GELAMIN®

fluid gelatine for agricultural use

dossier

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PECULIAR CHARACTERISTICS

GELAMIN® is ILSA's fluid matrix that, thanks to its specific characteristics, is the essential component of almost all ILSA's liquid and water-soluble fertilizers.

GELAMIN® is produced by means of **controlled and highly specific enzymatic hydrolysis** that makes it:

- Highly standardized, pure and homogeneous, and consistent in its Nitrogen content;
- Rich with intact molecules that are, therefore, biologically active;
- Bacteriologically stable;
- Free from risks of irritation for operators.

GELAMIN® has high **use efficiency** because:

- It contains organic nitrogen with high nutrition action;
- It contains organic nitrogen completely water-soluble and therefore readily available to plants;
- It contains a very high number of aminoacids, peptides and polypeptides that are fundamental in vegetal nutrition;
- The aminoacids it contains have a chelating and complexing function towards other elements, reducing the risk of their shortage and increasing their mobility;
- It is not leached when applied at the root level and is rapidly absorbed when applied at the leaf level, which means reduced loss.

GELAMIN® is derived from an enzymatic hydrolysis production process named by ILSA:

Fully Controlled Enzymatic Hydrolysis

THE FCEH® PROCESS (Fully Controlled Enzymatic Hydrolysis)

The plant allows the enzimatic hydrolysis of natural substances of vegetal and animal origin. The raw materials enter the reactors in a mixture with water and enzymes capable of modifying the molecular structure of proteins. The raw materials are rich in collagen and are selected from material **free from health risks.**

The FCEH® process

FULLY CONTROLLED ENZYMATIC HYDROLYSIS

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FULLY CONTROLLED ENZYMATIC HYDROLYSIS

With FCEH®, protein fractions of variable length are formed (polypeptides, peptides, and free aminoacids). The presence of these fractions with different molecular weight ensures its bio-stimulating and nutritional action, so enabling **numerous applications:**

- At both root and nutritional level in fertigation;
- At both leaf and nutritional level;
- As a biostimulant;
- As a co-formulator;
- In liquid or water-soluble form;
- Pure or complexed with macro-, meso- and micro-elements.

The **enzymatic hydrolysis** process set up by ILSA and defined as "mild", is the result of years of study and research.
The process is defined "mild" because the reaction takes place at low temperature (about 50-55° C) inside static reactors.

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Static reactor

The polypeptide chains forming collagen are attacked by a **pool of specific enzymes**, which "cut" peptide bonds in a targeted and always replicable manner: in this way, aminoacids do not undergo any alteration and present themselves in the levorotatory form, which is both biologically active and readily absorbable by the plant. Once the hydrolysis stage is over, vacuum concentration begins in order to extract excess water. (Fig. 1)

The combination of low temperatures and the use of a specific enzyme pool, therefore, ensures that the heat-sensitive molecules with biological function in the plant are not degraded.

Moreover, the enzymatic hydrolysis process is controlled at every stage and all parameters are monitored by a computer system: the process, thus, is highly standardized, allowing for a product with consistency in its content and in the physico-chemical properties characterizing it.

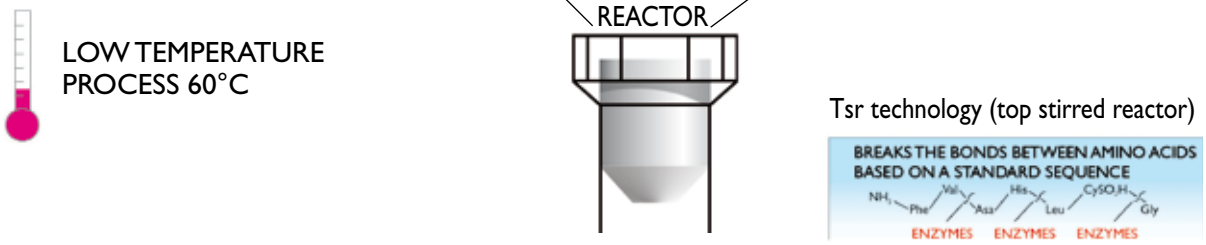
RAW MATERIAL: COLLAGEN

The raw material is examined and divided by size.

