



## **Feed for the best results: latest trends in broiler nutrition**

### **Eubiotic Nutrition**

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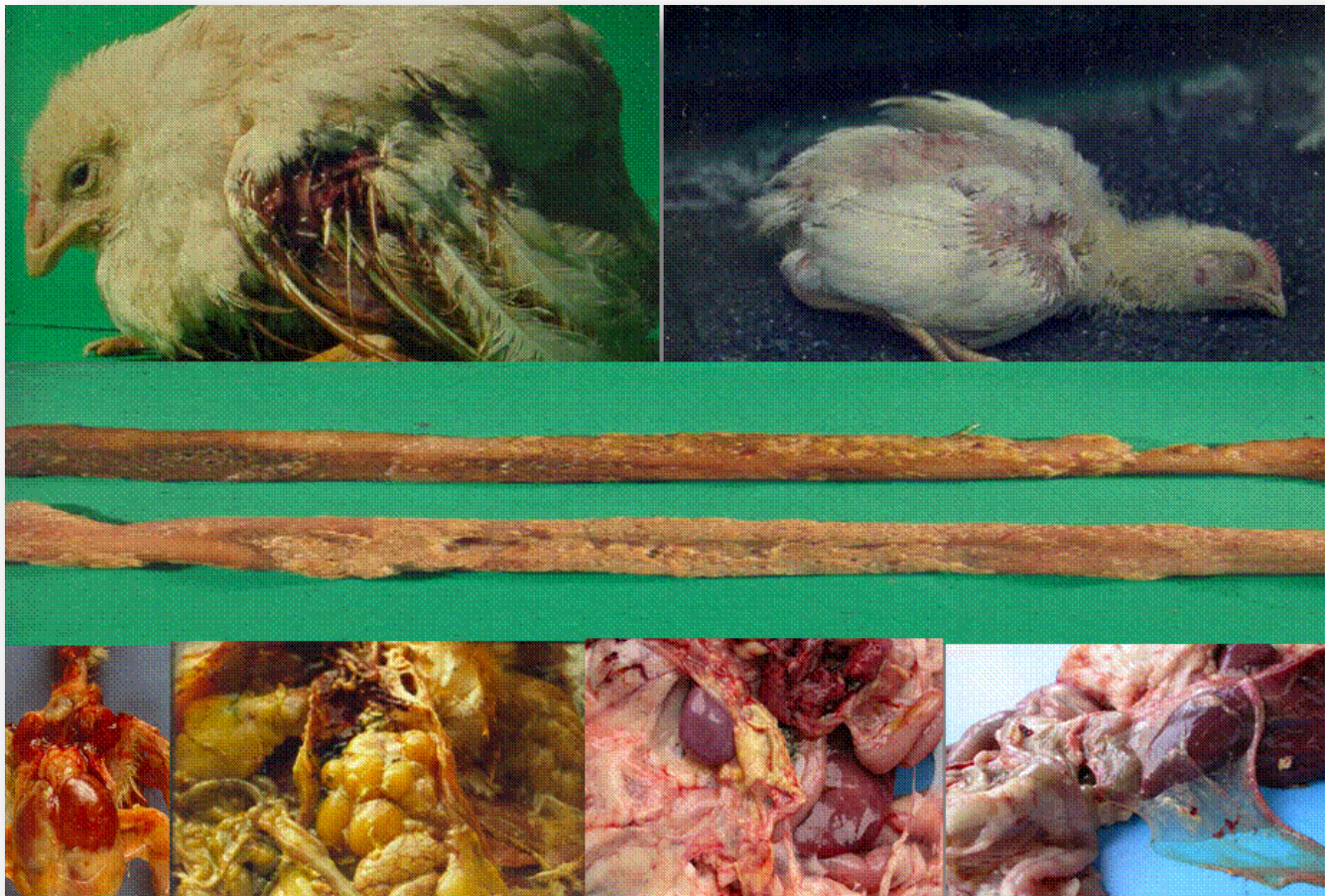


