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Physicochemical proprieties of dorsal and ventral muscles from red tilapia (*Oreochromis sp*)

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Alhamdulilah

I dedicate this work first to my parents for raising a son to become a man by providing everything to achieve my dreams and standing where they expecting me to be , may Allah bless you mostly

To my siblings and family members for encouraging and believing in me,

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May Allah bless you all and grant happiness in your life and wishes to become true

younes

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Summary

CHAPTER III : Results and discussion

ABBREVIATIONS LIST

- **FAO :** Food and agriculture organization
- **EC :** Electrical conductivity
- **WHC :** Water holding capacity
- **mS :** Milli siemens
- **WOS :** Weigh of sample
- **% :** percentage
- **BSA :** Bovine serum albumin
- **Ml :** milliliter (Volume measurement unit)
- **µl** : micro liter (Volume measurement unit)
- **g :** gram (Mass measurement unit)
- **pH :** Potential Hydrogen
- **nm :** Nanometer (Wave length measurement unity)
- **Kcal :** Kilo calories (energy measurement unity)
- **Kcal/100g :** Kilo calories in 100 gram
- **Cm :** Centimeters (length measurement unity)
- **SD** : Standard deviation
- **ISO** : International Organization for Standardization
- **AFNOR :** Association Française de Normalisation
- **AOAC :** Association of Official Agricultural Chemists

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Introduction

Introduction

Unlike fishing, which is stagnating at around 90 million tons per year, aquaculture is a dynamic sector in full development that is growing each year by approximately8.6%, which is much higher than the growth in the production of terrestrial animals (FAO, 2014). Aquaculture is a vital contributor to food production consisting essentially of the farming of aquatic plants and fish in controlled (cages) or semi-controlled (lakes) conditions called also known as underwater agriculture (STICKNEY, 1994).

The most important goal of aqua-culturing is to provide food for human consumption. Fish farming (pisciculture) is a subdivision of aquaculture, specifically for harvesting fish, where various aquatic species are cultured (LAZARD, 1990).

In the last decade, Algeria is considered one of the world's producers of tilapia due to an intense expansion of freshwater aquaculture where tilapia accounted for 60% of fish production in 2018 (FAO, 2023)

Tilapia (*Oreochromis*) is considered to be the Cornerstone of aquaculture and constitutes the basis of freshwater fish farming in the intertropicale belt of the world (LAZARD, 1990). It's considered the most farmed fish in the world and the most commercialized, being traded for 5.9 million tons in 2016 (FAO, 2018) because it's very appreciated by consumers for its appearance, lack of fish bones in the fillets, and flavor as well as for its high nutritional value since it is an excellent carrier of minerals, vitamins and a valuable source of easily digestible proteins with high biological value (VÁZQUEZ-SÁNCHEZ et al., 2020 ; GALVÃO and OETTERER, 2014 ; FONTAGNÉ-DICHARRY and MEDALE, 2010).It’s a relatively fast-growing fish that feeds mainly on plant products and by-products or combination foods with low protein content (25%). Moreover, it can be produced wherever water is available, with some species even having the ability to adapt to salty/brackish water. Depending on its diet, tilapia can reach 400 grams in just 8 months (LAZARD, 2007).

Red tilapia (*Oreochromis sp.*) became a popular fish in Algeria and is highly appreciated by consumers (ASSIA, 2022), but few studies have been done about its physicochemical compositions (SAHLI et al. 2020; PREMARTHNA et al. 2018) . Such data like lipids and protein content are useful for food processors and technologists to design optimal processing and storage conditions for this fish while maximizing production. Therefore, the objective of this study was to determine proximate composition, and some physical proprieties of both dorsal and ventral muscles of cultured red tilapia.

CHAPTER I :

BIBLIOGRAPHIC PART

I.1.Aquaculturing definition

Aquaculture is a generic term that encompasses all activities related to the production of animals or plants in aquatic environments. It includes several sectors, including (BARNABE, 1991) ;

- Fish farming, which involves the breeding of fish.
- Shellfish farming, which pertains to the cultivation of shellfish.
- Crustacean farming, which involves the rearing of crustaceans.
- alga culture.

I.2.History of aquaculturing

The initial forms of aquaculture involved confining wild aquatic animals in lakes, ponds, or small coastal areas. Evidence indicates that tilapias were already being cultivated in Egypt, and the cultivation of oysters was practiced by the Japanese, Greeks, and Romans.

It was not until the 17^{th} century that controlled reproduction techniques, such as hatcheries, were introduced, a practice that is prevalent in modern aquaculture. Starting from the 1960s, aquaculture gained significant recognition due to concerns about the sustainability of wild fish stocks as a protein source. Farming Salmones using cages emerged and became one of the most important practices in the global aquaculture industry (MILTHON., 2021).

