25 Years

BIVIT
NUTRITIONAL ENGINEERING

EUROPEAN PIG PRODUCERS

Speaker: Paul De Smet

Thursday June 4th 2015

25 Years

BIVIT
NUTRITIONAL ENGINEERING

EUROPEAN PIG PRODUCERS

Stress Support: the nutritional answer to stress, infection and disease

Thursday June 4th 2015

Table of content

Stress Support: the nutritional answer to stress, infection and disease

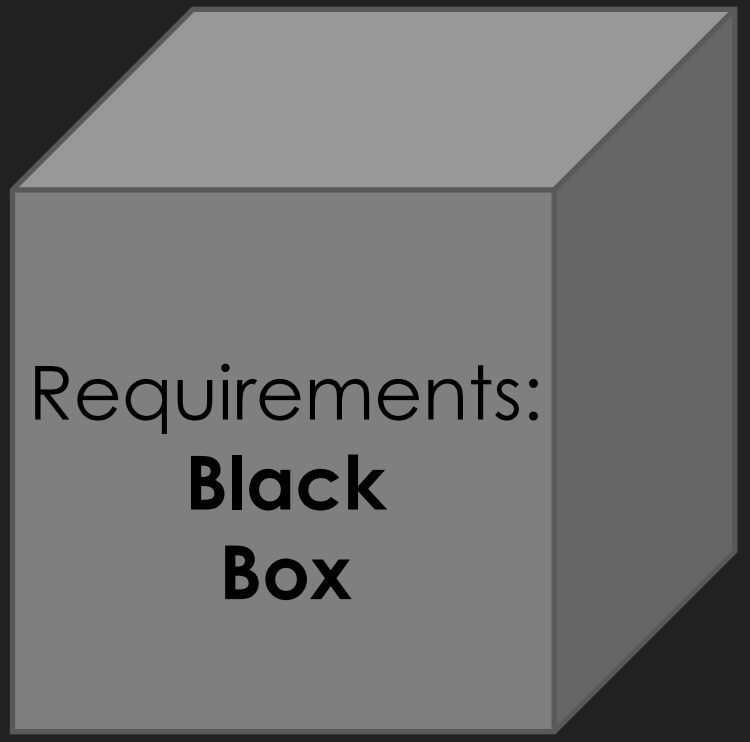
Introduction

Objective of feeding animals = to provide the animals with sufficient nutrients for:

- Maintenace
- Production

→ Requirements are well known

- Activity
- Stress resistance and immunity →



Feed consumption

	FC	Feed consumption
SPF farms	2.2 - 2.4	207 kg
High health farms	2.4 - 2.6	225 kg
Normal farms	2.8 - 3.0	261 kg
Stressed farms	3.0 - 3.2	279 kg

→ **Cost of immunity = 72 kg**

= **Total maintenance requirement of a normal pig during its lifetime**

Different kinds of stress

- Environment and hygiene
- Climate and air quality
- Weaning
- Transportation
- Crowding
- Infection and inflammation

