Training course packages targeting food operators on the adoption and management of the technological innovations

AQUACULTURE SYSTEMS

Incorporation of probiotics

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1. FoodLAND technical innovation for local food supply chains: concepts and approaches

The FoodLAND project has the ambition to impact on a large number of supply chains and communities, hence the process of food operators' capacity development has to be tailored and as much participative as possible. Accordingly, one of the assumptions of FoodLAND is that sustainable and nutrition-responsive farming systems can be achieved basically by strengthening the capacity development, and specifically by **a)** empowering farmers and processors through the implementation of capacity building processes and concrete opportunities; **b)** creating or consolidating cooperation and shared knowledge to overcome the lack of coordination among food operators; **c)** addressing the inefficient use of resources; **d)** trying to address and build resiliency to the high vulnerability of food systems to climate change; **e)** enhancing the integration of supply chains by creating commercial and stakeholders' networks; **f)** improving the responsiveness of the production sector to the market demand.

To implement these elements of capacity development, FoodLAND proposed the adoption of specific innovations, among which the organizational ones, to create strong and responsive links between producers and encompassing all the intermediate actors along the food value chain, such as researchers, SMEs, NGOs, local and national authorities. In order to ease the creation of those links and guarantee the sustainability over time of the results, 14 Food Hubs will be created in 6 countries as part of the organizational innovations. Food Hubs are conceived as multi-actors centers of innovation where to develop or enhance the organizational and operational conditions enabling local food supply chains (D3.6).

Functional to the implementation of the Food Hubs and of the innovations, the training courses were designed – in form of capacity development activities – as a two-phase process. Firstly, a training session focused on general, preparatory topics was provided to farmers as described and reported in D3.5 ("Group Introductory Training", GIT). According to the project GA, GIT broad set of goals were: to enhance the knowledge of consumers' nutritional needs and market opportunities, and to boost the notions about climate change, sustainability, resilience, and food culture. Secondly, a specific training session were organized to provide food operators with practical information on the adoption and management of the innovations tested at lab / small scale level and to contribute to validating them at appropriate scale.

However, as the whole approach has been designed by FoodLAND to ensure the inclusion of the local actors from the first moment, both the training sessions were set up accordingly. Indeed, yet in the inception phase of the project, an assessment on participatory methods has been run and Participatory Learning and Action (PLA) approach has been eventually assessed as the best one to ensure the inclusion of multiple perspectives. The main purpose of PLA is to support people within communities to analyze their own situation, rather than have it analyzed by outsiders, and to ensure that any learning is then translated into action (Gosling and Edwards 2003). In addition, a gender-sensitive approach has been applied to the trainings that have been designed considering gender roles and power relations; they have provided equal opportunities to participate in the process by caring to times, venues and use of local languages.

The GITs have been conceived as the first step towards the innovation validation and aim at involving the producers, yet from the inception phase. They are just the first step in a sequence of 6, summed up in **Table 1**. After the GITs, where farmers and processors meet and share their vision and goals for the Food Hubs and exchange information about specific topics, the Food Hubs were created and the innovation tested (first in pre-test, then in pilot phase). The constant iteration between researchers and local actors is a key feature of the project: specifically, the practical trainings focused the single innovations (step 5) are aimed at validating the innovations at adequate scale and planned to trigger feedback loops of control and improvement involving developers and adopters.

Table 1. Activities with farmers and food processors (SMEs) and participatory approach

Step	1	2	3	4	5	6
Task	**T3.3**	**T3.3**	**T3.4**	**T4.1¸T4.5**	**T5.1¸T5.5**	**T5.1¸T5.5**
Activity	Group introductory training	Food Hubs creation	Innovation undertaking	Innovation tests	Individual and group practical training	Innovation pilot and validation

2. FoodLAND practical training: aims and scope

According to the project bottom-up and participatory approaches, following the courses on introductory topics GIT organized in the early project phase (T3.3), and as component creating / strengthening the Food Hubs as local innovation centres, FoodLAND has organized a second set of training activities with food operators based on active learning methods and gender equality principle (Task 5.1-5.9). In this regard, specific mechanisms (being aware of the gender roles and power relations; providing equal opportunities to participate in the process by putting attention to the times, venues, use of local languages, etc.) will be lifted to ensure women's participation. These training packages are aimed at providing the local farmers and food processors with operational instructions on the adoption and management of the validated innovations.