WASHING - STERILIZATION - STABILIZATION

The hydrolysis times and the enzymes used vary depending on the raw material and the destination of the finished product.

SELECTION BY SIZE



FILTRATION BY ELIMINATION OF SUSPENDED SOLIDS

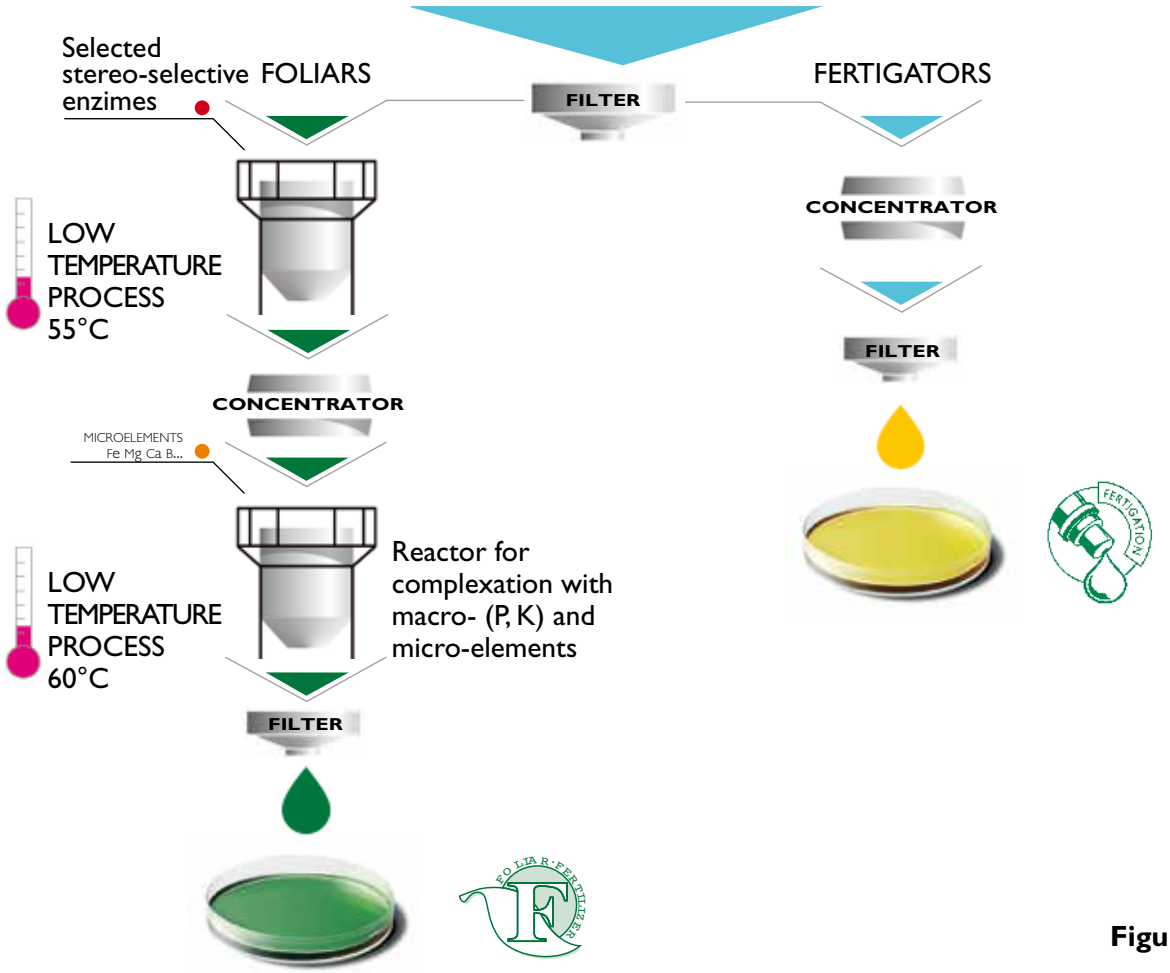


Figure 1.