# ANIMAL PRODUCTION IN EUROPE >2000

- **Ban of animal meals**
  - Diets become Total Vegetable
  - Increasing fiber content
  - Vegetable protein sources-less digestible
  - ⇒ **INCREASED MICROBIAL CHALLENGE**
    - ⇒ DIGESTIBILITY ENHANCERS
    - ⇒ OPTIMISING FIBRE
- **Complete ban of Antibiotic Growth Promoters (AGP)**
  - Compromises feed efficiency
  - Digestive disorders and animal health
  - ⇒ **DYSBIOSIS = bacterial disorder**
    - ⇒ DIARRHEA
    - ⇒ LOWER PERFORMANCES



# DO WE HAVE A PROBLEM?





# DO WE HAVE A PROBLEM?

- **Antibiotic Resistant Bacteria**
  - MRSA (*Methicillin Resistant Staphylococcus Aureus*) in swine production
  - ESBL (*Extended Spectrum Beta-Lactamase*) in poultry production

## News

### More antibiotic use in Dutch poultry industry

//20 FEB 2009

Antibiotic use in the Dutch pig and poultry industry has risen 9% in 2007 in comparison to 2006, Dutch agricultural newspaper Agrarisch Dagblad reports. Research by the Dutch agricultural economic institute (LEI), part of Wageningen University and Research Centre (WUR), revealed that growth appeared in the broiler industry as well as the finishing pig industry.





- **Cause of antibiotic treatments**
  - Digestive problems **58.52%**
- **Solutions**
  - Intestinal Health
  - Healthy Intestinal Microflora
  - Feed and feed additives

## DYSBIOSIS: bacterial disorder

Undigested feed



Watery droppings





# EUBIOSIS-EUBIOTIC NUTRITION

## EUBIOSIS:

*“a concept to encourage a healthy intestinal microflora by suppressing the pathogenic bacteria and promoting the LAB in the Gastro-Intestinal-Tract (G.I.T.)”*

## EUBIOTIC NUTRITION:

This strategy combines different feed additives with modern nutrition technology.

**→ Another approach for today’s modern animal production.**





# EUBIOTIC NUTRITION - Key strategies

- **Managing the gastro-intestinal microflora:**
  - Organic acids and their glyceride esters
    - Monoglycerides of SCFA and MCFA
    - Triglycerides of butyric acid
  - Eubiosis effect through ***Eubiotic Nutrition***
- **Maximizing energy and protein utilization**
  - Use of multi enzyme systems with good Nutrient Sparing Effects (NSE) for maize-soya diets
  - Enhance nutrient absorption with hydrolyzed phospholipids
  - Feeding the intestinal microflora through ***Eubiotic Nutrition***