This second set of training activities has been organised – triggering PLA approach – as individual and group practical (demonstration/capacity building) activities to be conducted in parallel to the implementation of the technological research (where relevant) and of the innovation pilots and validation. These technology-centred trainings aim at strengthening the participants' understanding of novel production and post-harvest techniques, innovative tools and systems (e.g., climate smart/precision agriculture, hydroponics, and integrated aquaculture), new technologies for primary and secondary processing, and supply chain management. Thus they aim at fostering knowledge and operational capacity to deploy, manage, and maintain the validated technological innovations – documented by the released guidelines D4.1 ÷ D4.11 (e.g., training pamphlets, user manuals, flow diagrams, and operational recommendations) and practice abstracts D6.5 – validated jointly at appropriate scale.

3. Second training packages on the adoption and management of the tested innovations: an overview

The second training course aimed at consolidating the food operators' knowledge and practical skills to adopt, manage and validate the project innovations and complement the related guidelines. Specifically, the realized training materials provide local farmers and food operators with a set of notions and concrete information on a series of innovative tools and systems as per the following **Table 2**. It is clear that both the contents and formats of the learning packages widely differ across technologies as well as Food Hubs (when the same type of innovation must be validated in different contexts). The diversity that emerges from the proposed solutions reflects the different needs highlighted by farmers and stakeholders as well as the conditions and opportunities characterizing the local communities. Nevertheless, in order to take into due account the existing heterogeneity inside the local communities, the developed learning materials have been let available on the project intranet so as to be used for further training initiatives across the network of Food Hubs.

4. Second training packages on practical information on the adoption and management of the tested innovations

Aquaculture systems

Incorporation of probiotics

INAT, Tunisia

- Incorporation of Probiotics in Nile Tilapia feed

10-15 fish farmers and women will be trained on Incorporation of Probiotics in Nile Tilapia feed

The training will be held at the office of the direction of dams of Bouhertma (Jendouba governorate).

Day 1	Day 2	Day 3
- Introduction to probiotics and their benefits in aquaculture -Fish nutrition	-Application of probiotics in aquaculture - Case studies	-Hands-on training

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Introduction to probiotics and their benefits in aquaculture

Probiotics are live microorganisms that, when administered in adequate amounts, confer health benefits to the host. In aquaculture, probiotics are used to enhance the growth, health, and immunity of fish by promoting the growth of beneficial bacteria in their gut and preventing the colonization of harmful pathogens.

The benefits of probiotics in aquaculture:

1. Improve growth and feed utilization: Probiotics can improve the digestion and absorption of nutrients in fish, leading to better growth and feed utilization.

2. Enhance disease resistance: Probiotics can enhance the immunity of fish by producing antimicrobial substances that inhibit the growth of harmful pathogens.

3. Better water quality: Probiotics can help maintain a healthy microbial balance in the water and reduce the risk of waterborne diseases.

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Introduction to probiotics and their benefits in aquaculture

The benefits of probiotics in Tilapia aquaculture:

Disease prevention: Probiotics can help prevent infections by promoting the growth of beneficial bacteria in the gut, which can compete with and suppress harmful pathogens.

Improve growth: Probiotics can enhance nutrient absorption and utilization in tilapia, leading to improved growth rates and feed conversion efficiency.

Stress tolerance: Probiotics can help improve the ability of tilapia to tolerate stressful conditions, such as changes in water quality or temperature.

Immune system support: Probiotics can help stimulate the immune system in tilapia, improving their ability to fight off infections and diseases.