Body response to stress

Stress → Brain: Hypothalamus

↓

Hypophysis

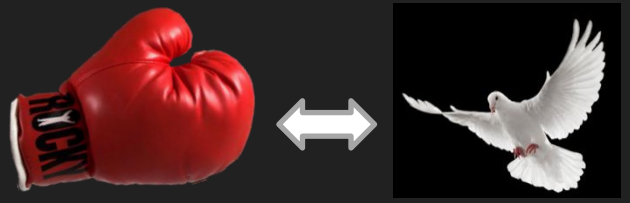
↓

Adrenal glands

↓

Cortisol and other corticosteroids

→ Adrenaline

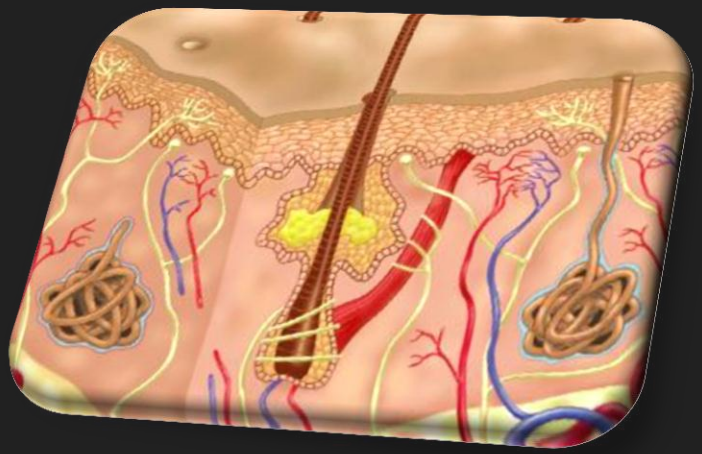


Secundary body response to stress

- Heart rate increased
- Breathing increased
- Fats and glucose released for energy
- Immune system suppressed