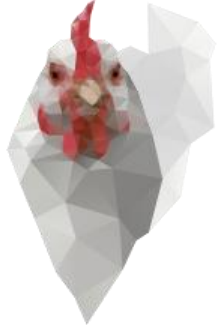




# MANAGING THE INTESTINAL MICROFLORA

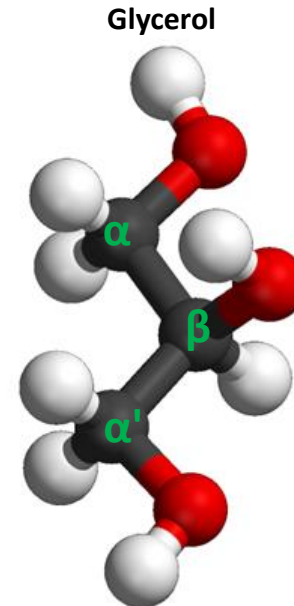
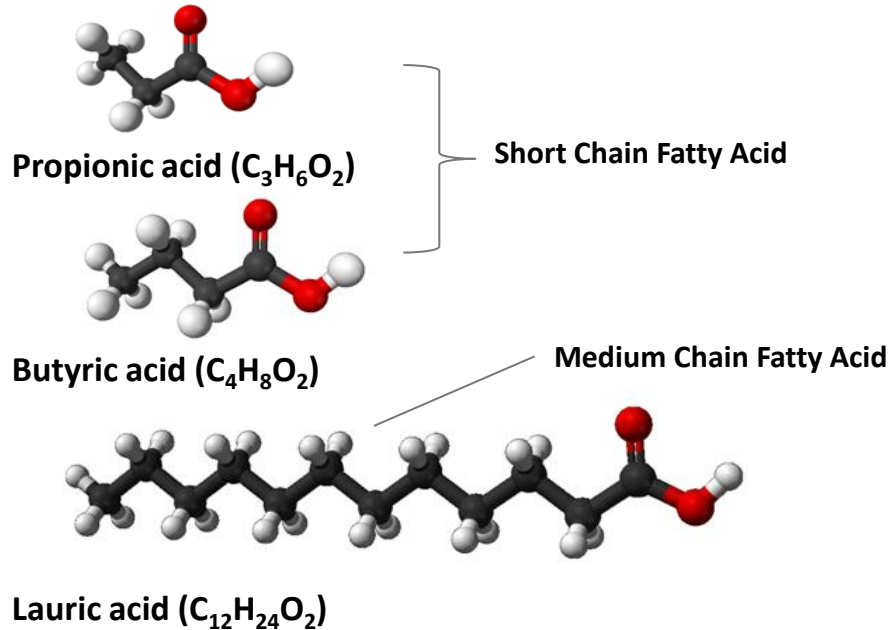
## Monoglyceride molecules the next generation acids

***“lipophilic and hydro-dispersible:  
active in the digestive tract and in the blood  
through the lymphatic system”***



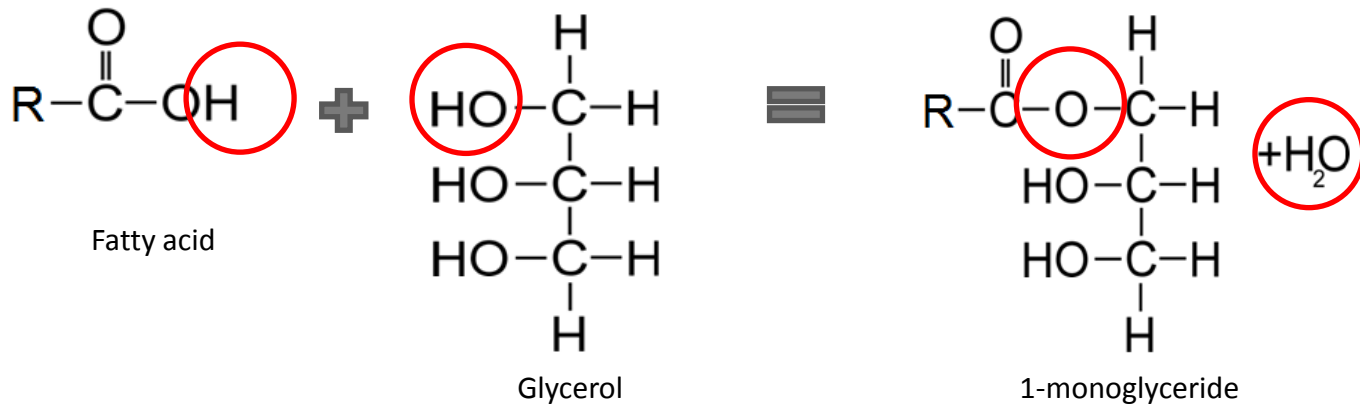


## SCFA – MCFA -Glycerol



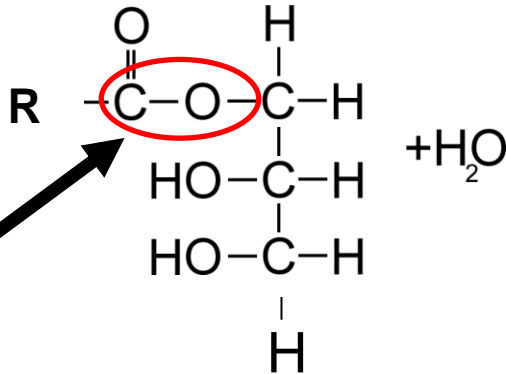
# Esterification

Technology of esterifying fatty acids to glycerol => glycerol ester



The Hydrogen atom **H** of the fatty acid is bound with the **OH** of glycerol

## $\alpha$ -monoglycerides



Covalent bond: attraction force between 2 atoms that share a couple of electrons

### Covalent bond

The chemical bond between the fatty acid and glycerol is not an ionic bond (pH dependent), but a covalent bond (pH independent)