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Fish nutrition

Fish nutrition is an important factor in aquaculture, as it plays a crucial role in the growth, health, and development of fish. The nutrient requirements of fish vary depending on the species, age, and physiological status of the fish, as well as the environmental conditions in which they are raised.

Tilapia's nutritional requirements can vary depending on the age and size of the fish, as well as the environmental conditions in which they are raised

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Fish nutrition

Some of the key nutrients that are required for tilapia growth and health include:

1. Protein: Tilapia require protein for growth, maintenance, and repair of body tissues. The protein requirements of tilapia can vary depending on the stage of development, but generally range from 25-35% of the diet.

2. Lipids: Tilapia require lipids for energy, as well as for the synthesis of cell membranes and hormones. The lipid requirements of tilapia can vary depending on the species and the environmental conditions, but generally range from 5-15% of the diet.

3. Carbohydrates: Tilapia can use carbohydrates as an energy source, although their requirements for this nutrient are generally low compared to protein and lipids.

4. Vitamins and minerals: Tilapia require a variety of vitamins and minerals for various metabolic functions, including the production of enzymes, hormones, and other cellular processes. Key minerals that are required for tilapia include calcium, phosphorus, and magnesium.

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Application of probiotics in aquaculture

There are several methods of administering probiotics to fish, including feed supplementation, water treatment, and immersion.

Feed Supplementation: This method involves adding probiotics to fish feed. The probiotics are mixed with the feed, and the fish consume the probiotics along with their regular feed. This is the most common method of administering probiotics to fish. The probiotics can be added to the feed as a dry powder or as a liquid suspension.

Water Treatment: This method involves adding probiotics to the fish tank or pond water. The probiotics are added directly to the water, where they can be absorbed through the fish's gills and skin. This method is less commonly used than feed supplementation.

Immersion: This method involves immersing the fish in a solution containing probiotics. The fish are placed in a tank containing the probiotics solution for a specified amount of time. This method is used primarily for disease treatment, rather than prevention.

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Application of probiotics in aquaculture

The efficacy of probiotics in fish depends on several factors, including the strain of probiotic used, the dosage, the duration of treatment, and the fish species. In general, the higher the dosage of probiotics, the greater the benefits. However, excessive dosages may have negative effects on the fish, such as gut dysbiosis or interference with nutrient absorption.

Other factors that affect the efficacy of probiotics include water quality, feed quality, and stress levels. Poor water quality, low-quality feed, and high stress levels can all reduce the effectiveness of probiotics. Therefore, it is important to maintain optimal environmental conditions and good management practices to maximize the benefits of probiotics in aquaculture.

