The PRIMA programme is supported under Horizon 2020, the European Union's Framework Programme for Research and Innovation.

# Project presentation

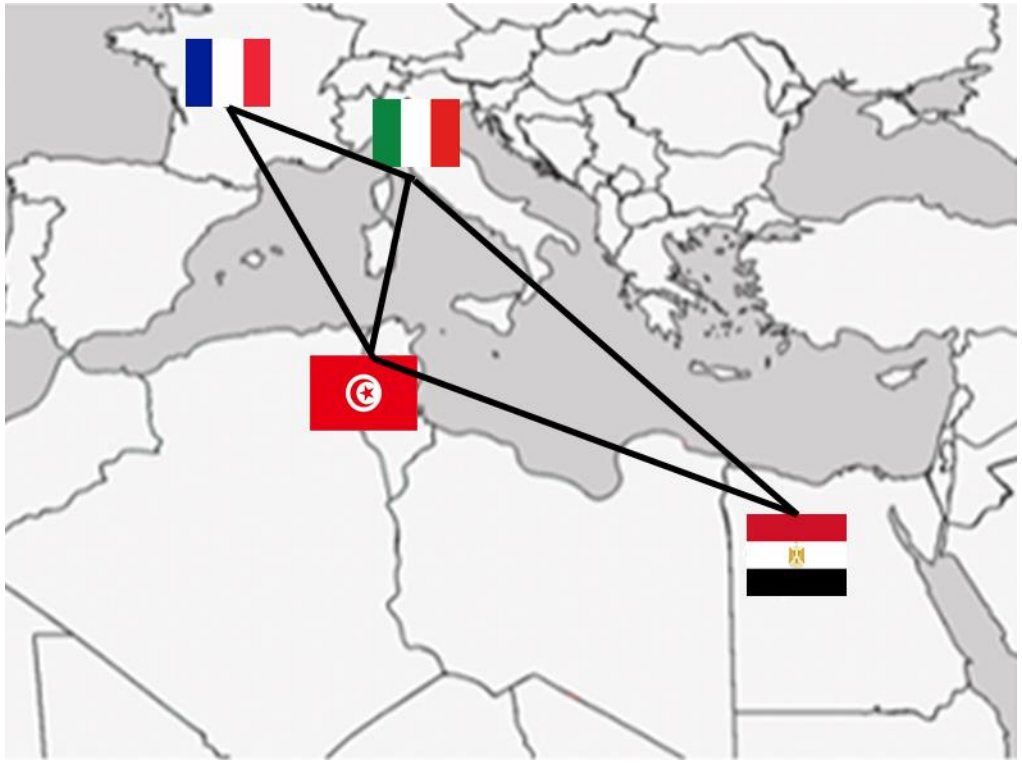
Prof. Gabriele Brecchia – PI and coordinator of the project - UNIMI

ΩRABBIT

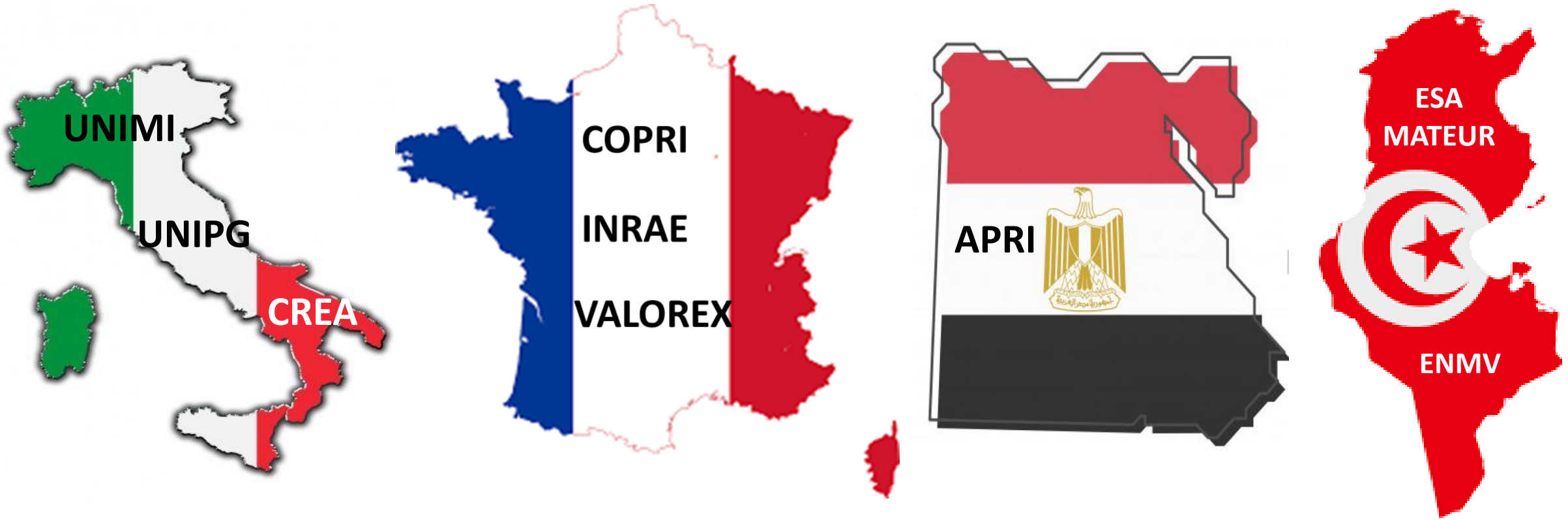
Omega RABbit: food for health BenefIT

RIA

# Project Countries



# Project partners



# List of partecipant

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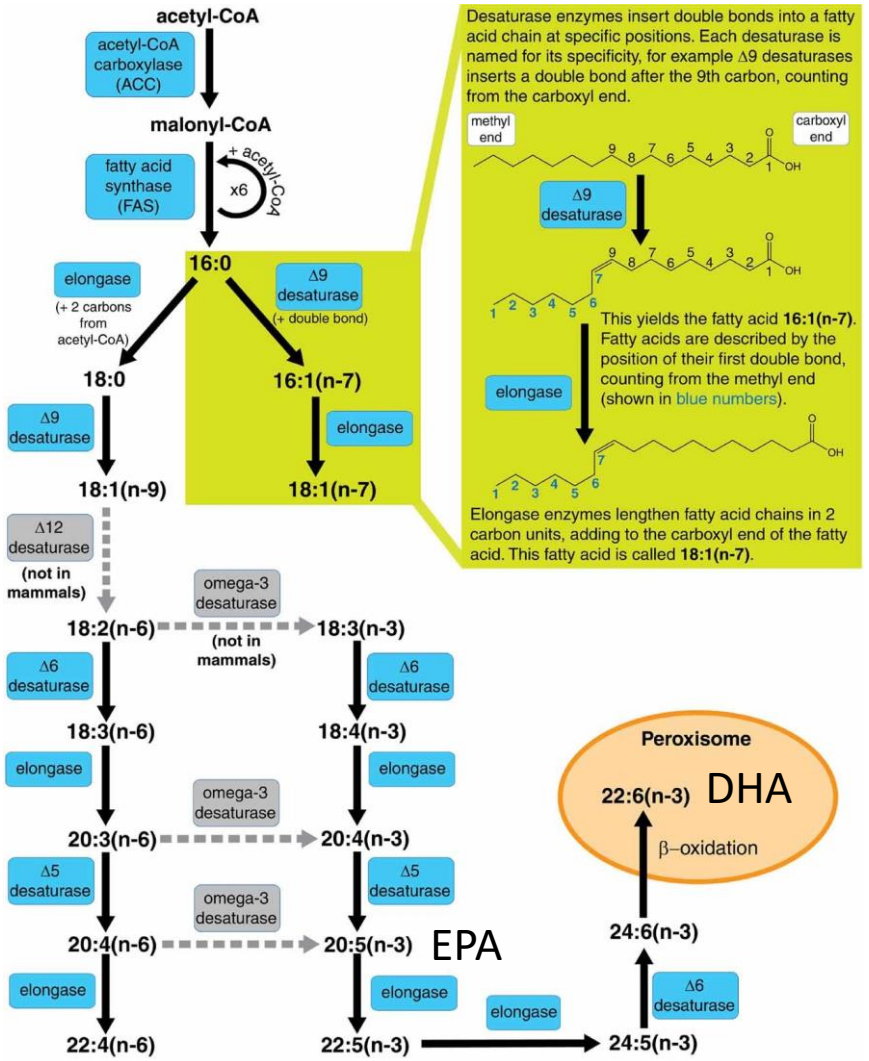
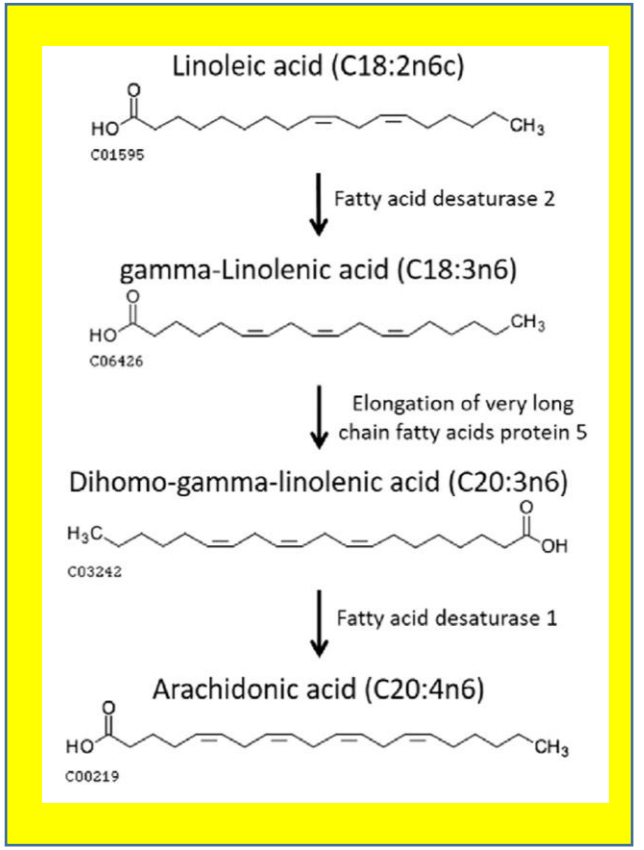
# State of art and innovation