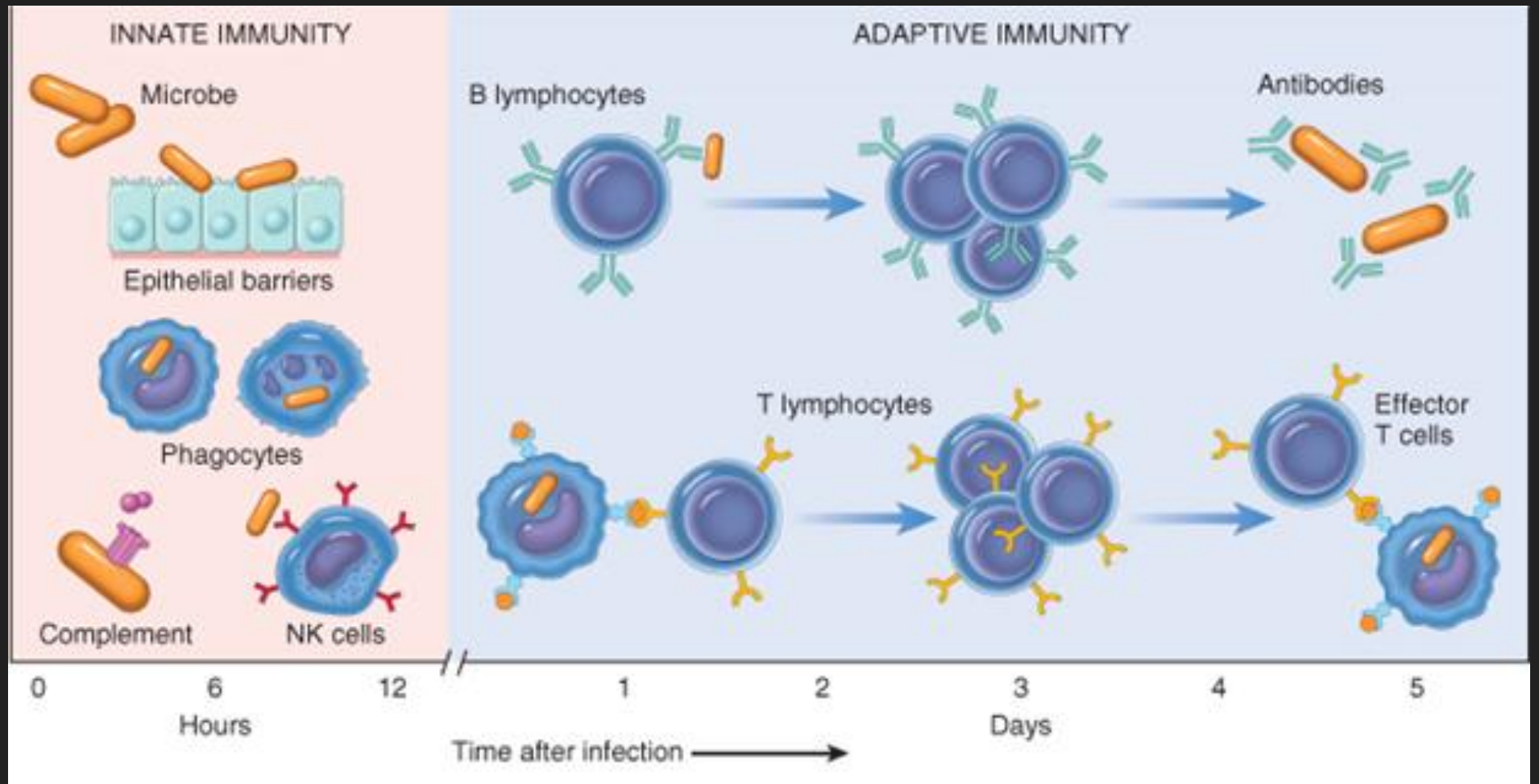
Body response to intruders

- First line defence:
  - Skin
  - Mucus

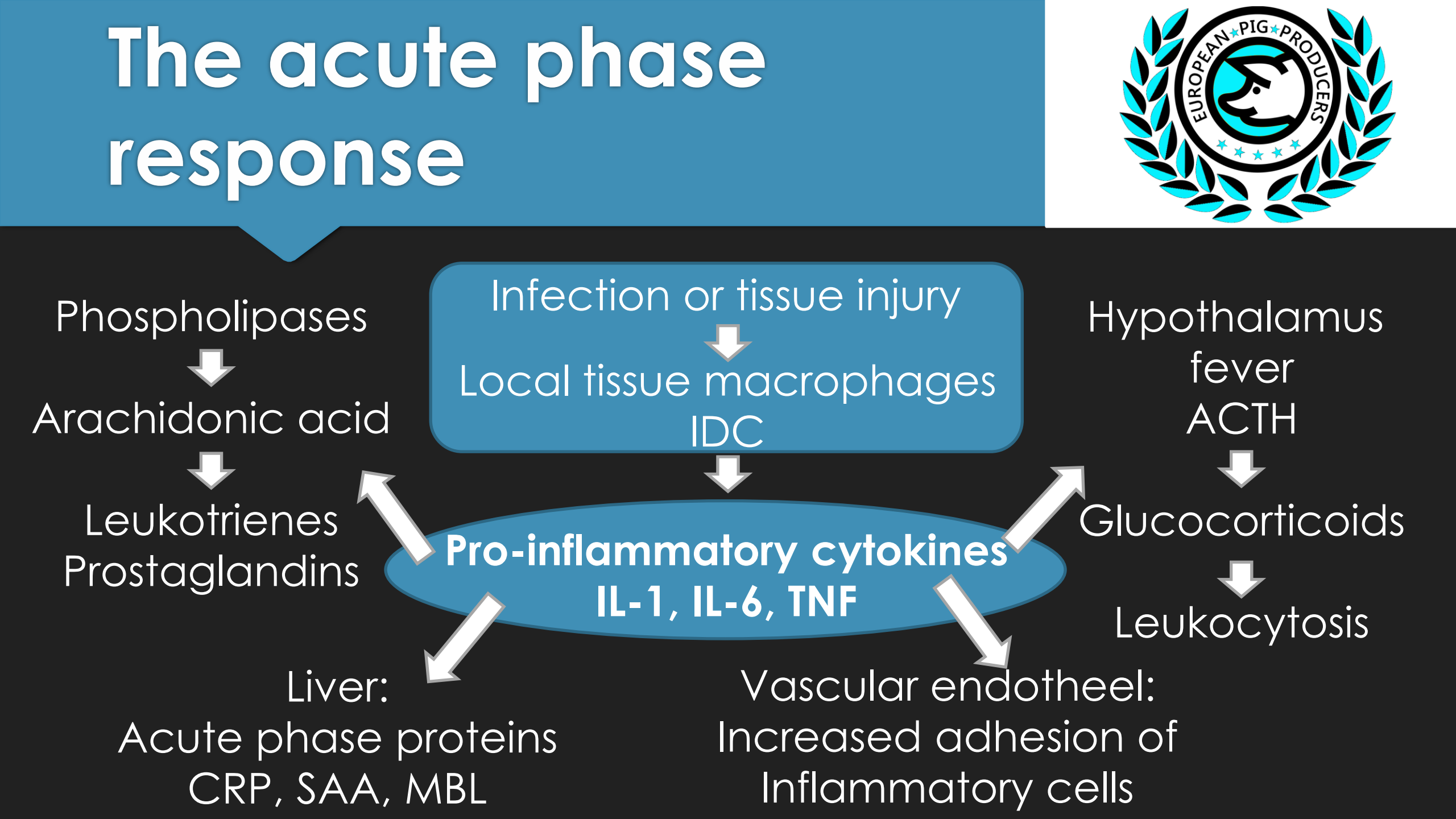


- Immunity System
  - Innate immune system = non specific
  - Specific immune system = acquired