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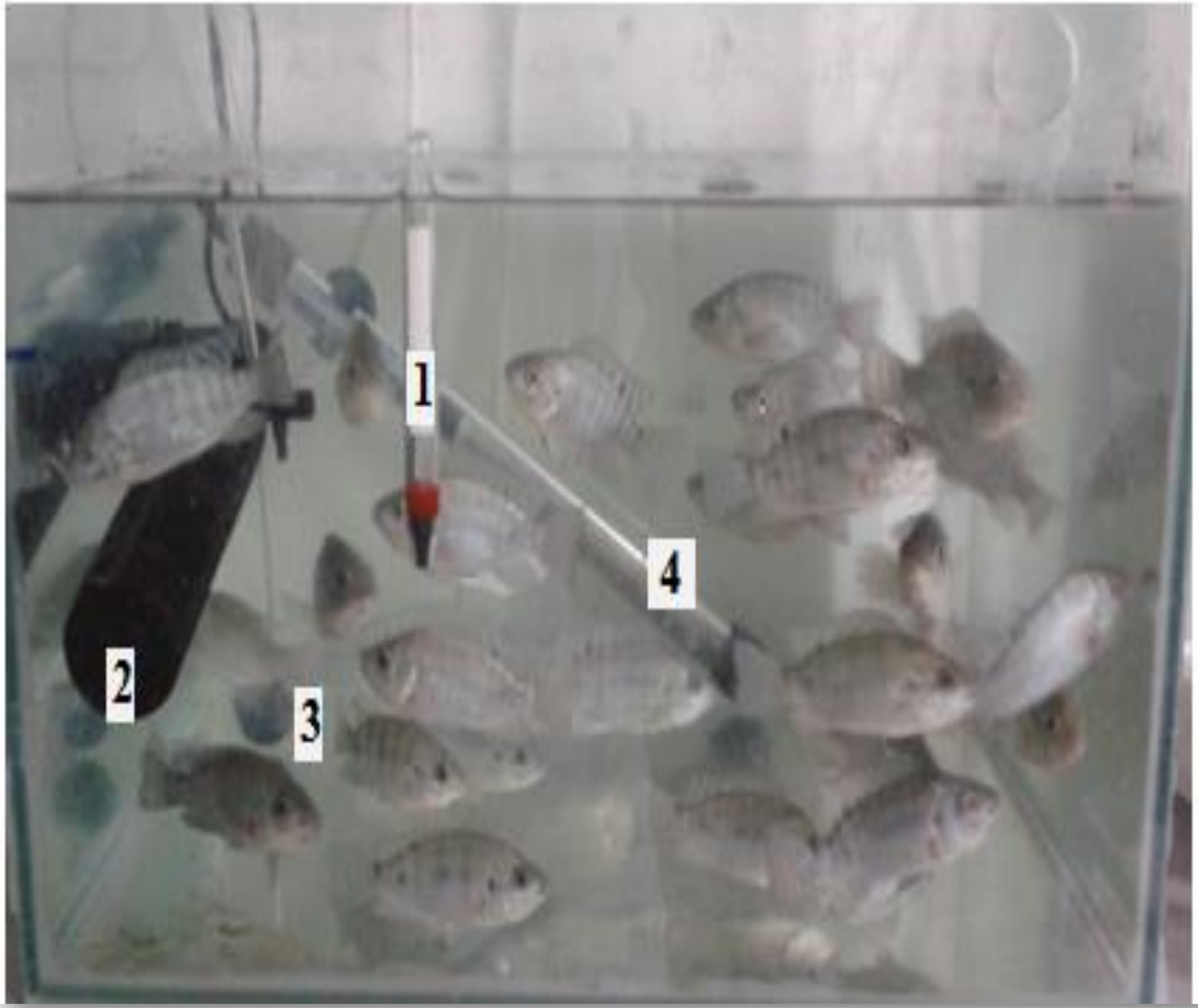
Case studies

--- Distribution of food (5g/d/fish)

---- Incorporation of lactic probiotic (10^7UFC/g of food)

----- Food ration and feeding frequency (2 times/day)



Différent types of food used :

- Tx : food without additives
- Ty : food +MRS (culture broth)

--Souche E (Prob E): food + Probiotic E

-Souche L (Prob L): food + Probiotic L.