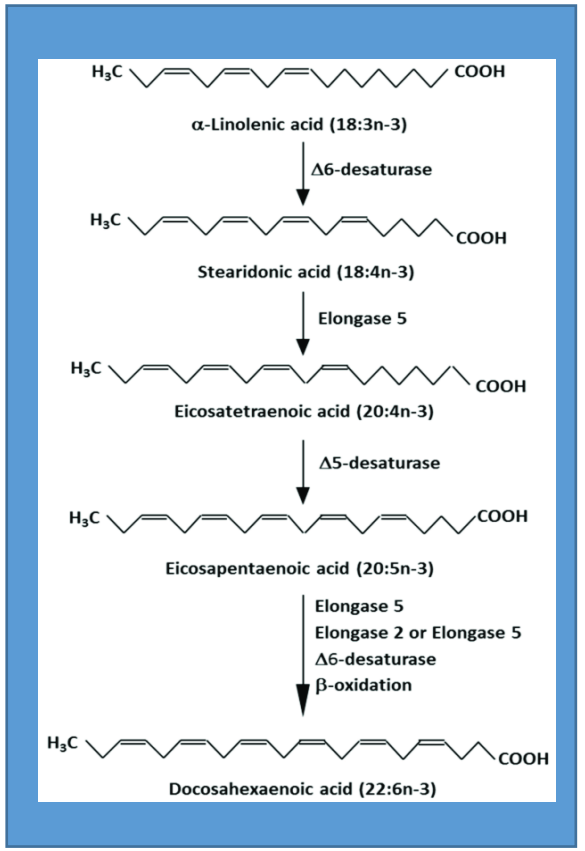
- Lipids play a crucial role in the structure and function of cells
- Human and animals cannot synthesize omega-6 (n-6) or omega-3 (n-3) fatty acids de novo due to a lack of appropriate fatty acid desaturase enzymes
- In particular, long chain (>20C) polyunsaturated fatty acids (LC-PUFAs) result from elongations and desaturation of two essential fatty acids: **linoleic acid (LA; 18:2n-6)** and **α-linolenic acid (ALA; 18:3n-3)** which concentrations depends on dietary intake
- LA and ALA have a structural role in the cell membranes, are precursor of several compounds, and are essential for numerous physiological processes including reproduction



# State of art and innovation

- The elongation and desaturation pathways are catalysed by the same enzymes but:
- **LA metabolites (n-6)** have prothrombotic and pro-aggregatory properties
- **ALA metabolites (n-3),** eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), have anti-inflammatory, anti-proliferative, and anti-atherosclerotic activity
- **This major dietary n-3 fatty acids are included in linseed (ALA), fish oil and algae (EPA and DHA)**

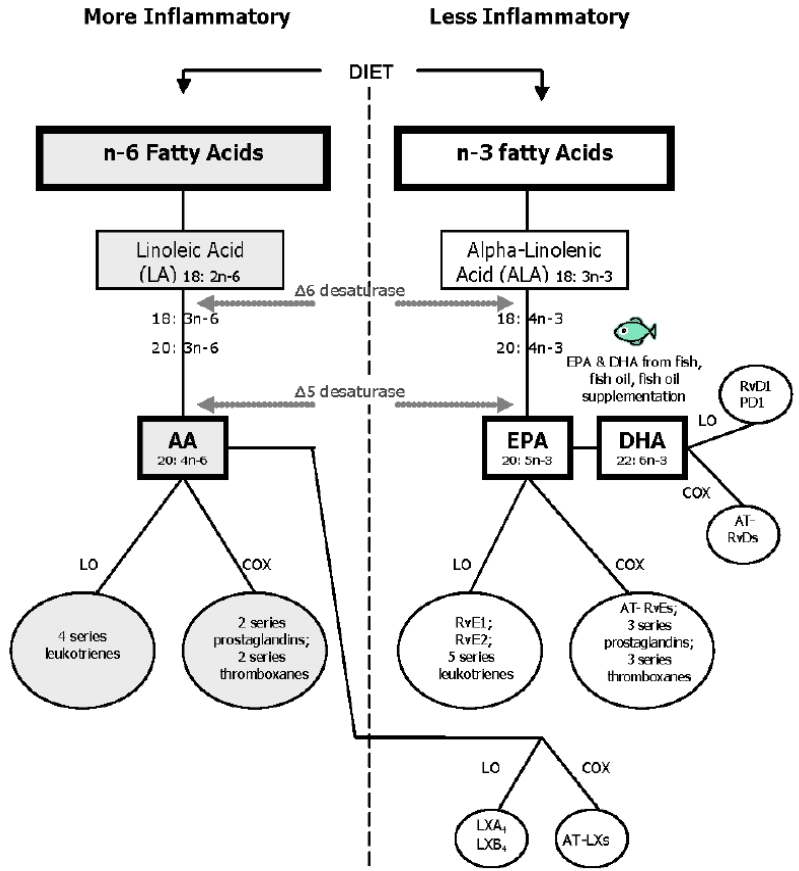


# State of art and innovation

- The anti- inflammatory actions of EPA and DHA are associated with their ability to:

1) modulate the production and activity of lipid mediators such as eicosanoids produced from n-6 and n-3 metabolism
2) alter cell membrane structure and function
3) modulate cytokines secretion (involved in normal and pathological cell functions)
4) directly suppress the expression of genes involved in inflammation, such as interleukin (IL)- 1 and tumor necrosis factor (TNF)-α