Innate & adaptive immunity



The acute phase response



The nutritional answer to stress & disease

- Immunomodulation to modify the different pathways in immune response
- Anti-oxidants to limit the damage provoked by inflammation process
- Nutrient requirements are modified and specific nutrients are required

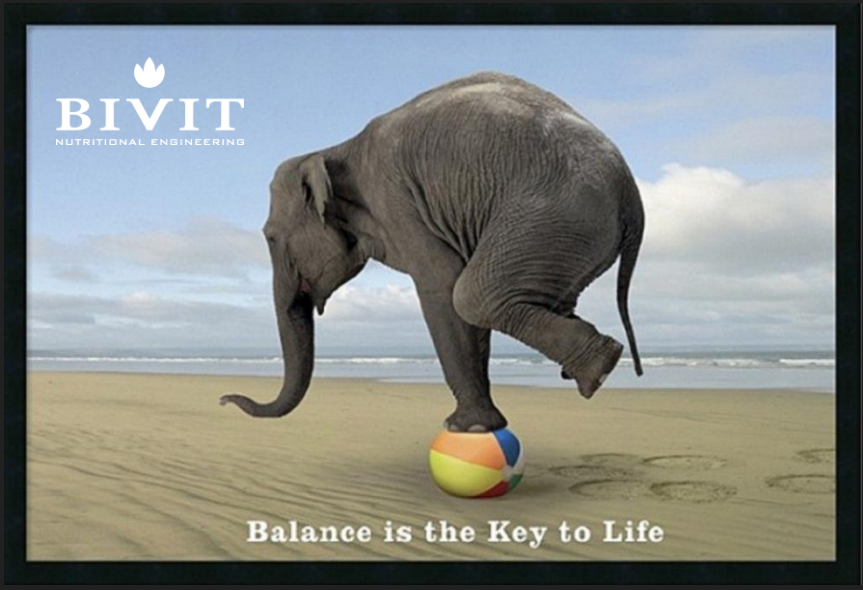
Modulation of inflammation:

Th1 versus Th2 response

- Pathogen-recognition receptors (PRR, TLR) induce inflammatory (Th1) and anti-inflammatory (Th2) response
- ω3/ω6 ratio in feed: anti-inflammatory (Th2)
- Vitamin A & D: anti-inflammatory (Th2)
- Lysine & carnitine

Conclusion

Nutrition is modulating the Th1-Th2-Th17-Treg balance by communicating with the innate immune system and can direct immunity to inflammatory or less inflammatory responses