I.3.Pisciculture: generalities

Pisciculture (fish farming) is a one of the sections derived from aquaculture that involves the rearing of fish in enclosed or partially enclosed environments such as ponds or plastic basins, traps, cages. These controlled spaces serve the purpose of safeguarding the fish from potential predators and facilitating management activities such as feeding, treatment, and capture (BENIDIRI, 2017).

Cage fish farming has been highly adopted by fishing communities living around Lake Victoria and several dams within the country. The annual production from cages is estimated to be 40,000 MT of fish per year. Although some aspects of this technology are still under study, the prospects are good. This is mainly due to the high stocking densities in these systems since the waste is constantly flushed out from the system by the waves. The main debate around the technology has been the potential negative environmental impacts it would have on water bodies (MUNGUTI., 2022).

Two primary categories of pisciculture exist (ABED et BELOUFA. 2019) :

Pond production utilizing earthen basins where fish are fed partially or entirely based on the natural productivity of their environment.

Intensive production in artificial basins or cages, where fish exclusively rely on feed provided by the fish farmer.

The majority of the global fish consumption is sourced from aquaculture, with Asia alone accounting for 90% of farmed fish. Carp is the most commonly raised species, followed by tilapia. Salmones species and catfish (BOYD. 2022; FAO 2008).

I.4. Objective of aquaculturing

The main purpose of is production amelioration through various interventions in the breeding process, such as regular stocking, feeding, and protection against predators. It involves individual or collective ownership of the livestock being raised (FAO, 2001). In rural poor populations, aquaculture often complements traditional fishing activities. Traditional fishing continues to play an important role and, in many areas, remains the most suitable solution for meeting basic subsistence needs. Additionally, it provides a remarkable source of cash income for the harvester (FAO, 2003).

I.5. Aquaculture worldwide

It's rapidly expanding global sector known worldwide and has developed as a sustainable way to feed the world's expanding population. It includes the managed rearing of aquatic species in freshwater and marine habitats, including fish, crustaceans, molluscs, and aquatic plants. As the global need for seafood rises, the aquaculture industry relieves pressure on overfished wild fisheries, hence reducing hunger and malnutrition everywhere. The Food and Agriculture Organization (FAO) claims that the industry is responsible for about 50% of the seafood consumed worldwide. Aquaculture also promotes socioeconomic development by fostering regional development and job possibilities (FAO. 2016)

I.6. Aquaculturing in Algeria

Aquaculture in Algeria has a relatively recent history, dating back to the late 19th century. According to the French biologist "Novella," the first trials took place in 1880 at the Arzew estuary (FAO, 2004).

Current aquaculture production comes from (ABED et BELOUFA. 2019) :

- Marine fish farming in tanks and floating cages by special operators.
- Shellfish farming practised by private operators producing a few dozen tonnes of Mediterranean mussels and hollow oysters.
- Inland fishing by private dealers at the level of dams and hill impoundments, for species such as common carp, Chinese carp, pike perch, black bass and barbeau.
- Farm-level integrated fish farming by farmers for species such as Tilapia.

Lagoon fishing in brackish and fresh water in the east of the country is carried out by a private dealer, according to the specifications signed by the latter, as part of a preservation of the area which has a special status. The species caught are diverse (sea bream, mullet, eel, sole, European bass, sar, clam, oyster, marbling, caramote shrimp, common and Chinese carp) (OULHIZ., 2019).

The development of aquaculture in Algeria can be summarized as follows According to (M.P.P.H, 2005) found in (TOUAHRIA. 2020)

- In 1921, the Bousmail aquaculture and fishing station was established with the aim of identifying the best sites for shellfish farming and fish rearing.
- In 1937, the hatchery station was created.
- In 1947, the Mazafran station was established for freshwater fish restocking and hydrobiological research.
- In 1973, the El Mellah Lake was developed for shellfish farming.
- In 1983/1984, the first efforts were made to establish a sea bass hatchery at the El Mellah Lake.
- In 1989, a mobile hatchery was established in Harreza for carp reproduction, along with another carp hatchery in Mazafran with double the capacity of the first one.
- In 1991, the focus shifted towards utilizing water infrastructure for fish farming.
- In 2000: Creation of a national committee on the subject: Aquaculture in Algeria, which resulted in significant outcomes in terms of prospects and the establishment of a national aquaculture plan in Algeria.

- In 2001: The start of the first fingerling breeding campaign, as well as a broader exploitation of aquatic sites throughout the national territory.

I.7. Presentation of red tilapia specie (*Oreochromis Sp*)

I.7.1. Red Tilapia

Red Tilapia (*Oreochromis sp*) is a hybrid species grows in freshwater, lakes rivers, ect it was initially produced in the 1960s, and was a result of crossbreeding between reddish orange mutant female (*Oreochromis mossambicus*) and male (*Oreochromis niloticus*).(GALMAN and AVTALION, 1983).