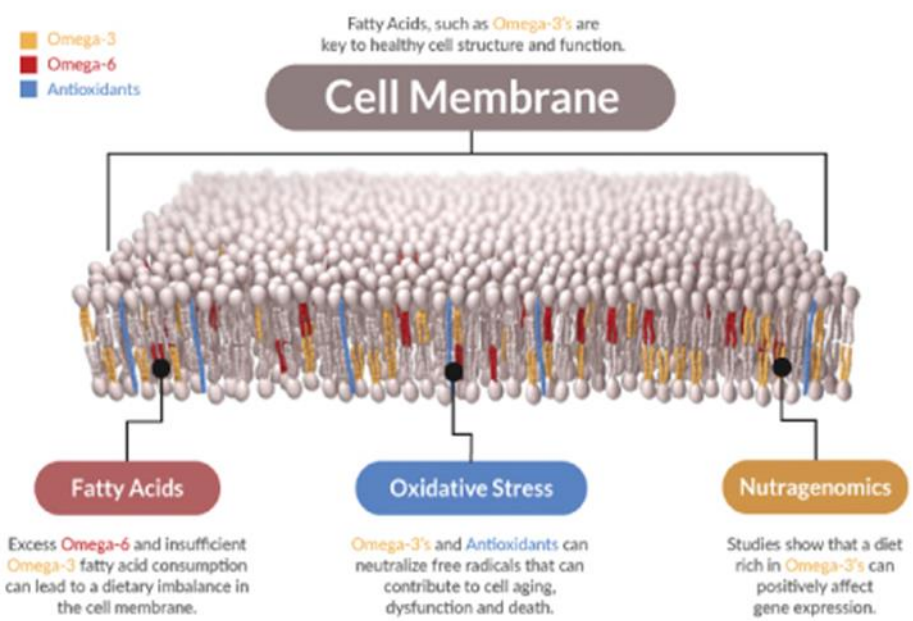



AA = Arachidonic acid; AT = Aspirin-triggered; COX = Cyclooxygenase; DHA = Docosahexaenoic acid; EPA = Eicosapentaenoic acid; LO = Lipoxygenase; LX = Lipoxins; PD = DHA-derived protectin; PUFA = Polyunsaturated fatty acids; Rv= Resolvins

n-6, n-3 polyunsaturated fatty acid pathways generating lipid mediators of inflammation

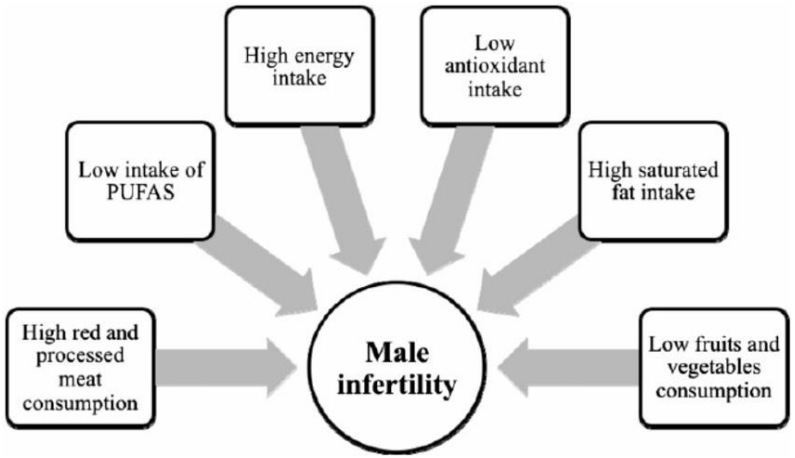
# State of art

- The Western diet is unbalanced in terms of PUFAs
- The WHO considers that the optimal n6/n3 ratio is <4, but, at the moment, it is above 15 in industrialized countries
- Consuming higher quantities of n-3 PUFAs is one approach to normalizing high n-6/n-3 ratios with an improvement of human health
- In fact, there is mounting evidence that an increase in dietary n-3 PUFAs (particularly EPA and DHA, is effective in treating and lowering the risk of developing chronic pathologies, such as cardio-circulatory diseases, obesity and diabetes) and fertility



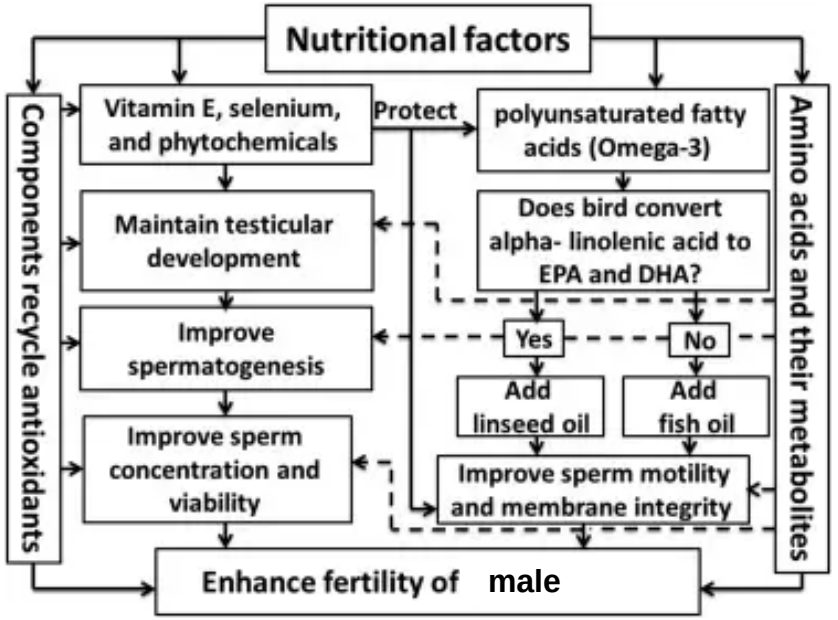
# State of art and innovation

- One of the major causes that affect **male's fertility** is the low sperm production
- The sperm count in Western countries is progressively and linearly decreasing (about 50-60% less) accordingly, in the next 30 years dramatic infertility rates are expected
- Between many factors the dietetic habits play a significant role on functions of both reproductive tissues and sperm
- One PUFA target is the sperm cell since the phospholipid fraction of normal mammalian sperm cell consists of about 50% of PUFA, in particular LC-PUFA
- In various animal species, the n-3 PUFA addition improves sperm traits



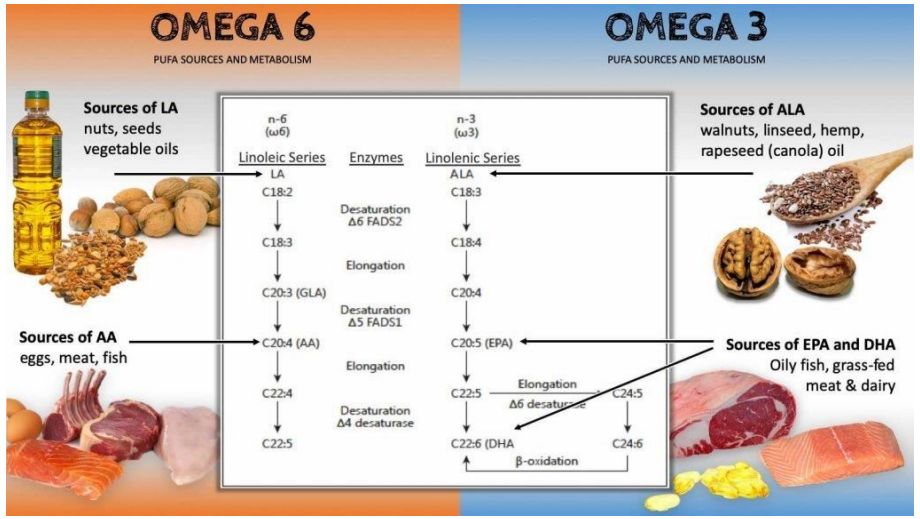
# State of art and innovation

- The dietary supplementation with n-3 PUFA improves sperm characteristics although oxidative damage must be prevented using, for example, over-nutritional amount of vitamin E
- Thus, there is mounting evidence that regular consumption of n-3 fatty acids, in a dose- or time-dependent manner, can improve the sperm traits of humans of both sexes and animals
- Increasing the contents of PUFAs in the diet could constitute a natural solution to improve the reproductive performance of rabbit, also in warm climatic condition



