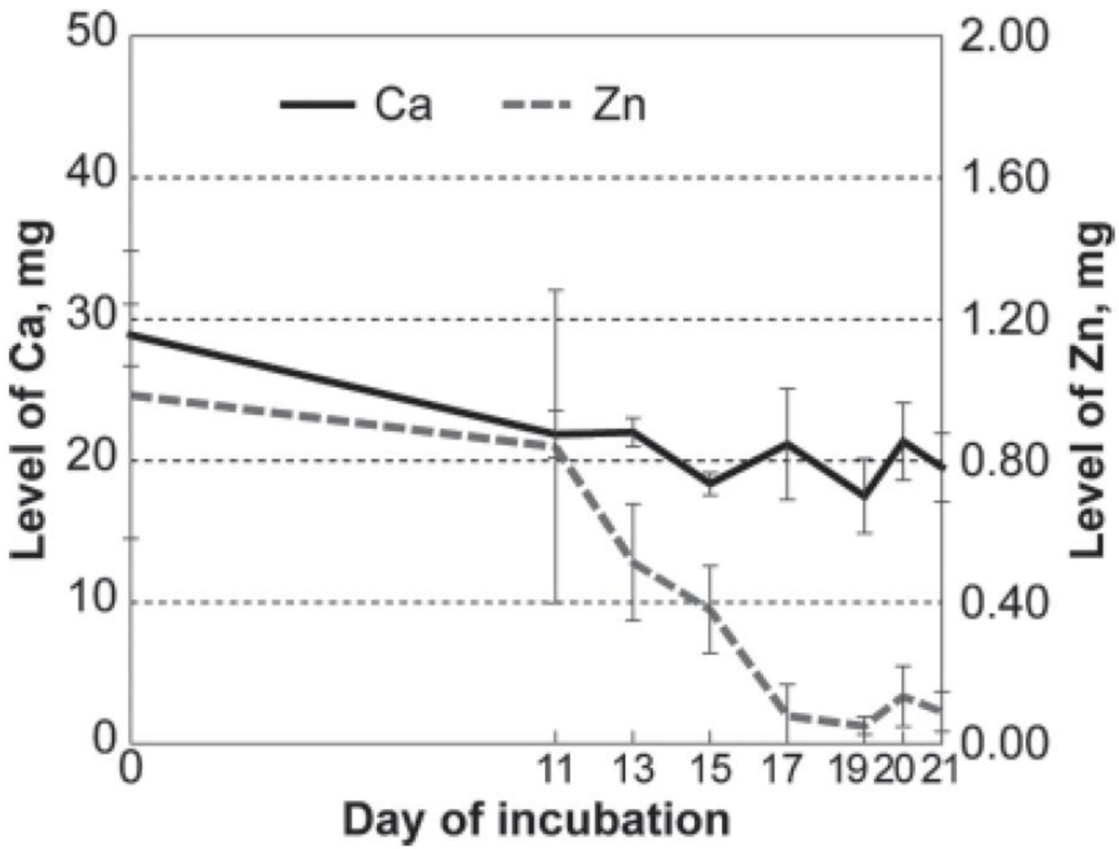

squamosal
quadrate
occipito-
mandibular
ligament
humerus
sternum
radius
uncinate
process
III
ulna
III
IV
II
I
rib
femur
metatarsus
tibiotarsus