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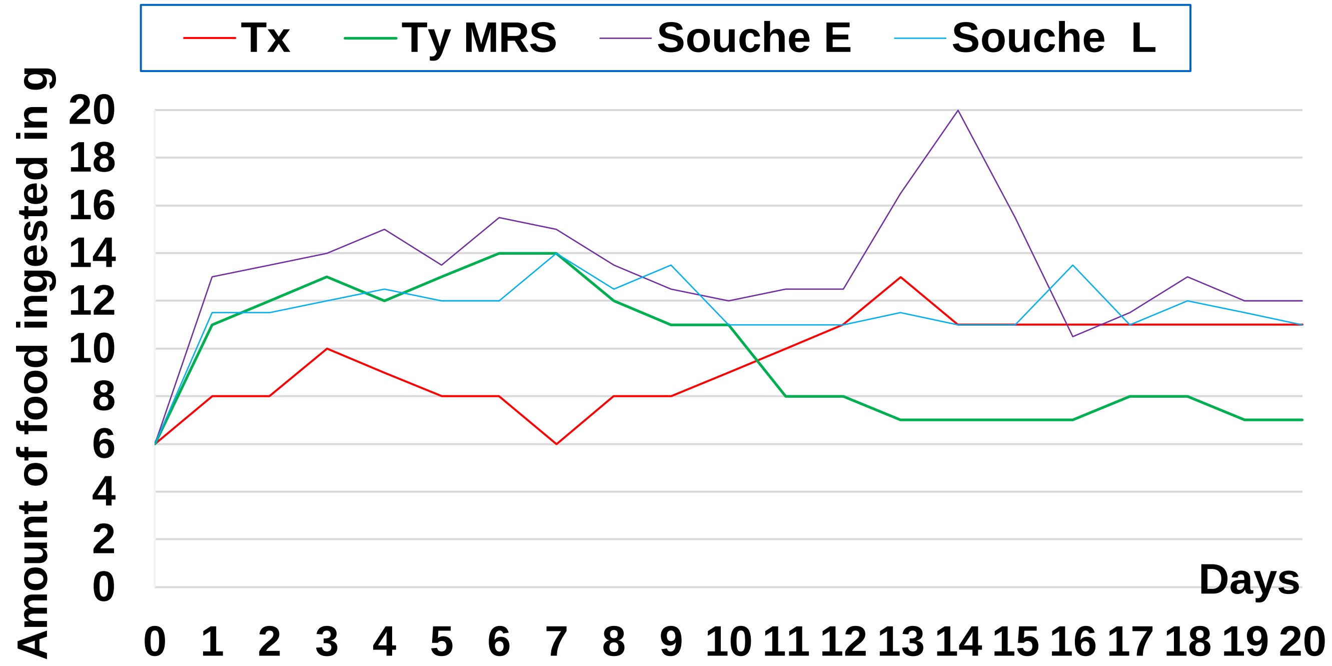
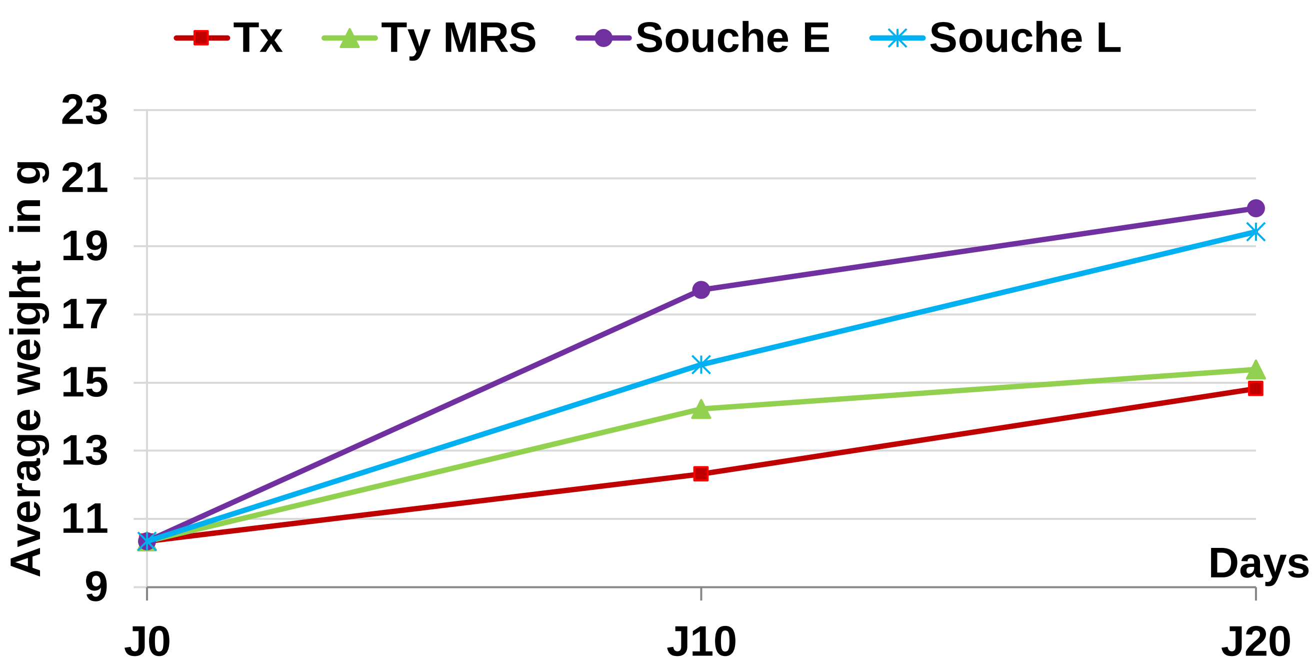
Case studies