# State of art and innovation

- The fatty acid composition of animal products (eggs, milk, and meat) reflects the tissue fatty acid biosynthesis and the fatty acid composition of ingested lipids
- There is evidence that animal feeds supplemented with products enriched in n-3 PUFA  such as linseed, increases n-3 fatty acid content and reduces the n-6/n-3 ratio in animal products
- Increasing the contents of PUFAs in the diet could constitute a natural strategy to improve the productive performance of rabbit , particularly for the local rabbit population characterized by a relatively low prolificacy and growth and high mortality
- Animal products, as the meat derived by these animals, it could be considered a good supplier of the n-3 for the consumers




ΩRABBIT

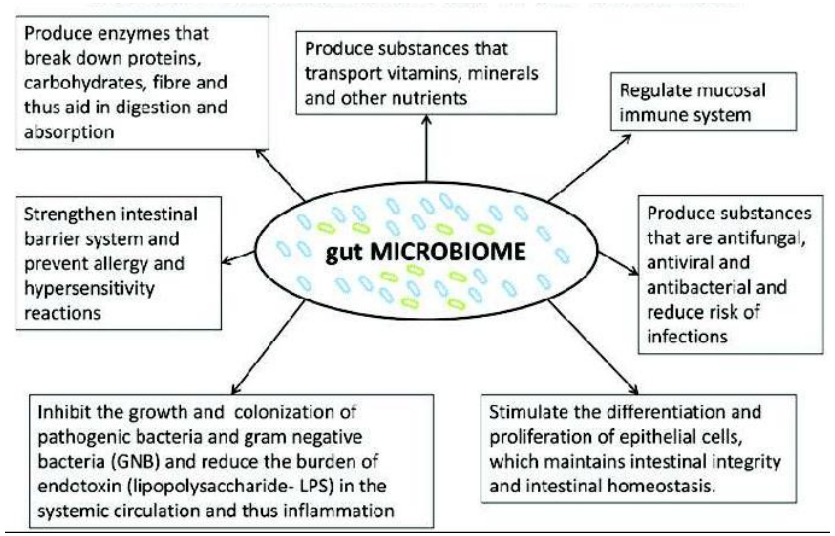
Omega RABbit: food for health BenefIT

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION
IN THE MEDITERRANEAN AREA

# State of art and innovation

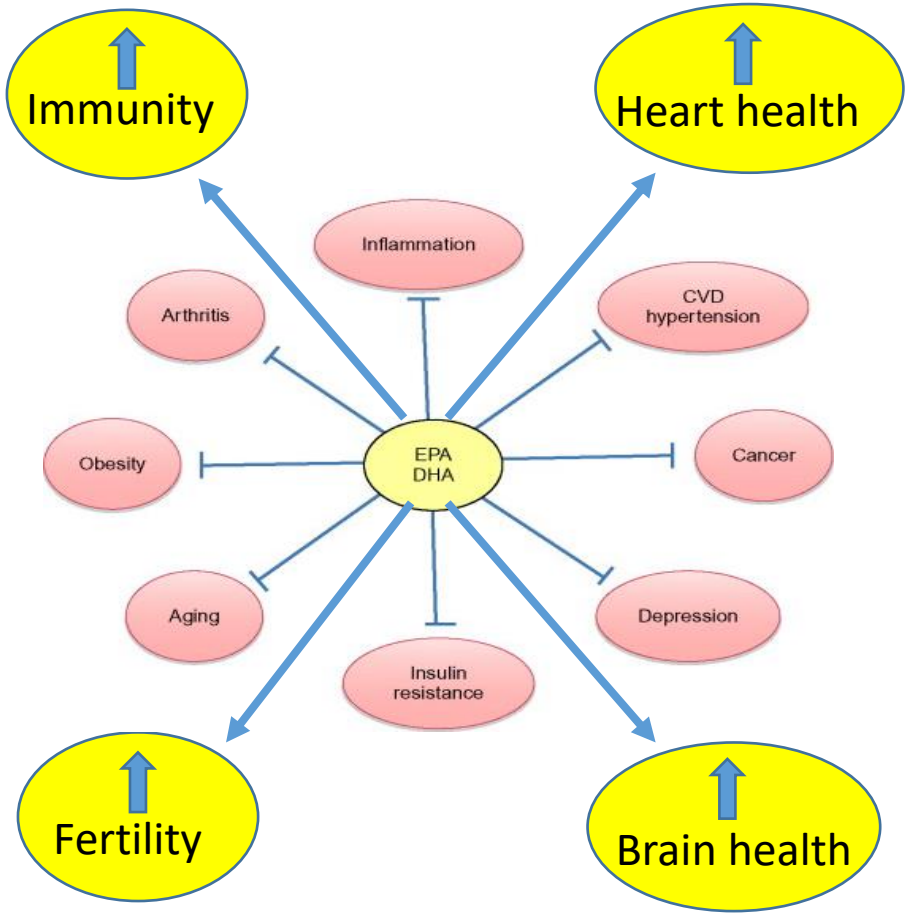
- The type of diet can **modulate the intestinal microbiota**
- The development of a beneficial microbiota modulate the intestinal immune system response against the pathogens favouring the growth, the health status and welfare of rabbits
- Secondly, the supply in PUFA should favoured the health status of the young rabbit through the quality of the doe milk
- Finally, increasing the **resistance to the disease** will be reduced the use of drugs in the farm, and as a consequence, the risk of antibiotic resistance, and the possibility to have residues of drugs in the meat.
- Moreover, breeders should improve their productive margin (less losses, expenses for veterinary and drugs)

**Intestinal microbiota functions**



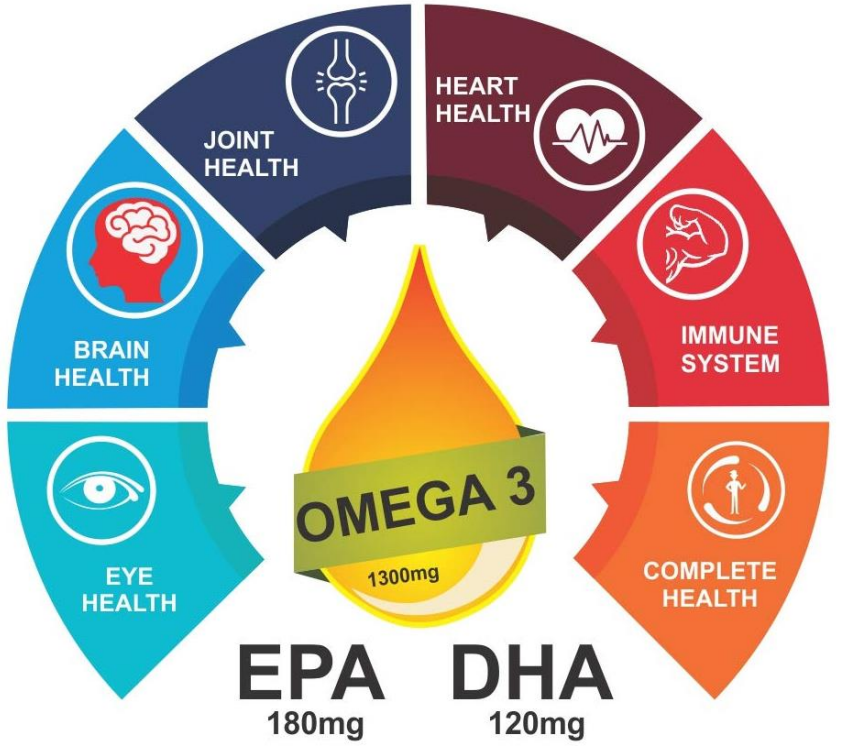
# State of art and innovation

- Feeding the fattening rabbits with the integration of flax and algae, we want increase the quantity of n-3 fatty acids in their meat, producing a **new functional food**, the **Ωrabbit meat**
- The effects of flax derived products with or without algae will be evaluated on the quality of meat and on its sensorial and technological characteristics
- ALA is susceptible to oxidation and could affect the *shelf life,* nutritional value, colour, sensory parameters and, therefore, consumer acceptance if used inappropriate conditions (too high level, poor quality, low level of antioxidants)
- Therefore, it could be very important to consider the duration of the treatment and the percentage of supplementation with linseed to overcome this inconvenience