CHEMICAL AND PHYSICAL CHARACTERISTICS

GELAMIN® is characterized by:

- high homogeneity;
- high purity;
- high stability.

The main physico-chemical parameters characterizing **GELAMIN**® are listed in Table 1.

ANALYZED PARAMETER	VALUE	NOTES
ORGANIC NITROGEN (N%)	6,0-9,0	Variability depends on the specific function of the GELAMIN®-based product.
SOLUBLE ORGANIC NITROGEN (N%)	6,0-9,0	Variability depends on the specific function of the GELAMIN®-based product.
ORGANIC CARBON (C%)	16,0-25,0	Variability depends on the specific function of the GELAMIN®-based product.
pH in water	5-6	
SALINITY (dS/m)	0,5-0,8	Variability depends on the specific function of the GELAMIN®-based product.
DENSITY (kg/dm3)	1,13-1,21	Variability depends on the specific function of the GELAMIN®-based product.
TOTAL AMINOACIDS	38,-58,0	Variability depends on the specific function of the GELAMIN®-based product.

Table 1. Physico-chemical parameters characterizing GELAMIN®

GELAMIN® also contains organic nitrogen derived from enzymatic hydrolysis of the fibrous proteins typical of skins, so it presents mainly the aminoacids: glycine, proline, hydroxyproline, glutamic acid, and alanine (fig. 2). Depending on the **GELAMIN**®-based product, the aminoacid profile does not change, but the percentage of individual aminoacids does so based on the specific function of the product.

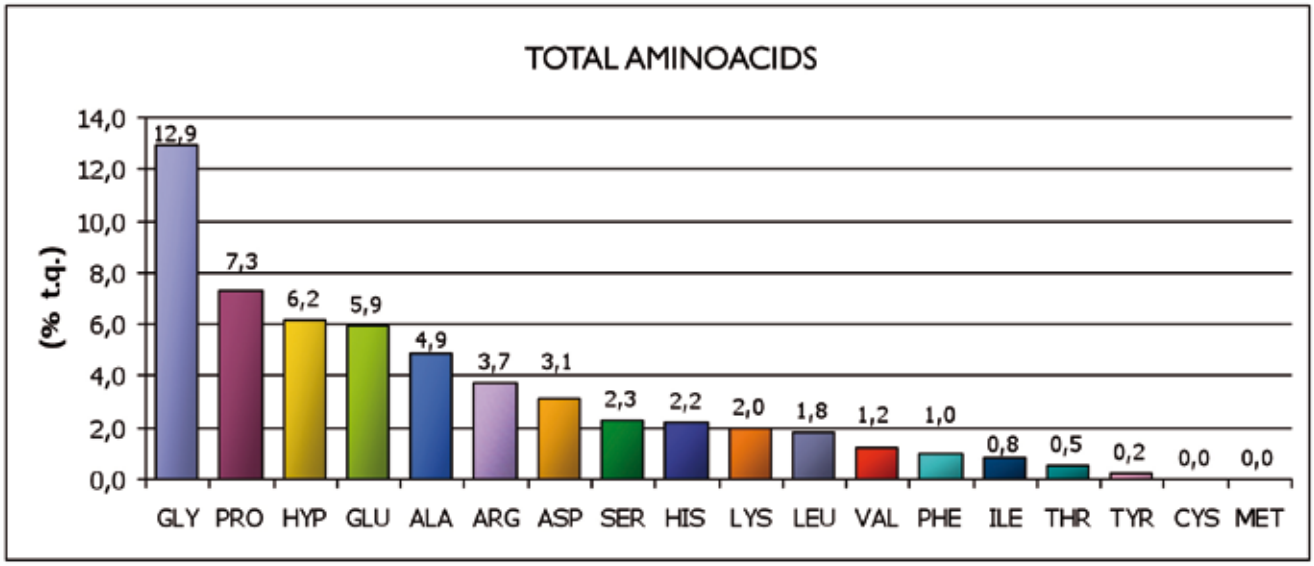


Figure 2. Example of aminoacid composition of GELAMIN®

GLY = glycine;
PRO = proline;
HYP = hydroxyproline;
GLU = glutamic acid;
ALA = alanine;
ARG = arginine;
ASP = aspartic acid;
SER = serine;
HIS = histidine;
LYS = lysine;
LEU = leucine;
VAL = valine;
PHE = phenylalanine;
ILE = isoleucine;
THR = threonine;
TYR = tyrosine;
CYS = cysteine;
MET = methionine;