Within the *Cichlid* family, Tilapia is a specific fish's commercial name (CHAPMEN, 2003). The synonyms for red Tilapia varies regionally. Some examples include "Rouget créole" in Guadeloupe, "St Pierre" in Martinique, "Gueule rouge" in Réunion, and "Tilapia rouge" in Africa.

I.7.2. Aquaculture of Red Tilapia (*Oreochromis sp*)

Due to its appealing colour, improved market value, and high tolerance to salinity in certain strains, the red tilapia (*Oreochromis sp.*) has become increasingly popular among producers. In countries like Colombia (GONZALEZ, 1997) and Jamaica (CARBERRY and HANLEY, 1997). The red tilapia has replaced the Nile tilapia as the preferred choice among producers, mainly due to the demand from local consumers. In the Philippines, red tilapias are cultivated, commanding a market price per kilogram that is twice as high as the more commonly cultured Nile tilapia (ROMANA and EGUIA, 1999).

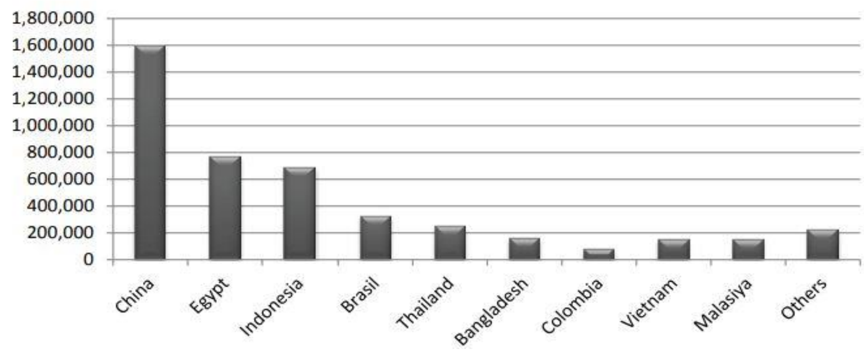


Figure 1. World production of Red Tilapia.(VADHEL et al. 2016)

The National Board for Aquaculture Development and Production (O.N.D.P.A.) and the Egyptian Fisheries Authority reached an agreement on the introduction of Tilapia in Algeria. Following the success of the first experiment concerning the launch in 2001 of tilapia production in Algeria, a cargo estimated at 1.5 tonnes of tilapia fry was delivered. These fry intended for the repopulation of dams, basins, and rivers, have well supported the cold climate of the northern regions of Algeria. Then, Algeria has now moved on to the stage of artificial production. This is the creation of farms specialized in tilapia cultivation according to modern techniques (by private promoters, some 30 aquaculture farms for the breeding of tilapia.

I.7.3. History of tilapia's farming

Nile tilapia have been farmed for centuries. Depictions on an Egyptian tomb (dated at 4000 years) display the fish in ornamental ponds. The culture of the tilapia genus on a global scale, primarily *Oreochromis mossambicus*, began in the 1940s. However, it was not until the 1960s that *O. niloticus* was exported worldwide (FAO 2012).

In the late 1960s The first red tilapia, produced in Taiwan, was a cross between a mutant reddish- orange female Mozambique tilapia (*Oreochromis mossambicus*) and a normal male Nile tilapia (*Oreochromis niloticus*) . It was called the Taiwanese red tilapia (TOWER. 2005).

In the 1960s and 1970s, aquaculture was hailed as the ideal method for producing protein for developing nations. Aid organizations promoted aquaculture as a way to increase food security with little impact on the environment and low grain to feed conversion rates (CANONICO et al. 2005).

I.7.4. Distribution of Tilapia

I.7.4.1.In the world :

Tilapias, originally from Africa and Jordan, have been distributed across the globe. The majority of farmed Tilapias are produced in countries with tropical or subtropical climates. While Tilapias can be grown in countries with temperate climates, they require warm water to survive the cold winter months outdoors. Asia serves as the primary hub for Tilapia production, with mainland China, the Philippines, and Taiwan leading the way globally (LOVSHIN, 1997). In the Americas, Tilapia farming is on the rise due to expanding domestic markets and increased exportation to the United States.

I.7.4.2. In Algeria :

Algeria stands out among Mediterranean countries for its very low production of fishery products. Although the food ratio was 5.4 kg/ha/year in 2010, this still remains well below the global average, which was estimated at 19.2 kg/ha/year in 2012 (FAO, 2012).

I.7.5. Importance of Tilapia production

Tilapia production is of great economic and ecological importance in African countries (ADEBO& ALFRED, 2008). It is the main source of income for fish farmers (ADB, 2005). In terms of projection, their production will amount to more than 9.2 million tonnes in 2030 (FAO, 2014).