# State of art and innovation

- **Ωrabbit meat** offers the possibility to bring these n-3 fatty acids in significant quantities, and to cover a large part of the human daily needs
- With regard to ALA, the consumption of 100 g of rabbit meat (rabbit fed with a standard food) provides 14% of the recommended dietary intakes for humans
- This consideration is very important taking into account the WHO guidelines and that recommends a n-6/n-3 ratio <4
- From this point of view, offering an n-3 enriched meat product on the market could contribute to improve health, fertility and prevent chronic diseases



# State of art and innovation

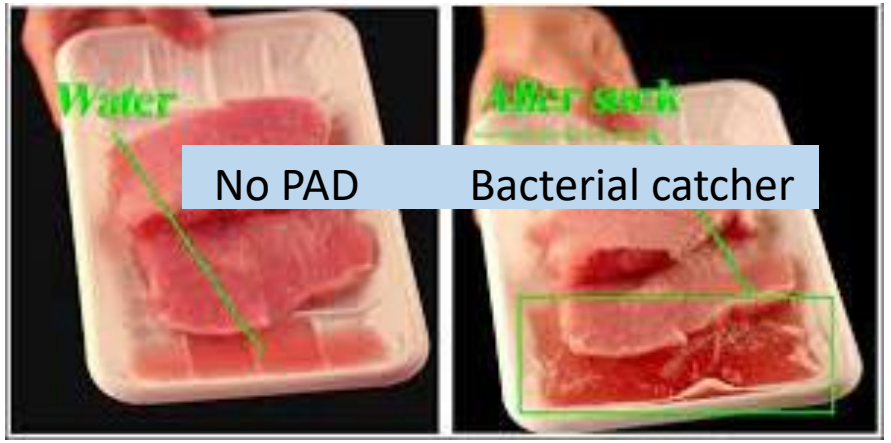
- The **acceptability of rabbit meat both for farmers, producers, SMEs and consumers** is due not only to its organoleptic and dietetic characteristics but also to food safety aspects and different technological factors as storage conditions, processing properties and packaging methods
- In this contest, the high quality of the rabbit meat should be maintained controlling the microbial growth and the development of lipid oxidation (rancidity) under storage
- Many **packaging options** exist for the preservation of meat
- The most widespread solutions are modified atmosphere (MA) and vacuum packed (VP) which inhibits the microbial development , maintains intact the organoleptic quality and preserves the colouring of the meat, since low concentration of $O_2$ slow the oxidative process

Modified atmosphere (MA)

Vacuum packed (VP)

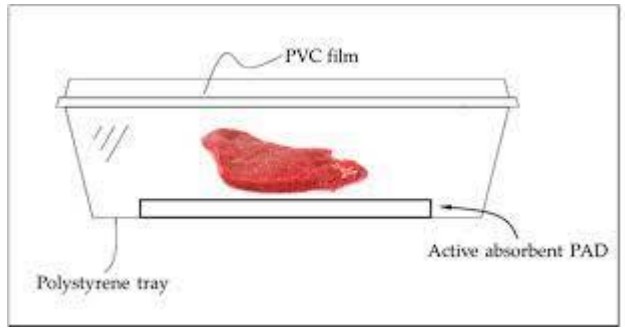
# State of art and innovation

- Exudates or drip derived from the meat can accumulate in the packaging and can:
- impact on the consumer
- create undesirable odours
- promote deterioration processes compromising hygiene and safety of the meat
- For this reason, the absorbent pads (AP) plays an important role in modern packaging strategies
- Therefore, the study of **new innovative adsorbent pads** able to reduce the bacterial growth represent a new frontier for decreasing the health risks associated with food storage and food packaging



# State of art and innovation

- This study will be able to validate the effectiveness of the **innovative absorbent pad "bacterial catcher"** in order to define the shelf life of the meat (under different storage conditions), with the consequent possibility to increase the local and national market and the exportation of **Ωrabbit meat** products (economic sector that is going through a profound economic crisis in several countries)
- Another alternative way to promote the consumption of the Ωrabbit meat, explored in the project is as **canned conserved product as *"paté"***
- The **Ωrabbit meat** will be evaluated for the physical, organoleptic and microbiological quality, the maintenance of this quality during storage and for acceptability tests (panel and consumer tests)
- Moreover, the canned **Ωrabbit meat** will be used also in a **clinical test** carried out at the Medicine University of Lorient to study the health benefits of meat on the lipid concentrations on human volunteers



# State of art and innovation

- Therefore, **the creation of ΩRABBIT Consortium** that specifically produces Ωrabbit meat can contribute to enhance the breed of the rabbit in specific areas of the countries partner
- The project intends to enhance the production of the functional food, **Ωrabbit meat**, rich in n-3, using a multi-actor approach from the farmer to the final consumers and also by the collaboration between actors of the same or other connected chains
- The **ΩRABBIT Consortium** produces **Ωrabbit meat**, a functional food which can contribute to human health as well as to sustainability and profitability in Agri-food sector

RABBIT

# State of art and innovation

- The **ΩRABBIT Consortium** reinforces the cooperation and integration among farmers, feed companies, breeders, packaging and processing enterprices and research centres (multi-actor approach) in the local communities, thus increasing the capacity of the food chain to compete against extra-EU rabbit producers and, in the meanwhile, assuring quality standards for production, control, traceability and protection of Ωrabbit meat



Research centers


Farmer


Feed mill


Breeder


Processing and distribution


Consumers

# State of art and innovation

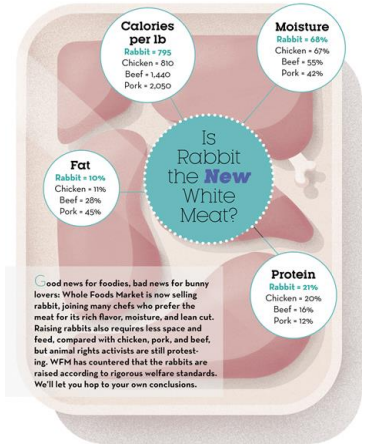
- The consortium will have a logo that will be affix on all the documents, to the meat of the rabbit at slaughterhouse and to the packaging
- The Consortium members will act according to their reference sector, will have to follow a technical specification for the production of the linseed derived products and algae/of the feed (formula) administered to the rabbit by the breeders, or for the distribution/commercialisation of the new functional food **Ωrabbit meat**
- During the project lifetime and beyond the consortium will work to engage other actors from the countries involved and from other territories in the Mediterranean area so to reinforce the competitiveness of this food product against big Asian producers by investing on the quality and healthy characteristics of the **Ωrabbit meat**
- As a consequence, the consumption of this meat could be increased with beneficial effects for the human health, the job opportunity, the monthly gain with economic effects not only for all the actors of the food chain but also for other local food producers