13
days

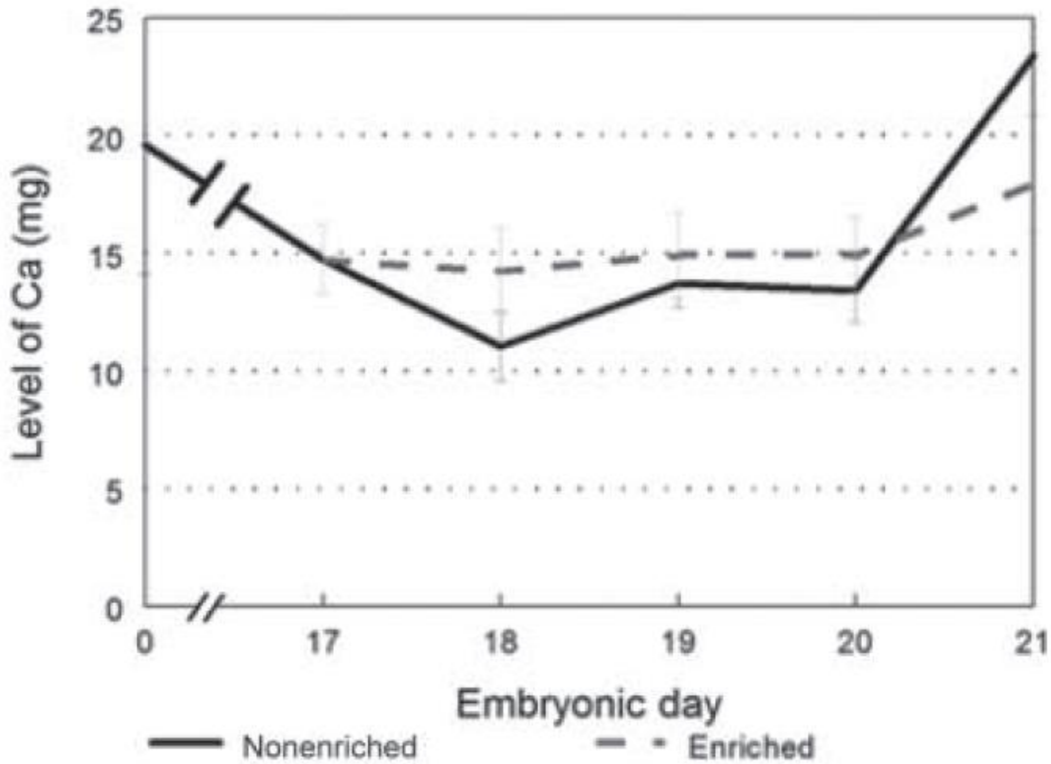

occipito-mandibular ligament
frontal
trachea
cervical vertebra
clavicle
radius
ulna
humerus
scapula
squamosal
rib
parasphenoid
orbit
uncinate process
nasal
II
IV
ilium
premaxilla
III
IV
tibiotarsus
sciatic foramen
ischium
III
patella
II
metatarsus
pubis
I


19.5
days


parietal
trachea
cervical vertebra
frontal
clavicle
radius
humerus
scleral ossicles
ulna
scapula
sternal rib
thoracic rib
femur
ischium
sciatic foramen
pubis
caudal vertebra
phalanges
pygostyle
metatarsus
tibiotarsus