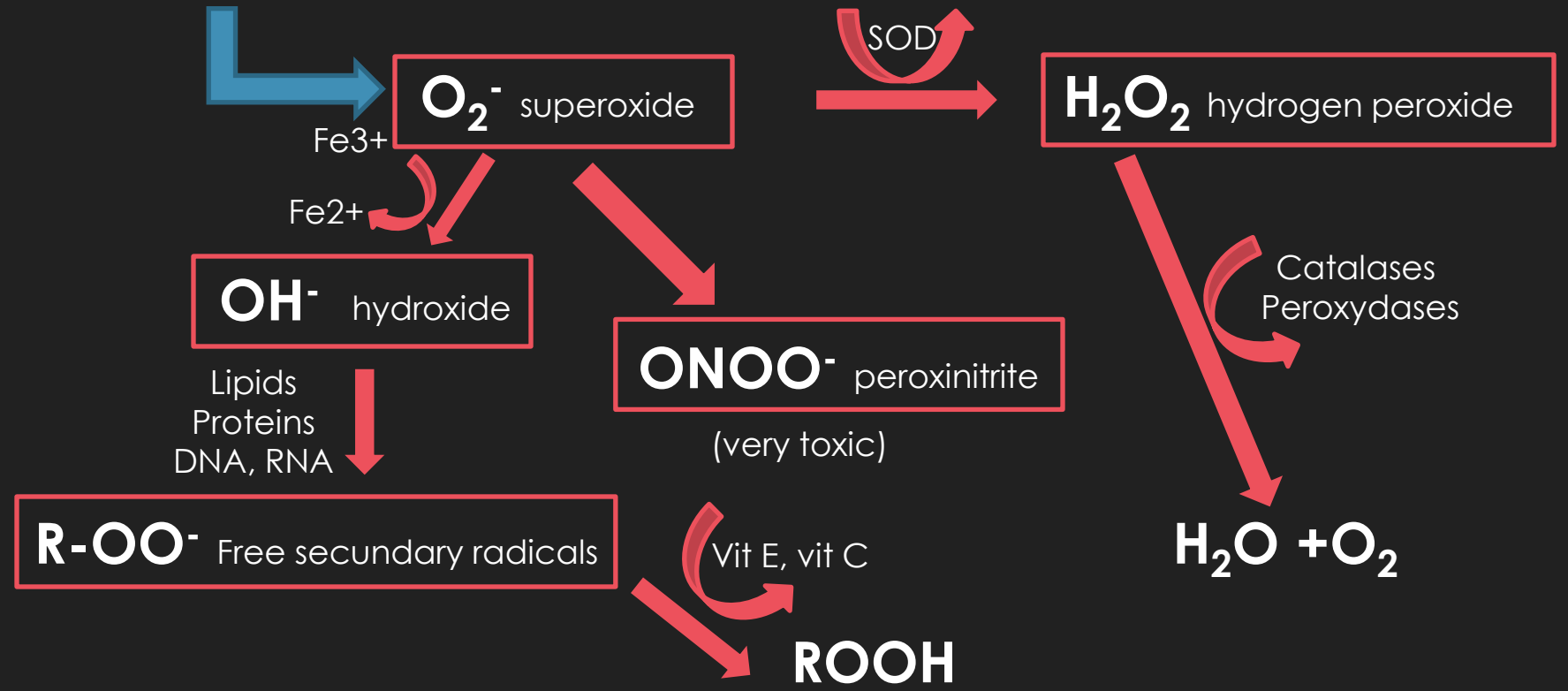


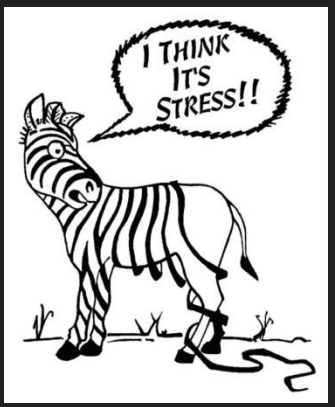
The nutritional answer to stress & disease

- Immunomodulation to modify the different pathways in immune response
- Anti-oxidants to limit the damage provoked by inflammation process
- Nutrient requirements are modified and specific nutrients are required

Oxidative Stress

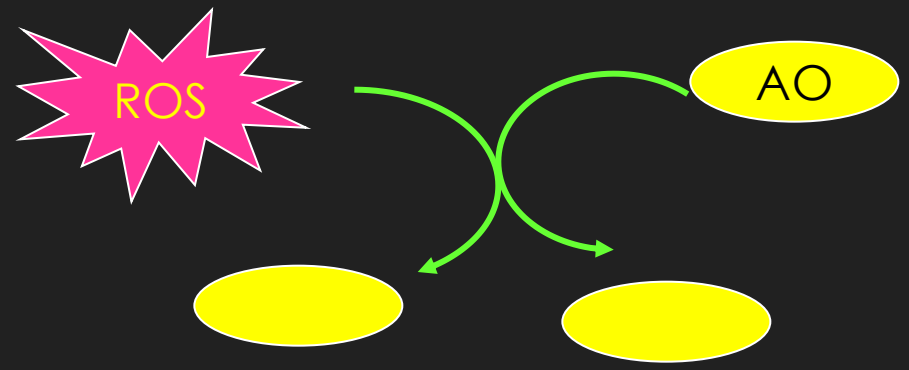
Stressfull conditions (inflammation, chemicals, carcinogens, radiation, air pollution, …)