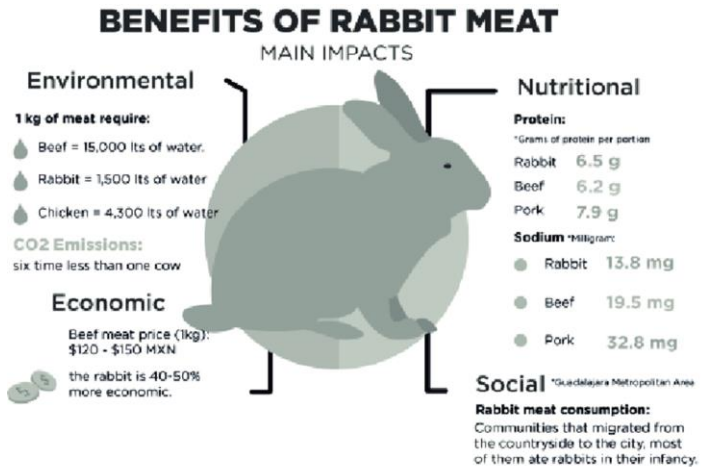
RABBIT

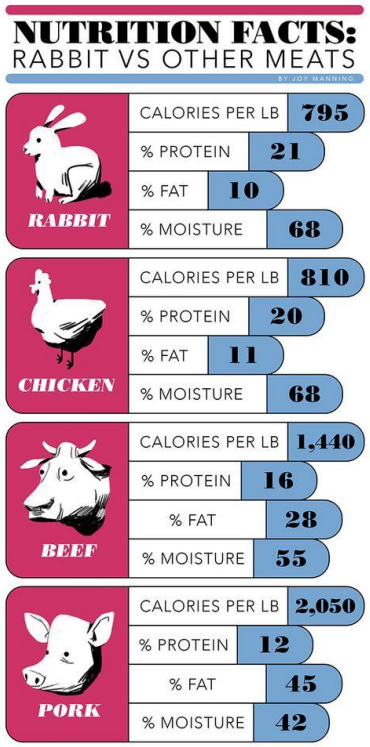
# Objectives

**1. To develop a new quality food product – “Ωrabbit meat”**

1.1 - To assess the impact of flax derived products (linen whole plant, linen straw, linseed bran, extruded linseed), with or without algae "*Padina pavonica*” and “*Chlorella vulgaris*” supplementation on the **rabbit meat quality** both at nutritional, chemical, physical, and organoleptic levels, and sensorial characteristics



# Objectives

1.2 - To increase the quality of the meat by a higher inclusion of n-3 in the muscle, producing a new functional food "**Ωrabbit meat**" that could have beneficial effects for the human health

1.3 **-** To increase the **consumption of meat**, thus contributing to reduce hunger and to contribute to the food security

1.4 - To favour the **human health** reducing the incidence of chronic pathologies especially those linked to an unbalanced n-6/n-3 ratio in the diet

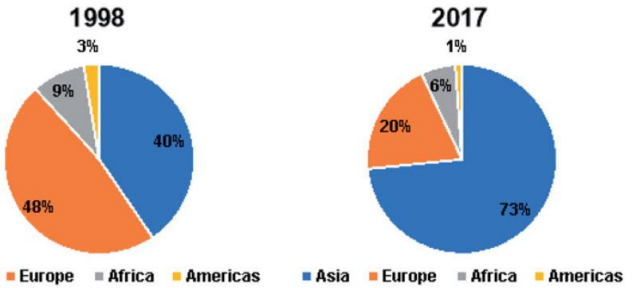




Figure 1. The contribution of the continents to world rabbit meat production between 1998 and 2017 (source FAO 2019).

# Objectives

**2. To optimise the production model of rabbit meat so as to reinforce the whole value chain both for local and foreign markets**

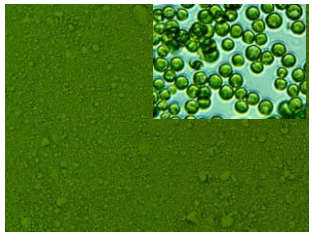
2.1 – To increase the local production of flax and algae to develop **specific feeds** for rabbits based on their supplementation


Linen whole plant


Linen straw


Linen bran


Extruded linseed


Chlorella vulgaris


Padina pavonica

**Feed for breeders**

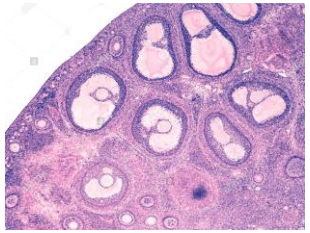
**Feed for fattening rabbit**

# Objectives

**2. To optimise the production model of rabbit meat so as to reinforce the whole value chain both for local and foreign markets**

2.2 - To increase the **rabbit reproductive and productive performances** so as to strengthen the sustainability of the business, for smallholders and the satellite activities

Rabbit male and female fertility



Receptivity

Prolificacy
Mortality

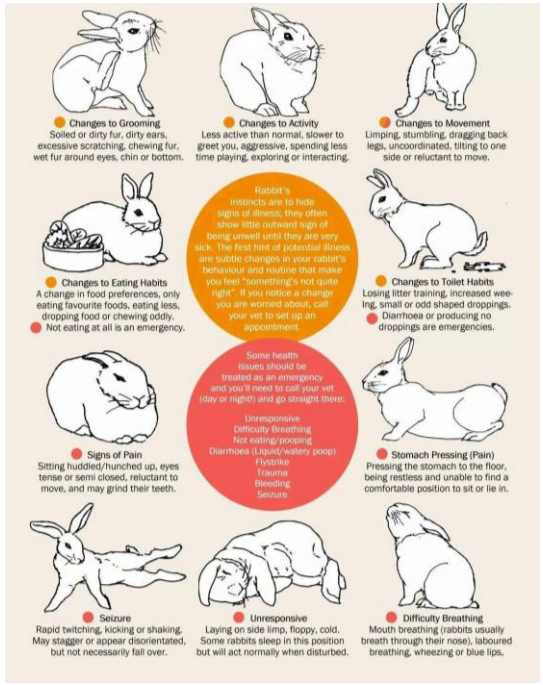
Lactation

Yield to slaughter
Quality of carcasses

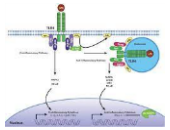
Body weight at weaning and slaughter
Feed conversion ratio

# Objectives

2.3 - To evaluate the impact of supplementation on **animal health** (beneficial microbiota that stimulate the immune system and the resistance to the diseases), and antibiotic resistance

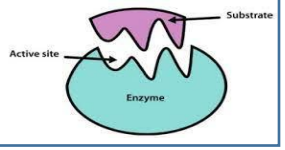



Modulate the inflammatory response (TLR4, cytokines)

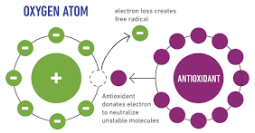


Produce antimicrobial substances


Digestive activity

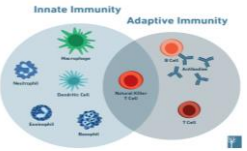



Antioxidant index





Immune response




Pathogens in the gut

Use of drugs

# Objectives

2.4 - To validate an **innovative absorbent pad "bacterial catcher"** (AP-BC) adapted to rabbit during modified atmosphere packaging of Ωrabbit meat

# Objectives

2.5 - To evaluate the effect of the supplementation on the **shelf life of the Ωrabbit meat**, packaged and maintained at refrigeration and freezing temperatures or canned (exportation)