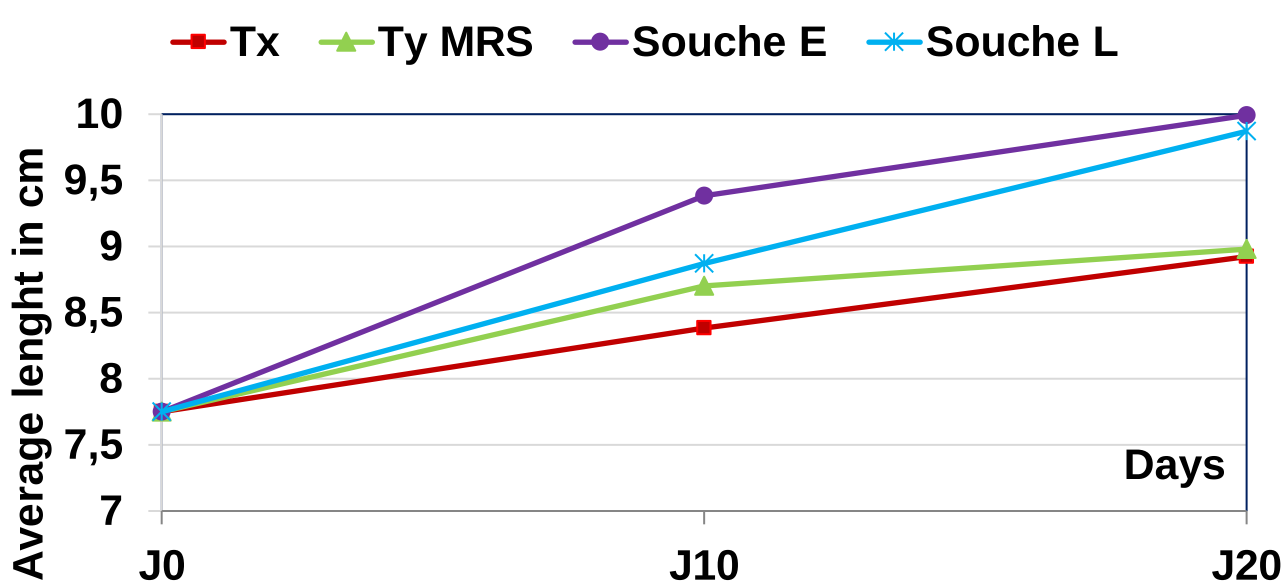
Results of different protocols



Food ration ingested by juvenile



Effects on fish weight



Effects on fish length