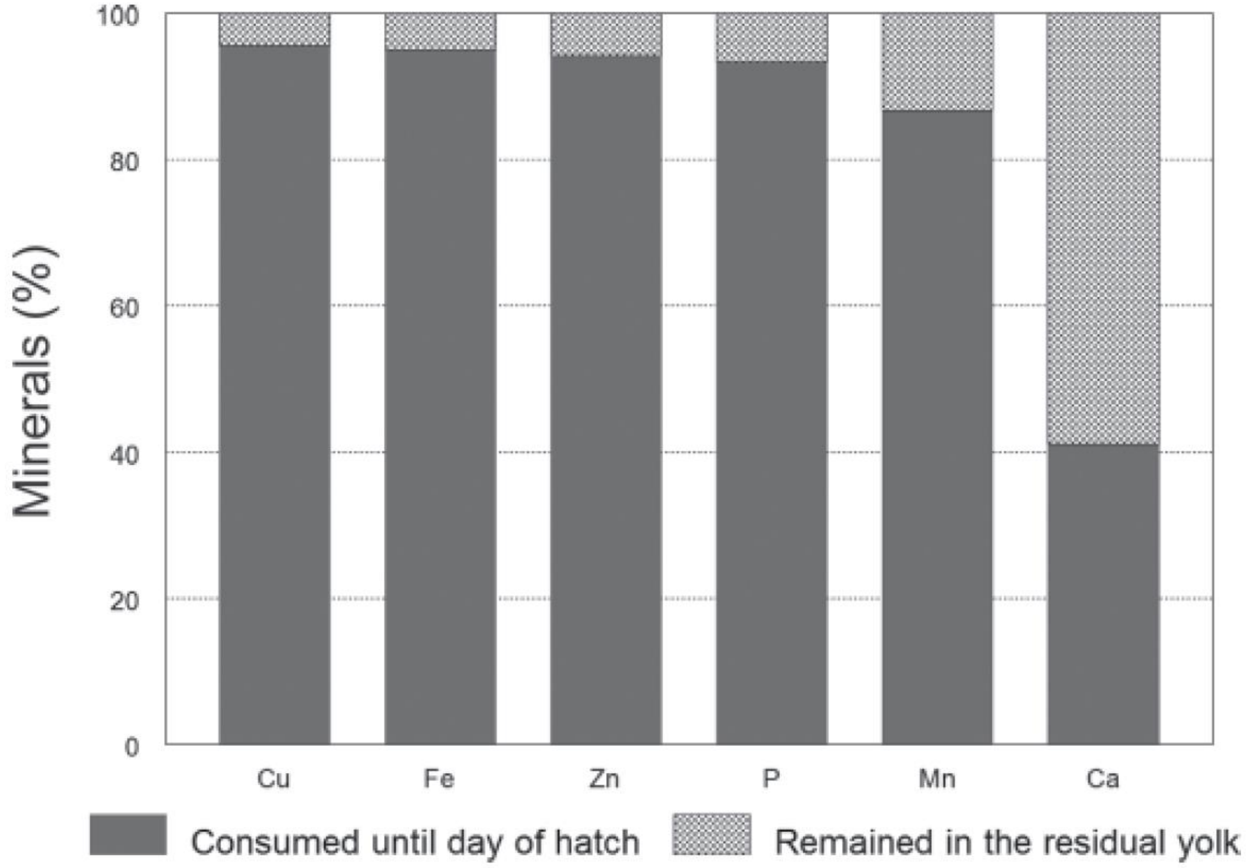



Amounts of Ca (solid black line) and Zn (dashed gray line) in the yolk sac of eggs from Cobb broiler breeder hens at 50 wk of age on different days during embryonic development. Data are expressed as means ± SE (n = 8).



Level of Ca (mg)
25
20
15
10
5
0
0
17
18
19
20
21
Embryonic day
Nonenriched
Enriched