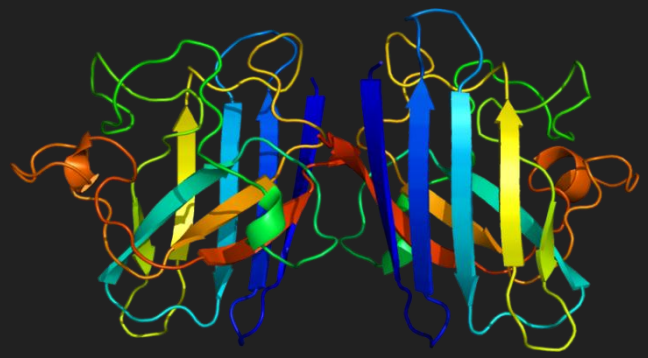
Oxidant & Antioxidant

- Oxidant = compound that is able to oxidise other molecules (lipids, proteins, DNA)
  - Oxidation = removal H or electron, or addition of O
  - Free radicals (unstable), e.g. HO°, NO°, O2-°
  - Very reactive, not radical molecules, bv. H2O2, HOCl, ONOO-
- Antioxidant = compound that is able to inactivate an oxidant without itself becoming reactive

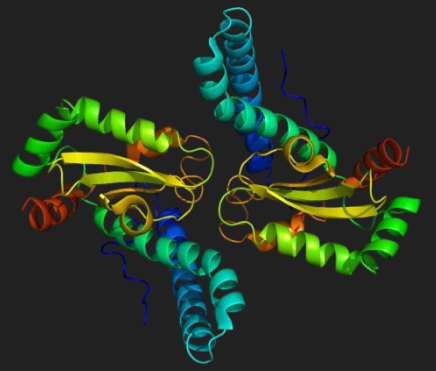


SOD and trace elements

- SOD1 : cytoplasm
  - → Cu/Zn components of SOD1



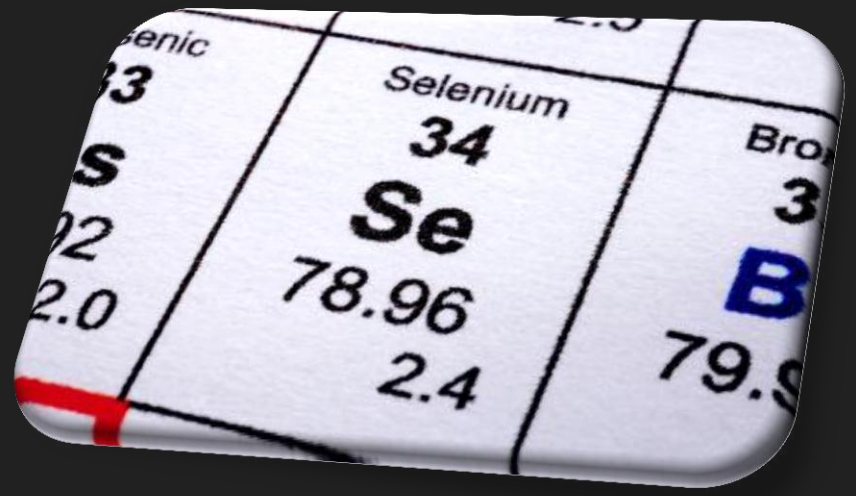
- SOD2 : mitochondria
  - → Mn component of SOD2