THE USE OF GELAMIN®

During the enzymatic hydrolysis process, protein fractions of variable length (polypeptides, peptides, and free aminoacids) are formed: the molecular size of peptides can be variable, depending on the intensity of hydrolysis, and ranging between a few hundred and several thousand daltons (Da).

The presence of these fractions with different molecular weight ensures both the nutritional and the bio-stimulating action of the GELAMIN® matrix. In particular, the bio-stimulating properties of protein hydrolysates are primarily derived from free aminoacids: the aminoacid content is therefore an important parameter for the agronomic evaluation of protein hydrolysates.

According to several authors, in fact, aminoacids, especially in free form, would affect the physiological activities of the plant and in particular:

- **chlorophyll photosynthesis**, since glycine is a constituent of chlorophyll;
- **protein synthesis**, since glutamic acid, glutamine, aspartic acid and asparagine are the starting aminoacids of protein synthesis;
- a **complexing action**, since aspartic acid, glutamic acid and glycine are capable of forming chelates with nutrients and molecules of different nature;
- **lignification**, since phenylalanine is one of the precursors for lignin biosynthesis;
- **resistance to abiotic stresses**, since proline (and hydroxyproline) accumulates in the cytoplasm as a result of water and osmotic stress; alanine (and γ-aminobutyrate) does in the case of anaerobic stress; glutathione (a compound derived from the aminoacid cysteine) does in the case of presence of heavy metals and oxidative stress, and; polyamines derived from arginine do in the case of potassium shortage and hydric or osmotic stresses;

- a **hormone-like activity**, given that several aminoacids are metabolic precursors of phytohormones (for ex., tryptophan is a precursor of indoleacetic acid; methionine is of ethylene, and; arginine is of polyamines);
- the **fruit ripening processes**, since alanine, isoleucine, leucine and valine are precursors of aromas; phenylalanine is a precursor of color, and; alanine, arginine, glycine and proline are precursors of flavor.

The aminoacids in the gelatin **GELAMIN®** are mainly in the L form (levorotatory), which is biologically active and recognized by plants. The levorotatory aminoacids maintain their biological activity since the use of specific enzymes and low temperatures during the enzymatic hydrolysis process allows reducing the racemization phenomena of free aminoacids, which are typical instead of chemical or high temperature hydrolysis.

Racemization is a natural phenomenon leading to the formation of dextrorotatory (in the D form) and levorotatory (in the L form) aminoacids from a mixture that only contains levorotatory aminoacids. Racemization proceeds very slowly at room temperature, while it is considerably accelerated at high temperatures: this is one of the reasons why dextrorotatory aminoacids are virtually absent in nature, and it has been proven that they can also have negative or even toxic effects on living organisms.

GELAMIN® is characterized by a very low degree of racemization thanks to the use of proteolytic enzymes that are active at low temperatures; in addition, enzymatic hydrolysis also allows avoiding some side effects related to chemical hydrolysis, such as the degradation of aminoacids such as tryptophan or arginine, which are metabolic precursors of some vegetal hormones.

GELAMIN®: root nutrition

GELAMIN® is used as a matrix for formulating ILSA products used in fertigation for nutritional purposes. Its use in fertigation is made possible by its peculiar characteristics, such as:

- low salinity;
- high water solubility;
- perfect miscibility;
- no bad smells;
- no phytotoxicity;
- no leaching;
- rapid absorption.

The **GELAMIN®**-based products used in fertigation provide organic nitrogen that is rapidly broken down by soil bacteria and converted into forms assimilable by roots (polypeptides, peptides and aminoacids), which allows a rapid response by plants and a more homogeneous and balanced vegetative growth. It has been shown, by measuring the increase in soil microbial respiration as a result of its application, that **GELAMIN®** stimulates the population of soil microorganisms.
Moreover, these products have also been shown to have a direct effect of stimulation on root development, which leads to a greater root volume and a greater ability to explore the rhizosphere, thus facilitating the absorption of nutrients.