# Relative consumption of Cu, Fe, Zn, P, Mn and Ca during incubation

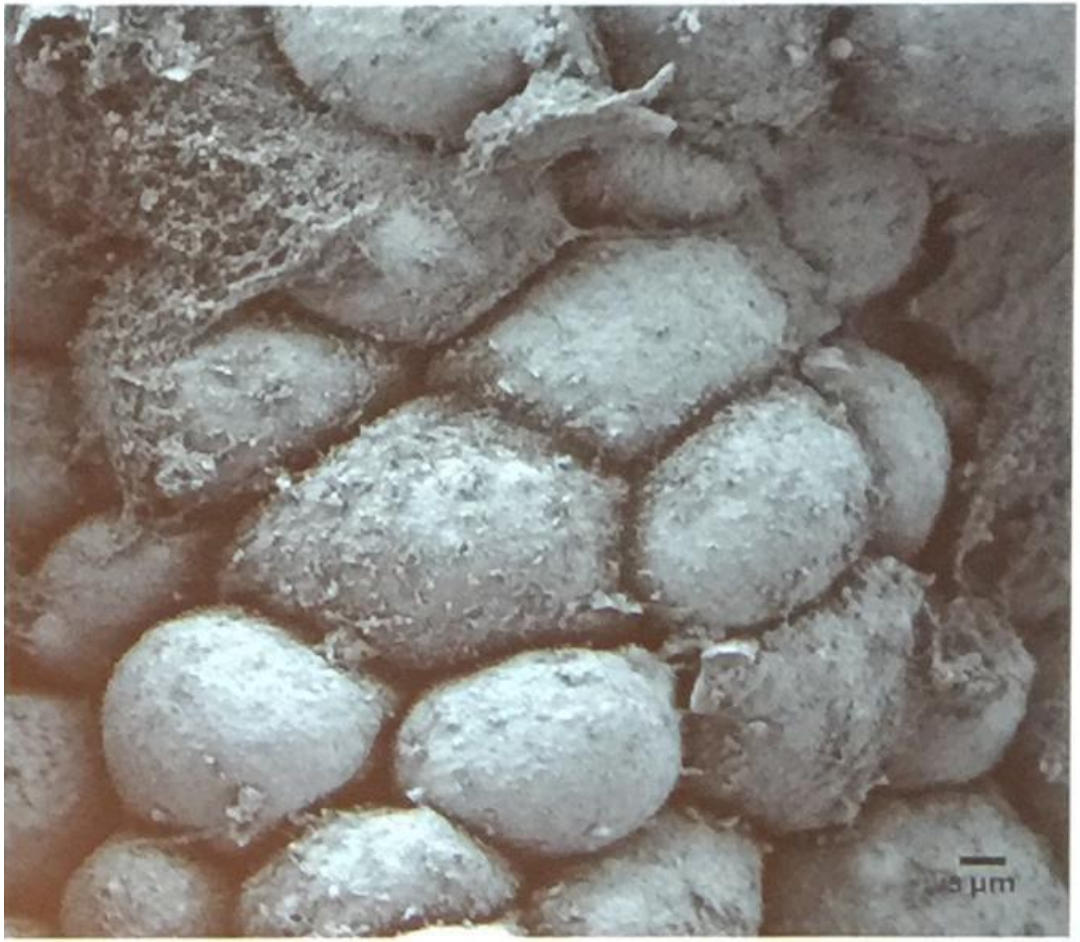


# YST Morphology throughout incubation (by SEM)


**E15:**

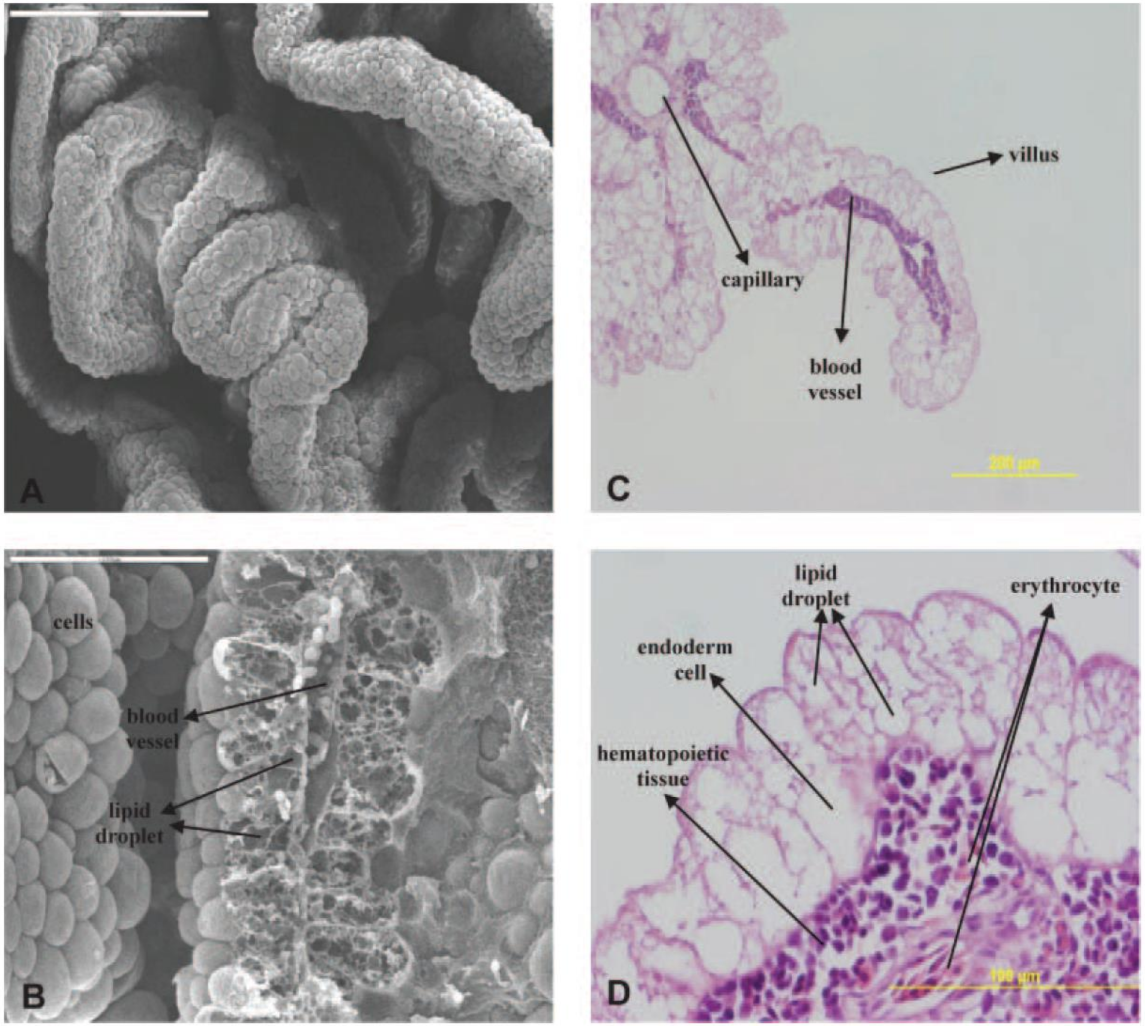
Cell surface area is large,
no microvilli structures
between cells

# YST Morphology throughout incubation (by SEM)




**E19:**

Cells begin to decrease in size, microvilli spread across cell surfaces




Electron micrograph (A, B) and hematoxylin and eosin-stained sections (C, D) of yolk sac membrane samples of broiler embryos on embryonic d 15.