## $\alpha$ -monoglycerides as structural isomers



$\alpha$ -monoglycerides



$\beta$ -monoglycerides

- ⇒  $\alpha$ -monoglycerides are much more bactericidal and virucidal than  $\beta$ -monoglycerides, because more lipophilic and surfactant power
- ⇒  $\alpha$ -monoglycerides are less prone to be broken down by lipases and esterases- no dimensional fit
- ⇒  $\alpha$ -monoglycerides are more lipophilic and therefore have a different absorption kinetic: via lymph to bloodstream



## $\alpha$ -monoglycerides: benefits

- Lipophilic and Hydro dispersible:
  - Active in feed, water and digestive tract
- Not pH dependent:
  - Active in acidic (stomach) and in neutral (intestines) environment
- **More active than acids (Kabara *et al.*, 1972: in general esterification of fatty acids less active – monoglycerides are the only exception)**





# Monoglycerides vs fatty acids

Minimum dilution able to inhibit the development of tested pathogenic bacteria (expressed as % in water)

Product	pH	S. Typhimurium	E. coli O 157
Butyric acid	4.5	2.00%	4.00%
<u>1-Monobutyryn (C4)</u>	4.5	0.06%	0.12%
1-Monopropionin (C3)	4.5	0.03%	0.12%
Butyric acid	7	<u>NA</u>	<u>NA</u>
1-Monobutyryn (C4)	7	0.06%	0.12%
1-Monopropionin (C3)	7	0.03%	0.06%

**>30 times stronger**





# $\alpha$ -monoglycerides: benefits

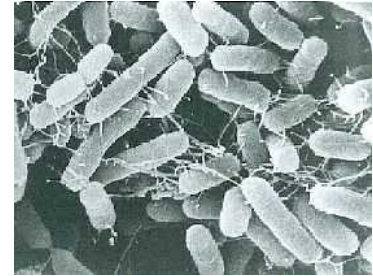
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  - Different working mechanism:
    - Uptake of lipid molecules is cell membranes
    - Uptake via transmembrane protein channels
    - Monoglycerides affect fat enveloped viruses and bacteria by disruption and or disintegration (causing leakage and cell lysis) (Sands 1977, Thormar 1987)
- Systemic uptake via lymph
- Very stable (feed process)
- Non-corrosive
- Non-smelling





# $\alpha$ -monoglycerides: typical applications

- ⇒ **Monopropionin and monobutyryn for Salmonella control via feed and/or drinking water**
  
- ⇒ **Monocaprylin, monocaprin and monolaurin for poultry with “sub-acute” infections of Clostridium (perfringens)**
  - Necrotic enteritis in broilers
  - Dirty egg syndrome in layers
  
- ⇒ **Tributyryn + lipase → butyric acid**
  - Energy for enterocytes
  - Increase villi height
  - Increase absorption capacity







# MAXIMIZING ENERGY AND PROTEIN UTILIZATION

- ⇒ **Multi enzyme systems that break down plant cell walls**
- ⇒ **Hydrolysed lecithin's that enhance nutrient absorption**





# Non-Available Carbohydrates

## Non-Starch Polysaccharides (NSP)

- **Soluble NSP's**
  - Arabinoxylans and beta-glucans are branched chains of xylose and glucose molecules
  - Are mainly present in viscous cereals such as wheat and barley and increase intestinal viscosity
- **Insoluble NSP's:**
  - The high fibre content in sunflower- and rapeseed meal was thought to be a limiting factor for their use in monogastric animals.
  - It should be noted that this fibre mainly consists of cellulose and pectins.
  - They shield many nutrients from digestion.
  - Insoluble fibre may be a good substrate for the intestinal micro flora and be beneficial to their health status and digestive system, whilst increasing the intestinal motility
- => **When broken up:**
  - **Unlock valuable nutrients: proteins and energy**
  - **Hydrolysed polysaccharides can be used by the intestinal microflora and provide additional energy**