Refrigerated whole rabbit


Frozen whole rabbit

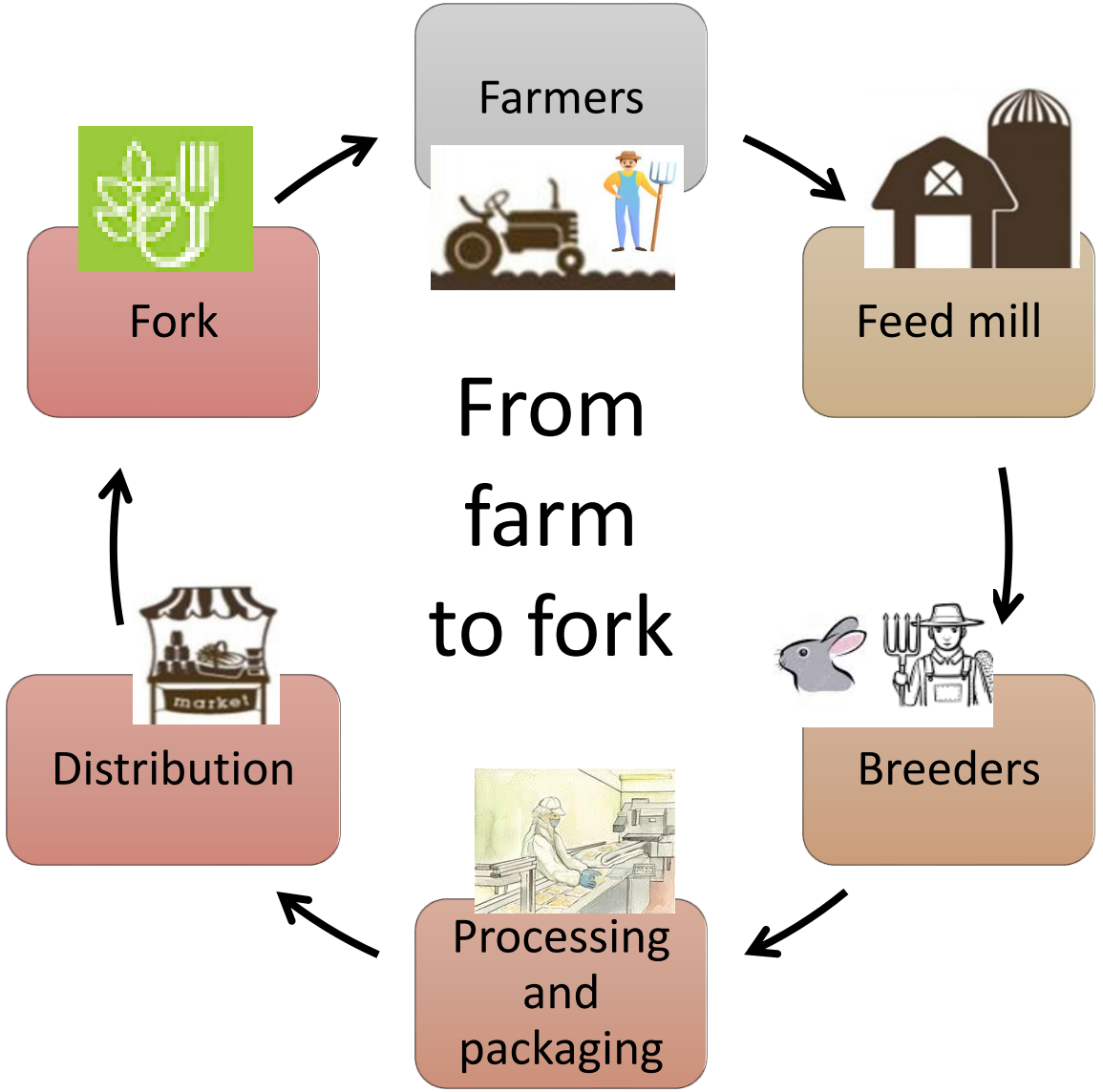
Frozen portioned rabbit


Patè

# Objectives

**3. To increase the competitiveness of small-scale farmers, manufacturers, local distributors and other intermediate actors**

3.1 - To involve key actors (including SMEs, distributors, academia, NGOs, and local research centre) to pooling the knowledge for **developing innovative food supply chains** and new markets, which guarantees the principle "from the field to the fork",



# Objectives

3.2 - To reinforce the cooperation among farmers, feed mill, breeders, packaging and didtributors and research centres by setting up the **ΩRABBIT Consortium**

RABBIT


Farmer

Feed mill

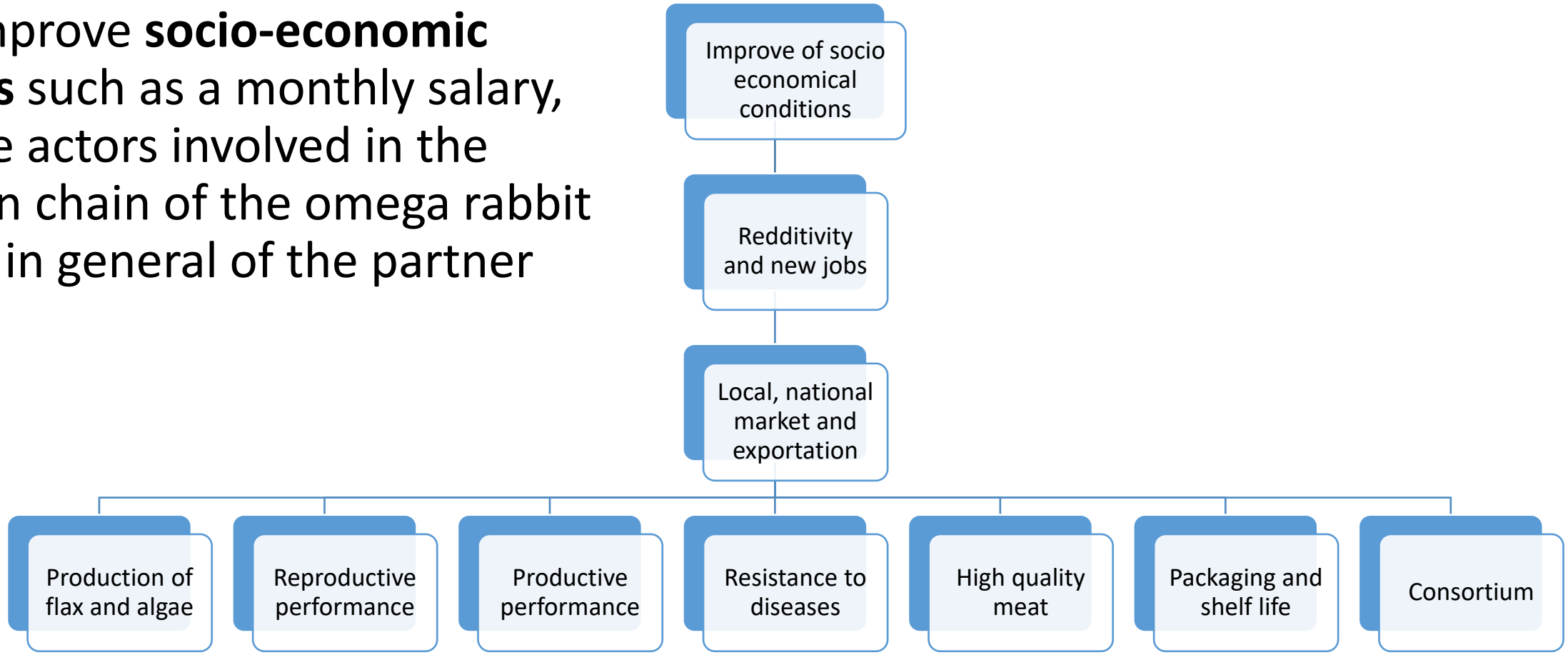
Breeder

Processing and distribution


Consumers

# Objectives

3.3 - To improve **socio-economic conditions** such as a monthly salary, gain of the actors involved in the production chain of the omega rabbit and more in general of the partner Countries



# Work package number and lead benficiary partners

**WP0 – Project management and quality assurance (UNIMI)**

WP1 – Scientific research on n-3 rabbit reproductive and productive performance (UNIPG and Esa-Mateur)

WP2 - Scientific research on n-3 rabbit meat quality and packaging (CREA and COPRI)

WP3 – Nutritive value of flax derived products, impact on digestive physiology (microbiota) and immune status of the rabbit (APRI and INRAE)

WP 4 – The ΩRABBIT Consortium (UNIMI and ESA-MATEUR)

**WP5 – Dissemination and exploitation of results (UNIMI and ENMV)**

**WP6 – Impact assessment (UNIMI and VALOREX)**

# WP 0: Tasks activity

- Task 0.1- Elaboration of Management Handbook - UNIMI
- Task 0.2 - Elaboration of Quality Plan – UNIMI
- Task0.3 - Organization of 5 project meetings /study visits by each national hosting team (Italy, France, Egypt, Tunisia, Italy)
- Task0.4 – Set up of an online shared platform and management of communication - UNIMI
- Task0.5– Elaboration of the Data Management Plan - UNIMI
- Task0.6 – Elaboration of internal management and quality reports – all partners
- **Task0.7 – creation of national Stakeholders' Committees - reports – all partners**

# WP 1: Tasks activity

1.0 - Evaluation of **quality of flax derived products** (linen whole, linen straw, linseed bran and extruded linseed) **and algae** *Chlorella vulgaris* and *Padina Pavonica* (APRI, COPRI, VALOREX, UNIMI and ESA-Mateur)