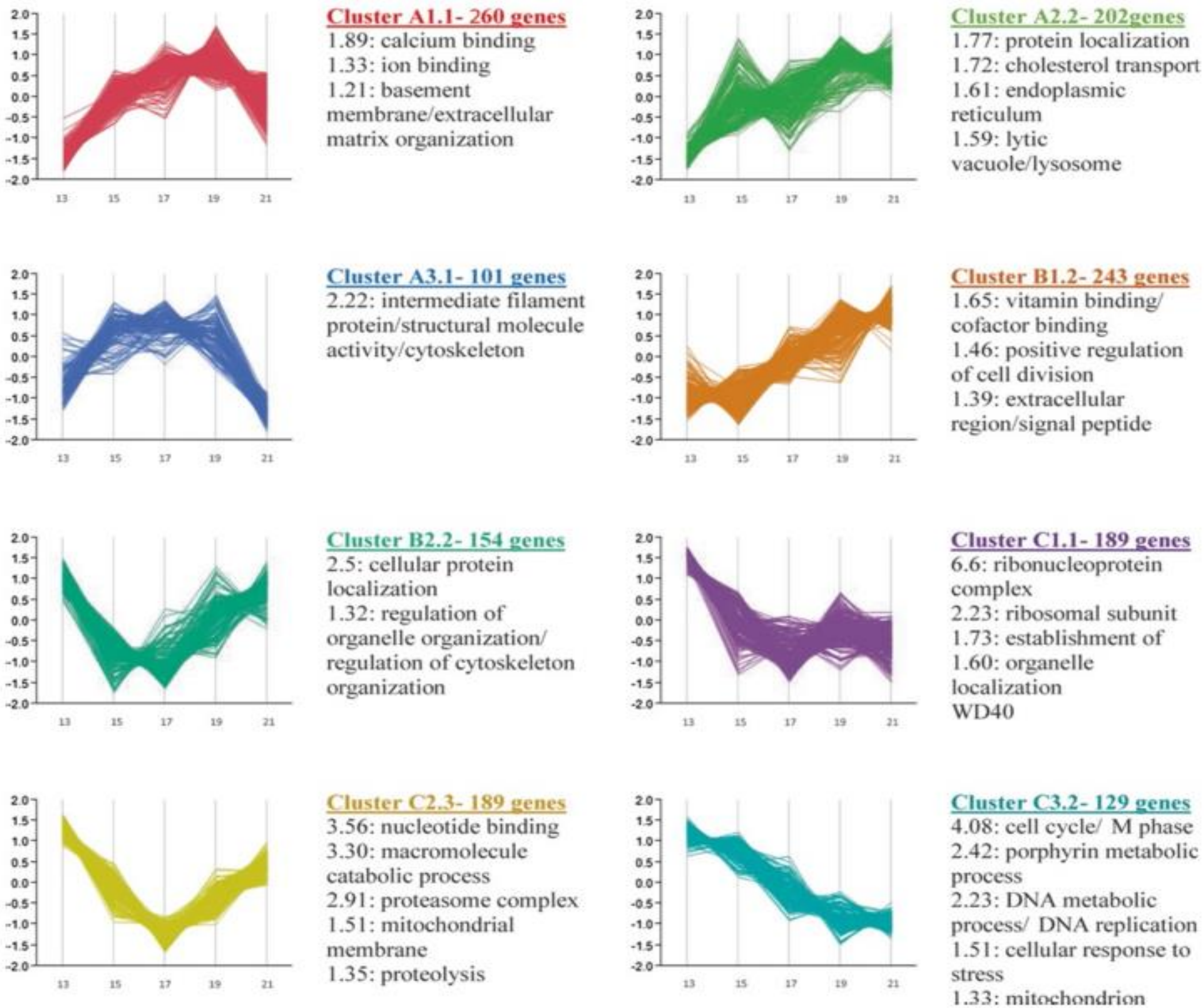

0005 1700X 15 kV
10u

# YST Morphology throughout incubation (by SEM)


**DOH:**

Cells are shrunken, microvilli cover entire cell surfaces

# Temporal transcriptome analysis of the chicken embryo yolk sac




Yadgary *et al*. *BMC Genomics* 2014, **15**:690
http://www.biomedcentral.com/1471-2164/15/690

# Summary:

- Differential uptake of yolk nutrients along incubation by the yolk sac tissue
- Uptake is dependent on environmental conditions (hatchery) and embryonic needs
- Yolk nutrients are digested along incubation by digestion enzymes produced by the yolk sac tissue.

# Overall Conclusion:
# The yolk sac is a multifunctional organ

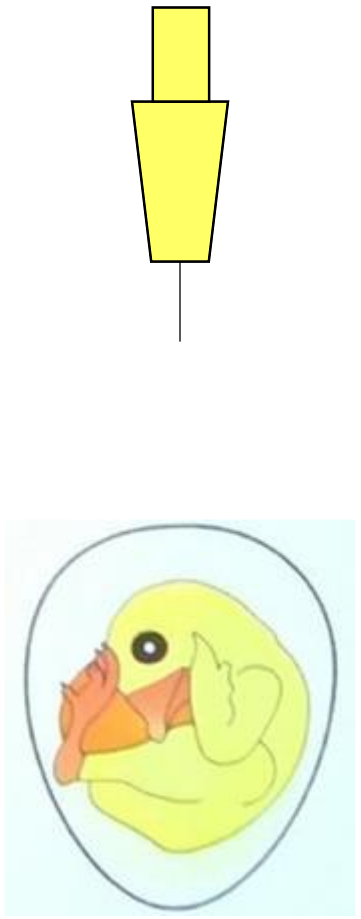
- Functions as an intestine, as it produces digestive enzyme and express nutrient transporters
- Functions as a liver, as it produces and accumulates glycogen during the incubation period
- Functions as a gallbladder, as it produces bile
- Functions as the bone marrow in the synthesis of blood cells

