Fat is composed mainly of triglycerides. The problem with fat digestion is that it takes place in an aqueous environment, when fat is not water soluble.

Fat is emulsified by the detergent effect of bile salts and hydrolyzed by lipases to fatty acids and monoacyl and diacylglycerides.

The transport of monoacyl and diacylglycerides is done by micelles. Hence biosurfactants are required such as phospholipids, lecithins, and lysolecithins. The latter are also known as lysophospholipids.

The problem of fat digestion is that it takes place in a aqueous environment when fat is not water soluble.
Phospholipids, lecithins and lysolecithins have surfactant properties: they are capable of solubilizing lipids in an aqueous emulsion

Supplementating broiler diets with fats and oils as an extra energy source has become common practice in the industry. However, young birds are deficient in the enzymes necessary for efficient digestion. This situation improves with age. Actually, there is a substantial improvement of apparent metabolizable energy values of fats in poultry from 1.5 to 3.5 weeks of age.

Since the 1990s the use of lysolecithins in animal nutrition has gained support among the scientific community. Although many experts agree on the benefits of its use, the mechanism by which these improve animal growth performance are often poorly understood.

Phospholipids including lysolecithins, are ubiquitous in nature, as an essential part of the cell structure, specifically membranes.

The plasmat membrane (fig.2) is a fundamental element of the cell architecture, separating the living from the inert.

However, this separation is far from being complete, because the membrane must allow both the entry of nutrients and the expression of metabolites. The ability of phospholipids and lysophospholipids to be arranged so that this exchange can be possible is due to its unique molecular structure.

Common phospholipids have a polar head and two hydrophobic fatty acid chains (Fig. 3). In the case of lysophospholipids only a single fatty acid chain is observed. The polar heads can be a choline, an ethanolamine, a serine or an inositol (Fig. 3). For a greater diversity fatty acids chains present variable lengths and degrees of saturation, so there are several parameters that may alter the physical and biochemical properties of these compounds.

Small changes in the molecule can dramatically alter its functionality, as it happens with lysolecithins, also known as lysophospholipids. >>

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**Fig.2 Plasmat Membrane**

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**Form & Function**

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**SMALL CHANGES IN THE MOLECULE CAN DRAMATICALLY ALTER ITS FUNCTIONALITY.**
However, not only do phospholipids form lipidic bilayers of cell membranes, but they also form *micelles or liposomes* (Fig. 4) spontaneously, i.e. microscopic capsules for the transport of substances. This characteristic also depends on the shape and charge of these molecules, and it affects how complex mixtures of phospholipids are able to arrange themselves macroscopically in a highly organized way.

A second attribute of phospholipids is its *surfactant* effect, i.e. its ability to solubilize lipids in an aqueous emulsion. Each of these properties can be used to positively affect animal nutrition and health, if used according to scientific principles.

Although *lysophospholipids* represent only a small percentage (<1%) of the total lipids of cell membranes, they play a fundamental role. One of its features is that they behave as modulators of membrane fluidity, and it is through this ability that it can modify its permeability. When a regular membrane (under equilibrium) contacts an excess of Lysophospholipids, these exogenous lipids are integrated into the bilayer. The membrane rapidly becomes more fluid and therefore more permeable.

The exact formula by which permeability affects membrane fluidity is complex but it can be explained simply at a macromolecular level: a membrane in equilibrium contains a series of *holes or pores*, those understood as areas in which phospholipids lack in the structure.
Sometimes aggregates of these gaps are observed, so there is a statistical distribution of pore sizes in the membrane.

When Lysophospholipids are introduced into the membrane, the distribution of gaps are affected in a manner that the number and size of pores increases. By **passive transport mechanism**, **high molecular weight nutrients may cross the membrane**.

If lysophospholipids are added to the diet, the intestinal absorption profile is altered by an increase in passive transport. If more lysophospholipids are not added, acyltransferase activity will return the lysomolecules to its diacyl form and the cell will return to equilibrium.