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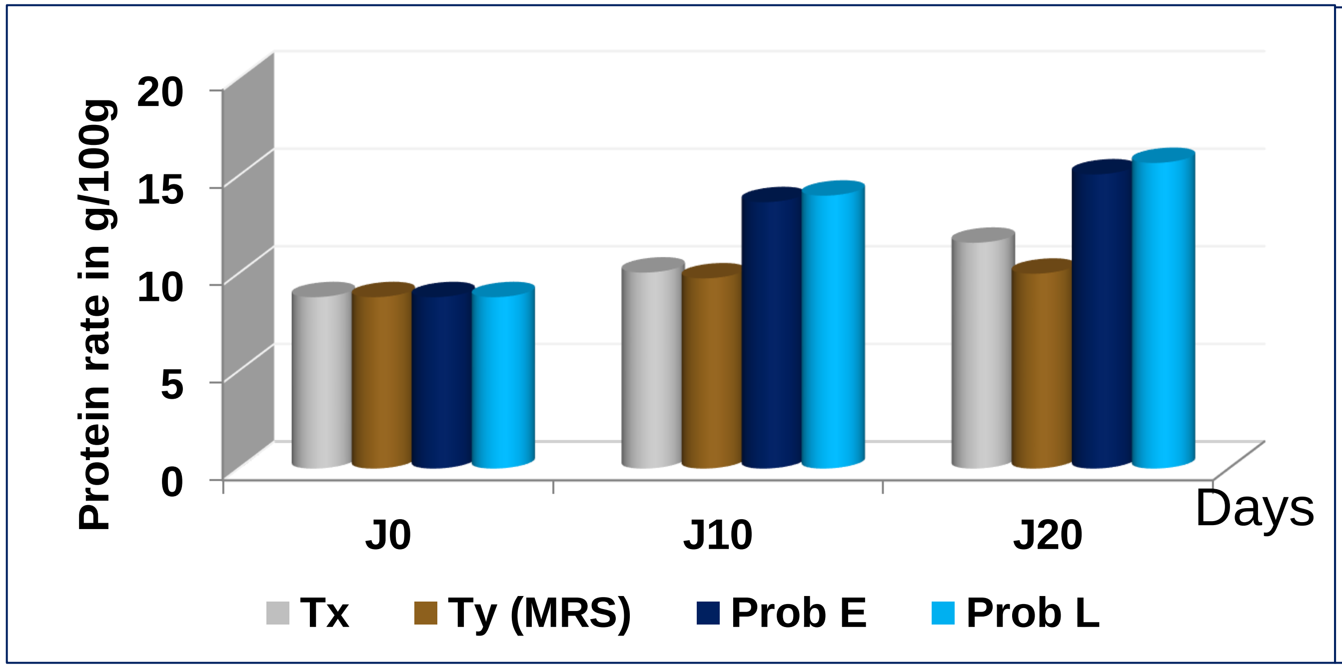
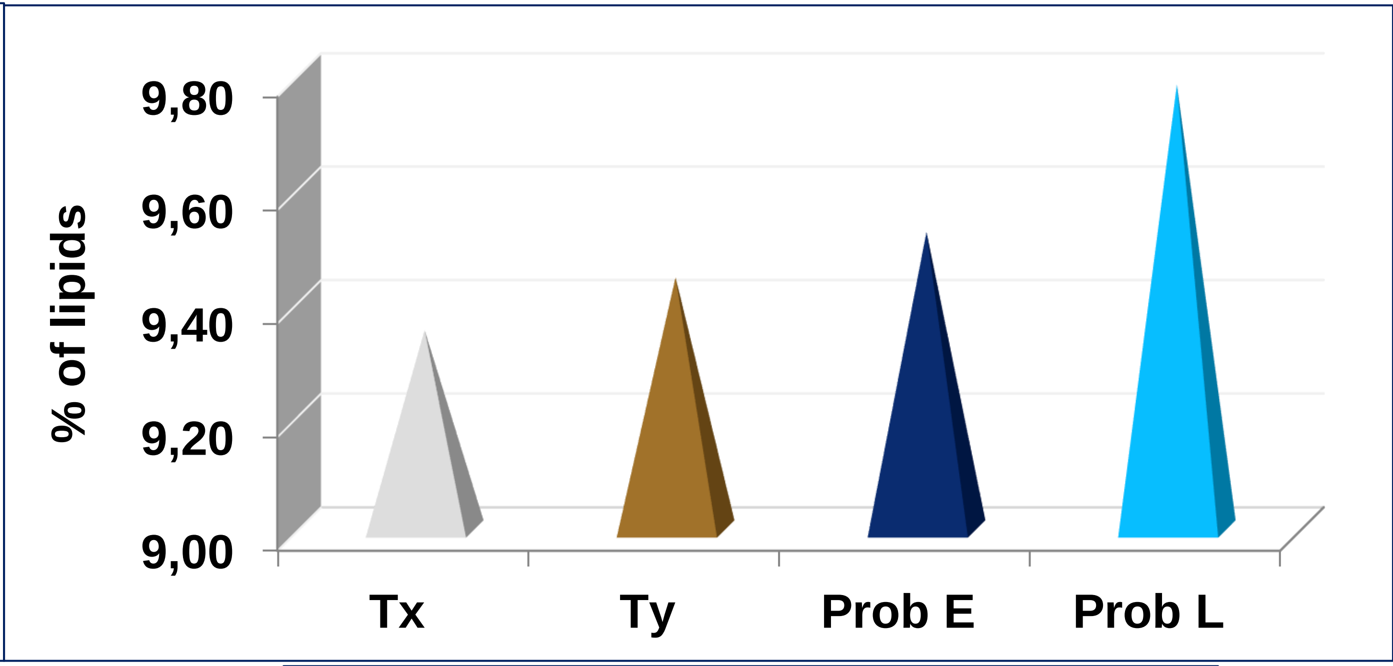
Case studies