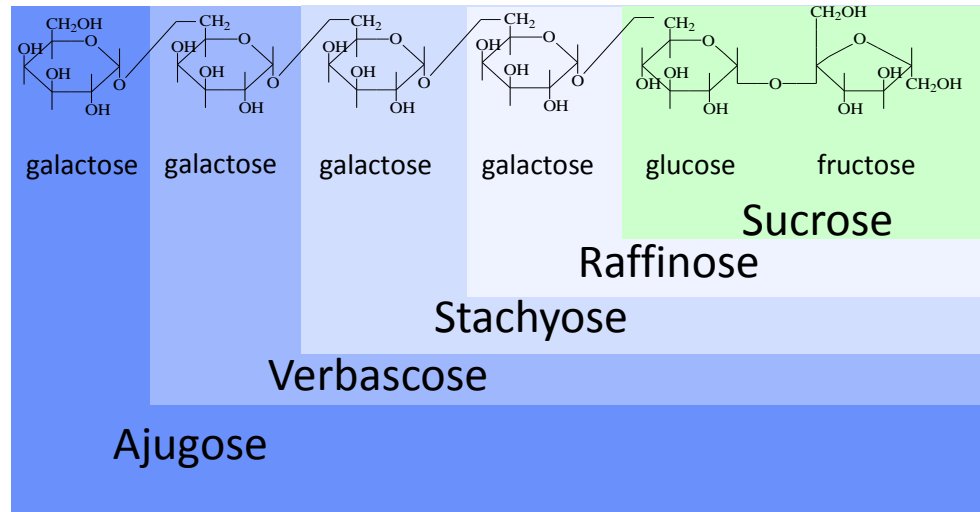


# Non-Available Carbohydrates



## Oligosaccharides:

Soybean remains still the major source of plant proteins although that alternative leguminous seeds such as peas, beans and lupines gain more interest. Galactosides are formed by galactose units and sucrose (disaccharide of glucose + fructose) by  $\alpha$ -galactosidic bonds.





## Typical multi enzyme system (for maize-soya diets)

⇒ 8 enzyme activities from different microorganism:

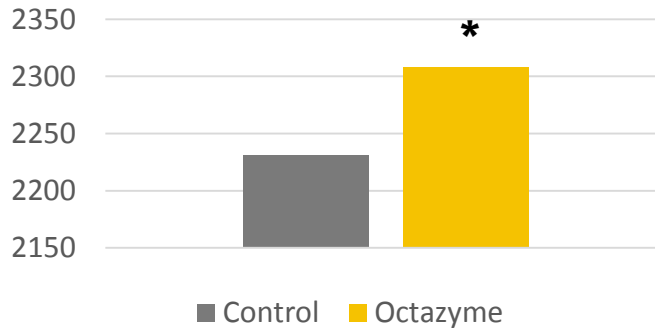
- **Xylanase IUB 3.2.1.8 from *Trichoderma citrinoviride/reesei***
- **Beta-glucanase IUB 3.2.1.6 from *Trichoderma viride/reesei***
- **Cellulase IUB 3.2.1.4 from *Trichoderma viride/reesei***
- **Pectinase IUB 4.2.2.10 from *Aspergillus niger***
- **Alpha galactosidase IUB 3.2.1.22 from *Aspergillus niger***
- **Mannanase IUB 3.2.1.78 from *Trichoderma citrinoviride/reesei***
- **Alpha amylase IUB 3.2.1.1 from *Bacillus amyloliquefaciens***
- **Protease IUB 3.4.21.62 from *Bacillus licheniformis***