1.1 - **Feed formulation and feed production** (APRI, COPRI, VALOREX, UNIMI and ESA-Mateur)

1.2 - **Management** of breeders and fattening rabbits (APRI, COPRI, INRAE, UNIMI, ENMV and ESA-Mateur)

1.3 - Evaluation of flax derived products and algae on **fertility** and productive performance of **rabbit does** (APRI, COPRI, INRAE, UNIMI and ESA-Mateur)

1.4 - Evaluation of flax derived products and algae on **fertility** and productive performance of **male rabbits** (APRI, UNIPG, ENMV and ESA-Mateur)

# WP 1: Tasks activity

1.5 - ***In vitro*** **experimental trials, effect of linseed bran on semen quality** (UNIMI)

1.6 - Evaluation of flax derived products and algae on **productive performance of fattening rabbits** (APRI, COPRI, INRAE, UNIMI and ESA-Mateur)

1.7 – Collection of blood samples and evaluation of **reproductive and metabolic hormones and metabolites** on breeders and fattening rabbits (APRI, UNIPG, ENMV and ESA-Mateur)

# WP 2: Tasks activity

2.0 - **Slaughtering** of rabbits, transportantion and reception of carcasses (UNIMI, COPRI, CREA-ZA)

2.1 – **Evaluation of carcasses and dissection** (COPRI, CREA-ZA)

2.2 - **Packaging and conservation** of rabbit meat (UNIMI, COPRI, CREA-ZA)

2.3 – **Consumer and panel tests and clinical trial** (COPRI, CREA-ZA)

# WP 3: Tasks activity

3.0 – Nutritive value assays for linen straw (LS), linseed bran (LB) and extruded linseed measure of the **concentration of digestible protein and energy** (APRI, INRAE and COPRI)

3.1 – Study of **caecal microbiota** (16SRNA sequencing) and **immune system** (IgA) according to the level of LS/LB in the diet (INRAE)

# WP 4: Tasks activity

4.0 - Setting up the ΩRABBIT Consortium – **registration of the trademark** (ESA-MATEUR)

4.1 – Setting up the ΩRABBIT Consortium – Agreement on **ΩRABBIT regulation** (ESA-MATEUR)

4.2 – **Launch of ΩRABBIT Consortium** (ESA-MATEUR)

4.3 – Analisys of consortium initial performances and potential member's expectation (ESA-MATEUR)

4.4 – **Roadmap for the development of ΩRABBIT Consortium** (UNIMI)

# WP 5 : Tasks activity

5.0 – Elaboration of dissemination and exploitation Plan (UNIMI)

5.1 – Design the project visual identity (UNIMI)

5.2 – **Launch of ΩRABBIT website** and social media accounts (UNIMI)

5.3 – **Organization of workshops** and final conference to disseminate the results to promote ΩRABBIT CONSORTIUM (UNIMI)

5.4 – Production of scientific publications (ENMV)

5.5 – Design and implementation of awareness-raising campaigns (UNIMI)

# WP 6: Tasks activity

6.0 – Development of the impact assessment system (VALOREX, UNIMI)

6.1 – Development of the impact assessment process (UNIMI)

6.2 – Elaboration of an impact assessment report (VALOREX, UNIMI)

# Impact

## Before the project

- The diet have to cover the needs of the categories of animals (breeding and fattening)
- The feeds must be formulated in compliance with the typical needs of the species (maintenance, pregnancy, lactation, growth)
- In rabbit farm are used two types of feeds one for the breeders and one for fattening rabbits
- Some nutrients can be used to specific reason: stimulate the growth, increase the reproductive activity, enhance the milk production and improve the welfare

## After the project

- Feeds for rabbit are supplemented with **flax derived products and algae**, **rich in n-3, able to improve**:
- the reproductive and productive performance (also in warming challenge conditions)
- the resistance to the infection (reduction of the use of antibiotics)
- the quality of meat
- the welfare of the animals

# Impact

**Before the project**

- Different kind of natural products are used to stimulate the growth and the reproductive activity of the animals and also to increase the fixation of specific compounds in their products, included flax, but the studies on rabbit are quite poor
- When new nutrients are used, the grade of their digestibility and the possibility for their compounds to be incorporated in the animal products should be evaluated

**After the project**

- Feeds for rabbit supplemented with flax derived products and algae **increase the fixation rate of n-3 in the meat**, contributing to create a new product with a high quality, **a new functional food (Ωrabbit meat)** to favour the consumption of the rabbit meat and of a beneficial health product and also to improve the nutritional conditions in specific countries areas

# Impact

## Before the project

- The most widespread packaging solutions for the preservation of the meat are modified atmosphere (MA) and vacuum packed (VP)
- They inhibit the development of microorganisms, preserve the organoleptic quality and the colour of the meat (low concentration of O2 - slow oxidative process) and extend the shelf life of food products
- Another important aspect for the consumer is the presence of exudates in the package because can create undesirable odors and promote deterioration processes of the meat
- The absorbent pad plays a role in modern packaging strategies in absorbing the fluids exuded

## After the project

- The Ωrabbit meat is packaged using an **innovative adsorbent pad "bacterial catcher"**
- This new pad able to reduce the bacterial growth represent a new frontier for decreasing the health risks associated with food storage and food packaging
- **It can maintain the quality and increase the shelf-life of the Ωrabbit meat**
- Another, method of storage of the **Ωrabbit meat** evaluated in our project is the **canned paté**
- These methods of packaging can contribute to **favour the local and export marketing** of the meat

# Impact

## Before the project

- The rabbit production is facing a strong decline in the last two decades (reduction of the number of animals, of the production and of consumption
- The perception that the rabbit meat is difficult to cook, the high prices compared to other meats, the vision of the rabbit like a pet and that rabbit production uses too much drugs (hormones and antibiotics), and the controversial image regarding the respect of the rabbit welfare are all linked to this decline
- If this trend continues, the Mediterranean diet may loss an important ingredient of its tradition, with relevant socio-economic consequence for the whole production and supply chain system

## After the project

- The **Ωrabbit meat,** as functional food, links agricultural producers to urban markets contributing to strengthen the local economy and the meat consumption, assuring both a fair profit share for producers and other key stakeholders in the supply chain, and a fair price to consumers

# Impact

## Before the project

- The technical and economic performance of industrial rabbit production, which depends on the quality of inputs, facilities and the expertise of the breeder, does not meet the requirements needed to assure a fair profit to breeders and other actors in the production and supply chain
- This increase the competition among them and hinder the cooperation
- The development of rabbit breeding meets relevant difficulties to adapt to national constraints and to integrate into the country's agriculture

## After the project

- Reinforced **cooperation and integration** among farmers, feed companies, breeders, packaging and processing enterprices and research centres (multi-actor approach) in the local communities by the **Ωrabbit Consortium**
- As a consequence, can increase the capacity of the food chain to compete against extra-EU rabbit producers and, in the meanwhile, assuring quality standards for production, control, traceability and protection of Ωrabbit meat
- Collaboration between the actors of the production chain from the production of flax derived products and algae up to the sale to an informed consumer

# Impact

## Before the project

- The Western diet is unbalanced in terms of PUFAs, with a higher abundance of n-6 compared to n-3 (15-20:1 as n-6/n-3 ratio)
- The World Health Organization considers that the optimal n6/n3 ratio should be less than 4
- Accordingly, the modulation of dietary intake (intended as a reduction of n-6/n-3 ratio) could be considered a valid nutraceutical intervention for the improvement of human health and fertility

## After the project

- Several studies have suggested that diets rich in n-3 PUFAs could be useful in the **prevention of different chronic pathologies** (cardiovascular diseases, obesity, diabetes, and reproductive disorders)
- In our study will evaluate the effects of the administration of the **Ωrabbit meat**, rich in n-3, for one months on the plasma cholesterol and triglycerides concentrations in a clinical trial that involve human volunteers

# Merci de votre attention

Grazie per l'attenzione

RABBIT

شكرا على انتباهك

Thank you for your attention