This is a key application of lysophospholipids in animal nutrition because it implies the possibility of extracting more nutritional value of each kilogram of feed, even when nutrients will normally show a low level of absorption.

A third feature of using Lysophospholipids in feed is its ability to form liposomes. Regular phospholipids tend to form micelles, but these are large and difficult to absorb. On the other hand, Lysophospholipids form very compact and small liposomes, which are more readily absorbed. This is because smaller vesicles fuse more readily with the membranes forming part of the gastrointestinal tract wall.

Finally, there is the question of their surfactant properties. Again, due to their size, shape and charge, Lysophospholipids are better oil-in-water emulsifiers than regular phospholipids. >>>
LIPIDOL alters the permeability of intestinal cell membranes

LIPIDOL is the new source of highly concentrated lysophospholipids developed jointly by ANDRES PINTALUBA S.A. and Pathway Intermediates Ltd.

To produce it, purified extract of lecithin is modified by enzymatic action (phospholipase A2).

The resulting product has a higher emulsifying power than phospholipids and it is able to alter the permeability of intestinal cell membranes, making absorption of micronutrients and macronutrients more effective. This results in a significative improvement of energy, protein and aminoacids digestibility.
Beneficial effects have been observed from the use of LIPIDOL in all species

RESULTS OF LIPIDOL USE IN ANIMAL NUTRITION

POULTRY

* Various experimental tests performed with Lipidol in broiler chickens in Dankook University (South Korea) in 2010 and 2011 showed a linear improvement in weight gain and feed conversion, when Lipidol was included at 0.5 and 1 kg/ton of feed.

A decrease in metabolizable energy (ME) of 100 kcal could be compensated, allowing substantial savings in the formulation.

* In another test at the Federal University of Lavras (Brazil) in 2011, the use of Lipidol at 1kg/ton in broiler diets helped to compensate ME 150 kcal lower diets without side effects on any production parameter, compared with controls.

* The positive effect of Lipidol applied to laying hen diets was observed in an experimental test carried out at Sungkyunkwan University (South Korea) in 2010. 1kg Lipidol/ton of feed supplemented hens and with ME 100 kcal less produced eggs with better trade size classification. Dry matter, protein, energy, fat and amino acids digestibilities are all improved. Lysine, Methionine and Threonine digestibilities were also improved significantly.

PORCINE

* Lipidol use has been studied in piglets and sows. A study of Sungkyunkwan University (South Korea) conducted in 2011 in piglets weaned at 28 days of life shows how Lipidol inclusion at 1kg/ton improved weight gain and feed conversion by 12% significantly (P <0.05) until day 56. In addition, there was a significant improvement (P <0.05) of dry matter, crude protein, fat, energy and amino acids digestibilities. Actually, it improved the digestibilities of Lysine (5%), Methionine (6%), Threonine (5%) and Histidine (4%).
In a study conducted at Dankook University (South Korea) in 2009 with piglets of 10 kg live weight, Lipidol was supplied at 1 kg / ton in diets with 75 kcal ME less than controls. 4 weeks after, it was observed that the ME reduction had no negative effect on piglets performance, when supplemented with Lipidol.

In a test conducted at Sungkyunkwan University (South Korea) 160 sows were supplemented for one year with 1 kg of Lipidol / ton of feed. These sows showed an improvement of all production parameters.

OTHER SPECIES

It has been hypothesized that homogenization of food increased by lysophospholipids enhances many water-soluble nutrients digestibility. It has also been observed that lysolecithins improve the solubilization of long chain fatty acids in sheep.

Several studies show how fish benefit from lysolecitins in several ways. Many fish species are Choline defficient. Including a source in the diet has important effects. Besides, lysolecitins increase tocopherol and cholesterol absorption. Furthermore, fish apparently need an exogenous source of phospholipids to maintain an adequate lipoprotein biosynthesis level.