- SOD3 : extracellular
  - → Cu/Zn components of SOD3

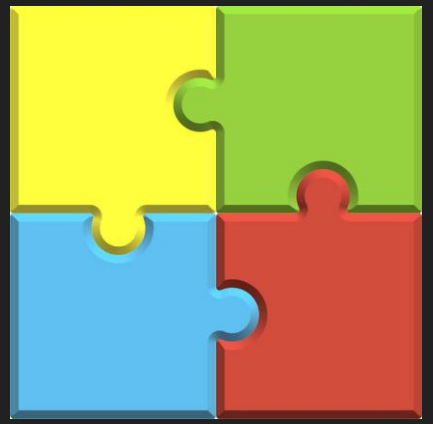
Selenium and glutathion peroxidase

- Selenium : component of glutathione peroxidase
- Traditionally Sodium Selenite (Na2Se3)
  - pro-oxidant → Toxic!
- Organic Selenium :
  - Better absorbed
  - Much lower toxicity
  - More efficient



Vitamin C and Vitamin E

- **Vitamin C**
  - Water soluble
  - Active in cell cytoplasm and body fluids
- **Vitamin E**
  - Fat soluble
  - Protects cell membranes, mitochondria and lipids



Synergism between Vitamin C, Vitamin E, Selenium and glutathione

The nutritional answer to stress & disease

- Immunomodulation to modify the different pathways in immune response
- Anti-oxidants to limit the damage provoked by inflammation process
- Nutrient requirements are modified and specific nutrients are required

Effect of stress on amino acid requirement?