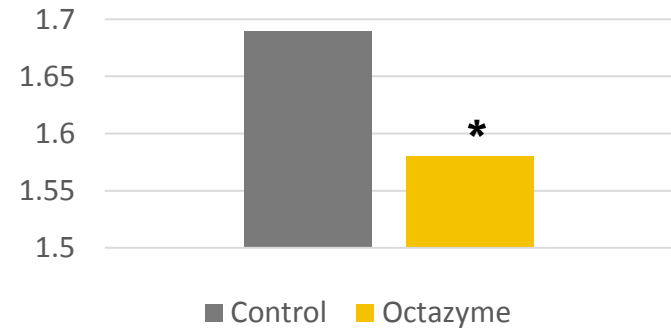


# Typical performance results on maize-soya broiler diets

## LIVE WEIGHT (grams)



## FCR



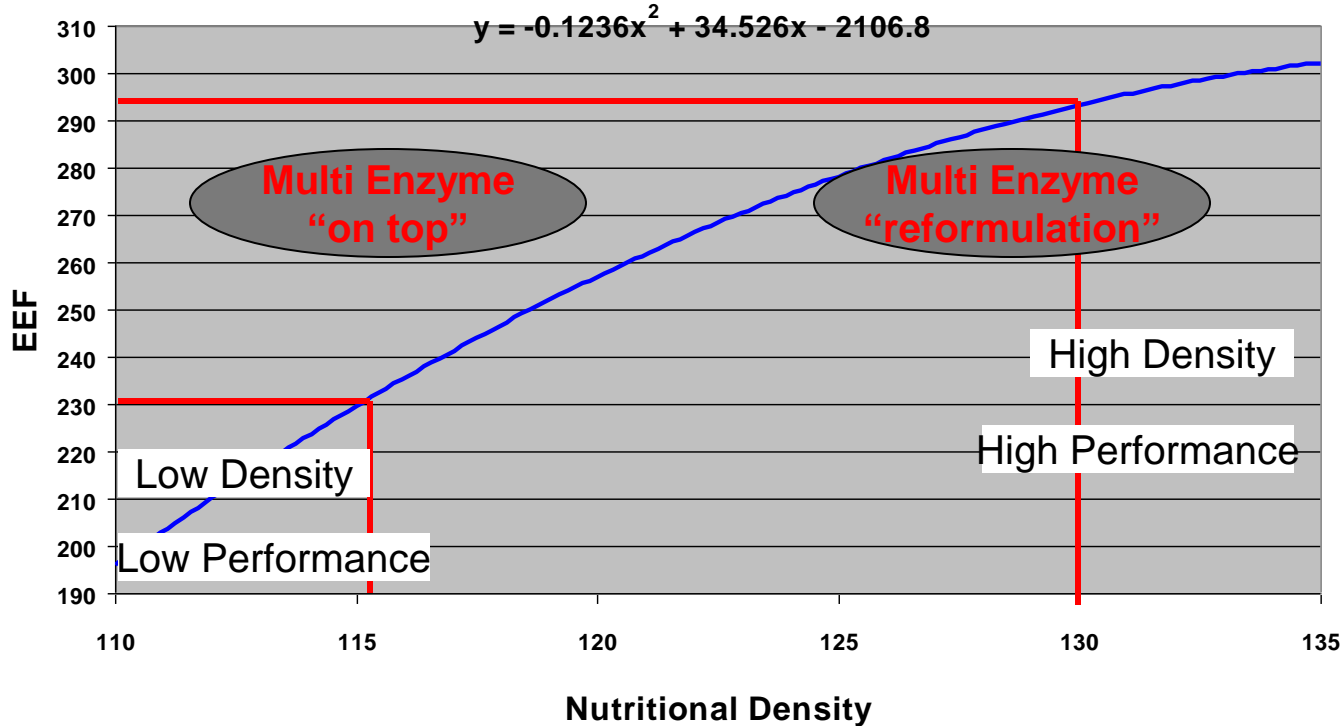
\* Statistically significant difference at  $p < 0,05$

Department of Feed and Food Biotechnology,  
University of Debrecen, 2012  
(trial ref: **EL\_Fra\_120004**)





# Growth performance is a quadratic function of feed density (European example)

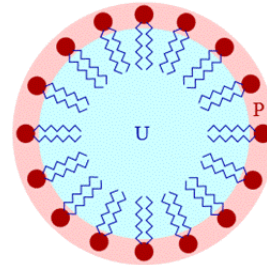




# Fat emulsification => micelle formation

- Phospholipids are isolated from vegetable oils and termed '**lecithins**'. Lecithins from soya oil or sunflower oil contain primarily '**phosphatidylcholine**'
- Lysophospholipids or lysolecithins have a higher HLB value.