# Strategies

- In Ovo

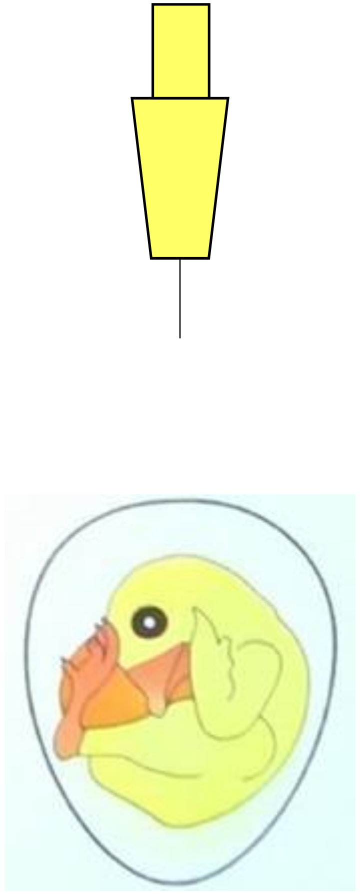
# Strategies

- In Ovo



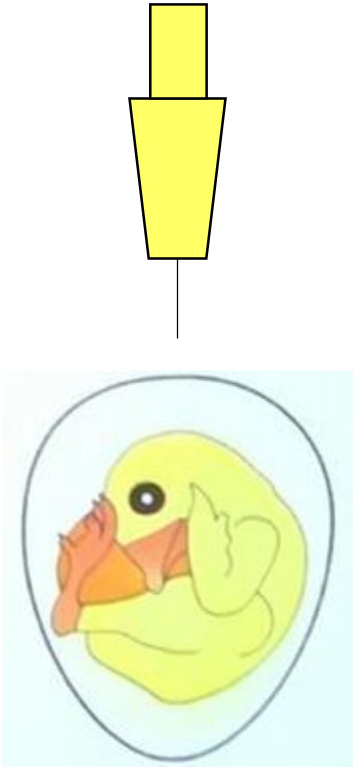
# Strategies

- In Ovo



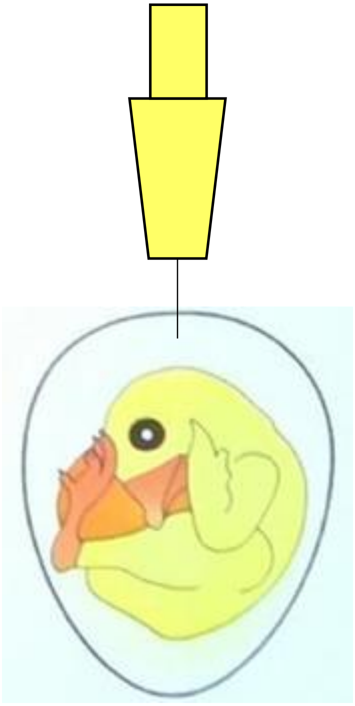
# Strategies

- In Ovo



# Strategies

- In Ovo



# Strategies

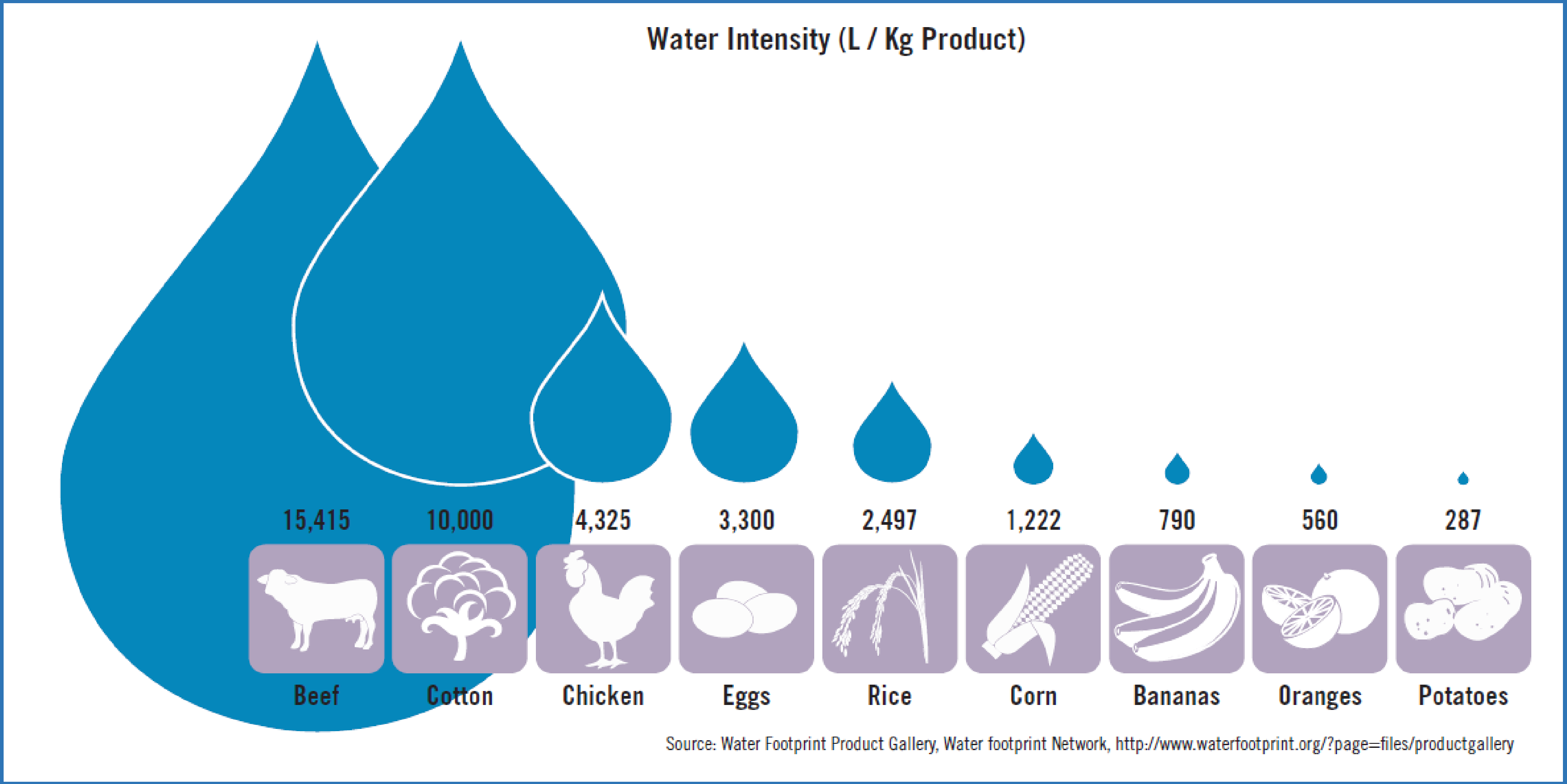
- In Ovo
- At the hatcher

# Strategies

- In Ovo
- At the hatcher
- At transport

# Strategies

- In Ovo
- At the hatcher
- At transport
- Hatching at the farm


Water Intensity (L / Kg Product)
15,415
Beef
10,000
Cotton
4,325
Chicken
3,300
Eggs
2,497
Rice
1,222
Corn
790
Bananas
560
Oranges
287
Potatoes
Source: Water Footprint Product Gallery, Water footprint Network, http://www.waterfootprint.org/?page=files/productgallery