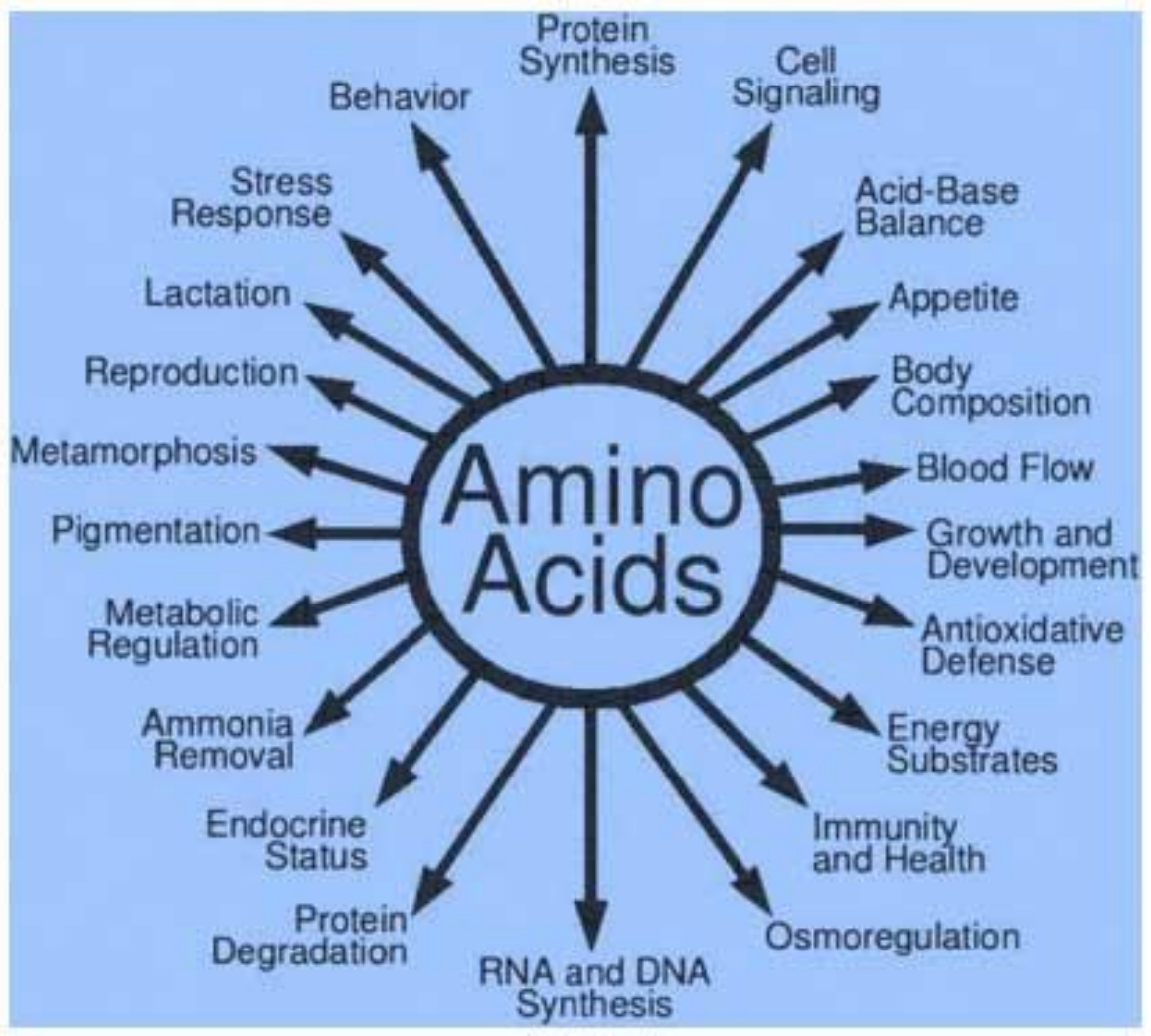
Protein requirement

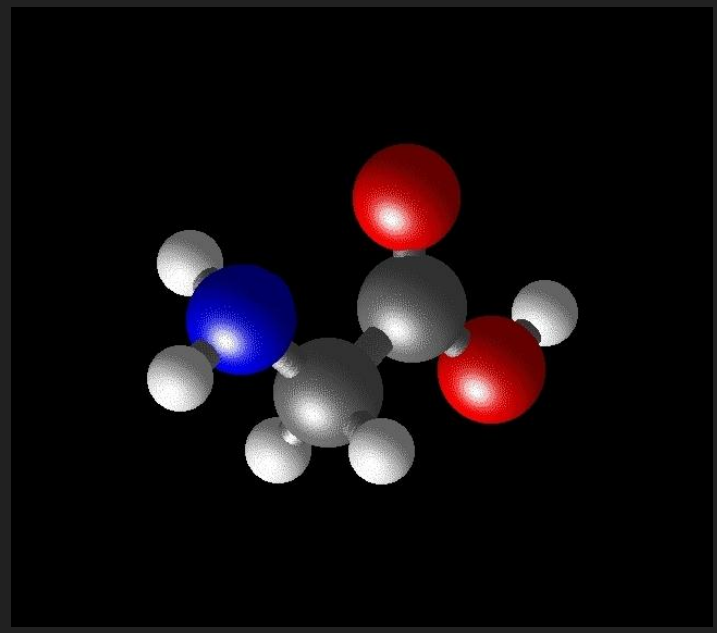
- *Maintenance*
- *Body protein*
- *Foetuses*
- *Milk*
- *Stress and disease??*

Relative AA Requirement

	Maintenance		Protein Deposition	
	Mg/kg MW	% LYS	g/16g N	% LYS
LYS	36	100	7.0	100
MET	9	25	1.8	26
M+C	49	136	3.4	49
THR	53	147	4.0	57
TRP	11	31	1.0	14
ILE	16	44	4.3	61
LEU	29	80	7.0	100
VAL	25	69	4.7	67

Functions of Amino Acids





Wu, 2010

Shift to other amino acids in stress situations?

ESSENTIAL	SEMI-ESSENTIAL	NON-ESSENTIAL
Lysine		Glycine
Threonine		Glutamine
Methionine	Cysteine	Asparagine
Tryptophan		Alanine
Valine		Serine
Isoleucine		Proline
Leucine		Serine
Phenylalanine	Tyrosine	Arginine
Histidine		

Shift to other amino acids in stress situations

- traditionally classified NEAA (glutamine, arginine) :
  - regulating gene expression
  - cell signalling
  - antioxidative responses
  - immunity
- EAA (leucin, tryptophan) : modulate neurological and immunological functions
- Other EAA (methionine, threonine) are building blocks of specific proteins involved in immunity

<u>new concept of functional AA</u> defined as those AA that regulate key metabolic pathways to improve health, survival, growth, development, lactation, and reproduction of organisms. *Wu, 2010*


STRESS


I AM SO HAPPY