Micelles in polar solvent (such as water)



- **Lysophosphatidylcholine** (LPC) is one of the main active component in biosurfactants because it interferes with the lipophilic bilayer of the epithelium cells

HLB

15

14

13

12

11

10

9

8

7

6

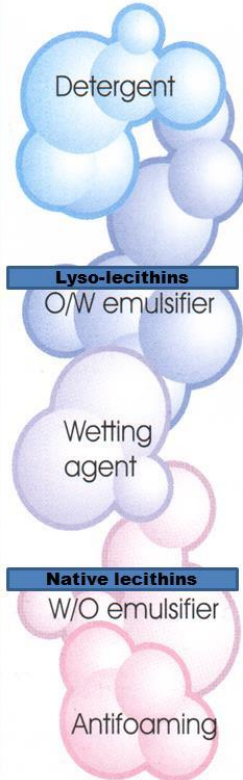
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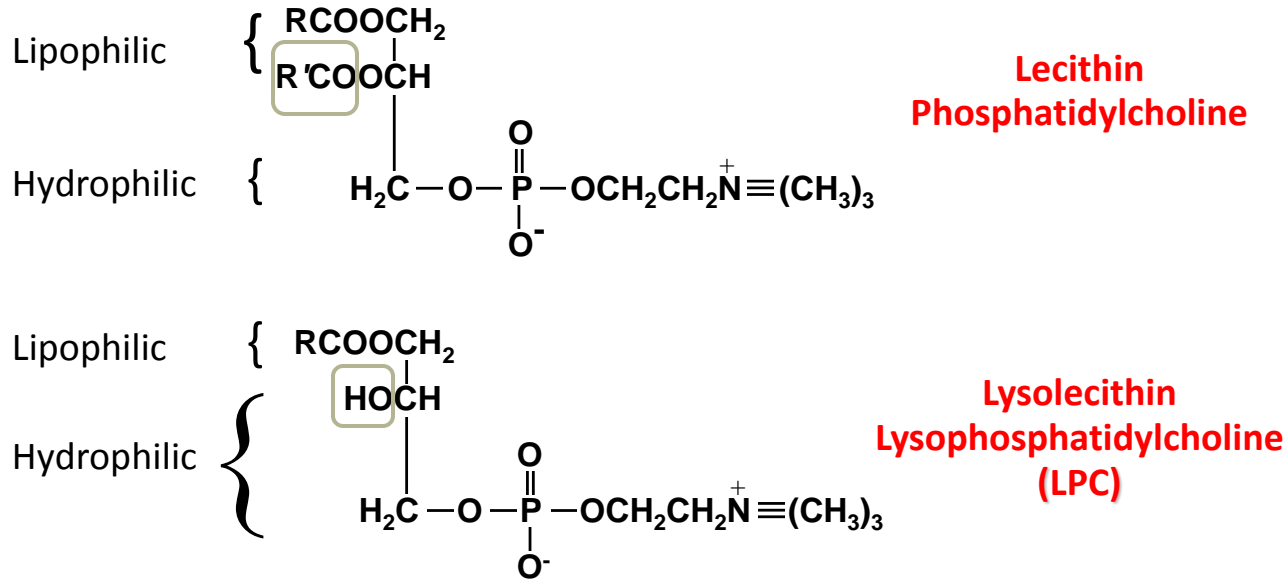
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# Lysophosphatidylcholine (LPC)

Is obtained by the enzymatic hydrolysis of phospholipids into lysophospholipids by the phospholipase A2







# Typical broiler performances with Eubiotic Nutrition in The Netherlands in 2015

	FRA Lecimax group
Mortality and cullung	3,77%
Slaughter age (days)	39
Average live weight (grams)	2425
Average daily gain (gram/day)	62,2
Feed Conversion Ratio (FCR)	1,625
FCR corrected for 1500 gram	1,256
Footlesions	1,33%





# Eubiotic Nutrition - interaction with digestive system