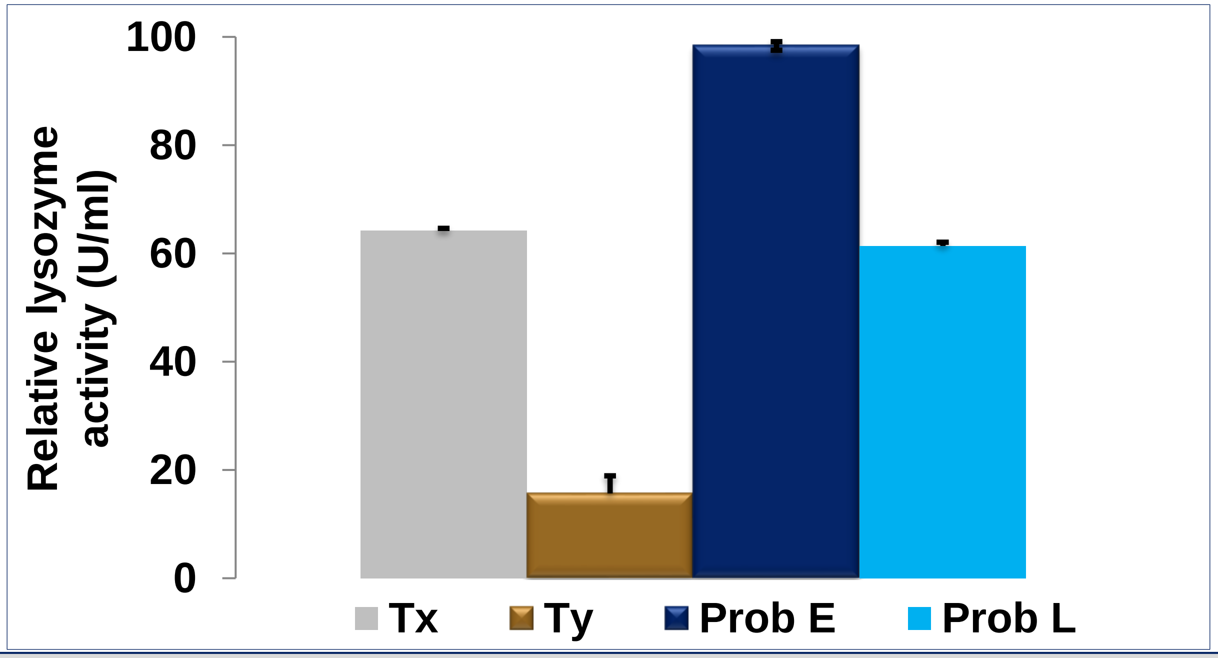
Results of different analysis



Rates of protein for different protocols



Rates of lipid for different protocols



Effects of probiotics on lysozym activities after 20 days of supplementation

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Thank you !

Aquaculture Working Group

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