Agronomic tests confirm that the **GELAMIN®**-based products ensure:

- an increase in the root and foliar biomass;
- an increase in photosynthetic activity;
- an increase in production, in terms of both biomass and fruit swelling;
- an increase in the product quality, with the reduction of production waste.

GELAMIN®: foliar nutrition

GELAMIN® is used as a matrix for formulating ILSA products used as foliar fertilizers. Its foliar use is made possible thanks to its characteristics, already shown in the previous paragraph.

The **GELAMIN®**-based foliar products are assimilated and translocated within the plant very quickly and, due to the presence of levorotatory aminoacids, are readily used in the processes of primary metabolism of the plant, thus ensuring its uniform and balanced development. The latter leads to an increase in biomass and then in production.

The foliar fertilization with **GELAMIN®** -based products also presents application benefits since, by ensuring rapid absorption, allows taking timely action in the case of nutritional deficiencies or critical periods for the plant.

GELAMIN®: foliar nutrition, complexed with macro-micro elements

GELAMIN® is the basis for the formulation of a series of products with nutritional function, applied at the leaf level and containing complexed macro-, meso- and micro-elements.

GELAMIN® indeed, for its high organic matter content and the presence of free aminoacids, peptides and polypeptides, can form complexes or natural chelates with nutrients, thus increasing their availability to plants and microorganisms.

The action of the organic component and different protein fractions in the fluid gelatin **GELAMIN®** is then diversified: on the one hand, the complexation and chelation properties help keeping the elements active and usable by plants even in a wide pH range: in fact, the high presence of aminoacids, oligo- and polypeptides whose binding domains are involved in the metal-complexation processes, promotes solubility in pH conditions under which, as a rule, the various elements would naturally tend to precipitate.

On the other hand, aminoacids and peptides act as both carriers of the elements, facilitating their absorption, and complexers that, by keeping the elements in a biologically active form, favor their translocation and mobility through the phloem transport system. This is the system carrying the substances absorbed by the foliar apparatus to the other plant organs (flowers, fruits, seeds, storage organs, roots and young leaves).
In particular, the levorotatory aminoacids inside **GELAMIN®** complex boron and make it available to fulfill its physiological roles of synthesis of cell wall pectins and carriage of sugar-borate complex systems from photosynthetic organs to fruits.
As for calcium, an essential component of cell walls, when chelated by aminoacids and peptides it has greater mobility and availability. Moreover, the presence of levorotatory aminoacids and peptides enhances the absorption and translocation of potassium and magnesium in all organs of the plant: the synergy between aminoacids, magnesium and potassium allows improving their activity inside the plant.

Microelements such as zinc and manganese, which are important cofactors of enzymes, due to aminoacids are complexed and more easily conveyed within the plant, thus enabling rapid and efficient assimilation. The complexing properties of the matrix **GELAMIN®** give the products containing it the property to keep the iron available to the plant and in the biologically active form, i.e. the bivalent (Fe2+). There is evidence that **GELAMIN®** is able to keep the iron in solution over a wide pH range in the form that plants can absorb.

It can then be concluded that the **GELAMIN®**-based products containing complexed elements provide physiological benefits to the plant, since they:

- facilitate the transport of sugars and photoassimilates;
- increase photosynthetic activity;
- improve fruit set and the formation of new vegetal tissues;
- increase the plant resistance to adverse conditions by increasing the consistency of tissues.
- provide isoleucine, histidine, proline and hydroxyproline, which have structural functions and belong to the proteins associated with cell membranes.

Support to the plant physiology results in quantitative and qualitative increases in production, since:

- the emergence of deficiencies is countered;
- the production quality and homogeneity is increased, by improving the color, texture and flavor of fruits;
- the fruit hardness and preservation is increased.

GELAMIN®: nutrition, in the water-soluble form

GELAMIN® is also used for formulating products with nutritional function whose peculiarity is that of coming not in liquid form, but in water-soluble microgranules or powder.

Therefore, these can be used as both foliar fertilizers and fertigators, due to their fast and perfect solubility and miscibility.

Such products, besides giving the same agronomic benefits as the **GELAMIN®**-based liquid products, generally have higher nitrogen content. As a consequence, their role in the plant nitrogen nutrition is more relevant.

GELAMIN®: biostimulating action

GELAMIN® is also the matrix for ILSA products used at the leaf level as biostimulators. There is evidence that its characteristics allow using it as both a nutrient and a stimulant: the stimulation activity mainly depends on a few aminoacids that, by means of the enzymatic hydrolysis process at low temperatures, remain intact.

In the composition of **GELAMIN®**, as a fact, besides there being aminoacids involved in primary metabolisms (protein synthesis, photosynthesis…), there are also aminoacids with biological function in secondary metabolisms that affect abiotic stress resistance on one hand, while improving production quality on the other hand. A clear biostimulation activity has been extensively proven, both in the foliar apparatus and in the root one, with a growth in the foliar and root masses without any actual raise in the nitrogen nutritional levels.

GELAMIN®: co-formulating activity

GELAMIN® is also the matrix for ILSA products with specific action that can be used in synergy with other fertilizers or products with phytosanitary action (insecticides, fungicides, herbicides ...). Its use in products with co-formulating function is possible due to its perfect miscibility and solubility.

The characteristics of **GELAMIN®** increase use efficiency in the products distributed synergically, since Gelamin:

- increases the wetted surface of sprayed droplets, slows down their drying out and thus favors the absorption of nutrients;

- allows, through its carrier function and retention action, the leaf to remain wet longer due to the ability of polypeptides to form a semipermeable film that slows down the evaporation of water distributed;
- optimizes the action of the mixed active substances;
- conveys the absorption of nutrients, facilitating their access and assimilation by foliar way;
- conveys the absorption of synthesis organic compounds, thus increasing their effectiveness and consequently decreasing their dosage, with benefits in both economic and environmental terms;
- provides, however, proteins, peptides, and aminoacids with all the functions already widely described.

Its activity as co-formulant is possible due to the presence of aminoacids, peptides and polypeptides that can act as carriers, i.e. carriers of other molecules through the leaf surface.

The positive influence of **GELAMIN®** in conveying pesticides is visible especially in the absorption, translocation and toxicity of the active principle, since the effectiveness of this latter is increased: protein hydrolyzates indeed contain aminoacids and peptides that are able to actively overcome cell membranes and act on different metabolic pathways. Therefore, the penetration and translocation of other molecules is facilitated, both directly through mechanisms of active transport (symport) and indirectly by increasing the free energy available to the cell for active transport mechanisms.

The positive influence of the matrix in the use efficiency of fertilizers is due to its ability to increase the retention of the aqueous solutions containing the fertilizers on the leaf edges. Moreover, the product, as a result of increased retention, also increases the surface area between the droplets and the leaf blade, thereby increasing the absorption of the nutrient solution applied.

From an agronomic point of view, the application of products containing **GELAMIN®** leads to several positive effects on the physiology of the plant, such as:

- acceleration of the main metabolisms and the absorption of nutrients, since the loss by leaf leaching decreases and the amounts potentially absorbable increase;
- an increase in production and an improvement of the quality of products;
- an increase in the capacity of overcoming stress phases;
- an increase in the foliar and root biomass;
- an improvement of quantitative and qualitative production parameters;
- a strong buffer effect capable of reducing the negative effects caused by extreme changes in salinity.

CONCLUSIONS

GELAMIN® is a protein matrix derived from the FCEH® enzymatic hydrolysis production process, used exclusively by ILSA. This same process ensures a highly standardized product, consistent in its content, highly pure and homogeneous, and with a high agronomic efficiency, due to the high presence of organic nitrogen and protein fractions (aminoacids, peptides and polypeptides) that are maintained in their biologically active form.

The physico-chemical properties allow the **GELAMIN**®-based products to find different application solutions at the nutritional and bio-stimulation level, and also as co-formulators, thereby ensuring rapid absorption and translocation within the plant.

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