Tilapias have many advantages that explain their success in aquaculture like their opportunistic diet allows for appropriate dietary intakes at all levels of intensification, including simple organic/mineral fertilization of ponds

I.7.6. Biologically

Tilapias demonstrate adaptability to diverse environments and can thrive in temperatures ranging from 9°C to 40°C. Species such as *O. niloticus* and *O. mossambicus* are capable of tolerating up to a maximum temperature of 41°C, as evidenced by research conducted by (ALLANSON and NOBLE 1984 ;DENZER 1968).

Under optimal conditions in natural environments, females of Oreochromisniloticus begin to reproduce at the age of 5 to 10 months (DUPONCHELLE&PANFILI, 1998). The breeding process begins when the male establishes a territory by creating a crater-like spawning nest, which he then guards. When the female is ready to spawn, she releases her eggs into the nest and the male fertilizes them. The female then collects the eggs in her mouth and moves away to incubate them. She continues to brood the eggs until they hatch, and cares for the fry until the yolk sac is fully absorbed, which typically takes around 1-2 weeks depending on the temperature. Despite being a maternal mouth brooder, this species produces fewer eggs per spawn compared to other pond fish. If the fry are threatened, they may seek refuge in the mother’s mouth. (MIRES.,1995).

The following figure represents the breeding steps of tilapia’s male and females

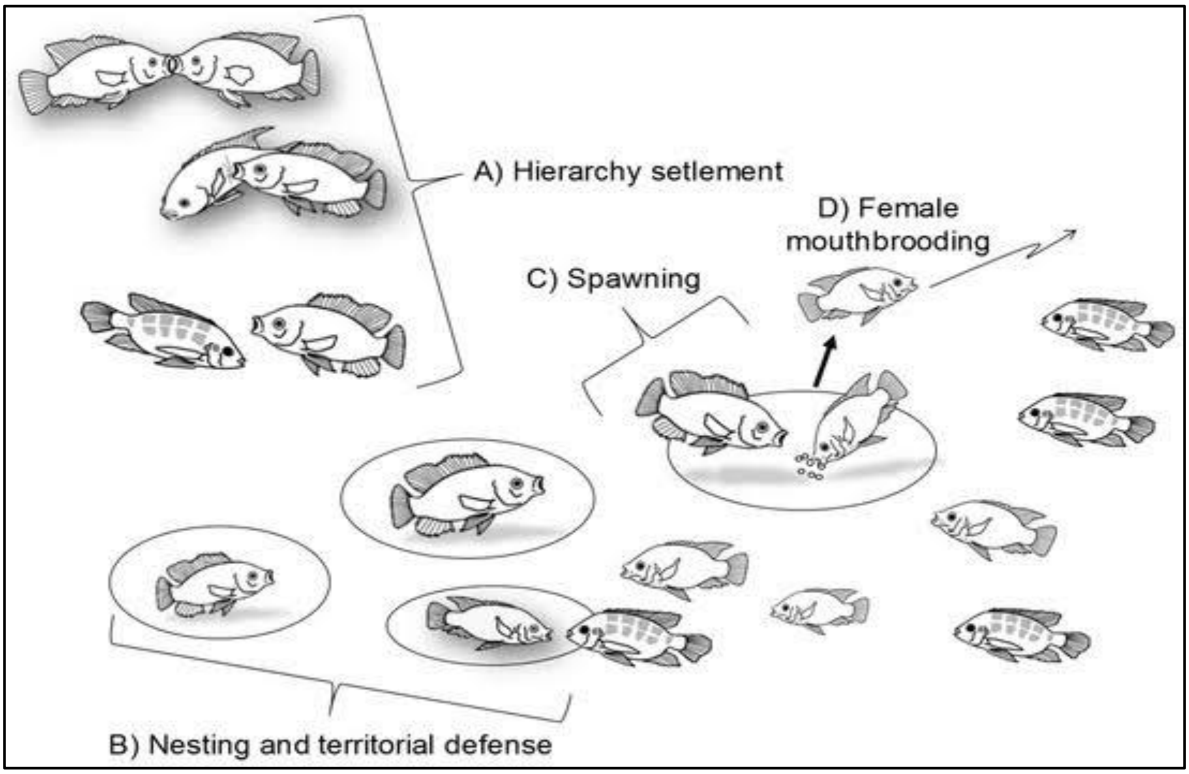


Figure 2. The breeding steps of Tilapia (GONCALVES. 2019)

I.7.7. Tilapia morphology

According to the morphology of the tilapia closely resembles that of the sunfish or crappie, however it can be readily distinguished by its discontinuous lateral line, a hallmark feature of the *Cichlid* family. Exhibiting laterally compressed body structures, these fish possess elongated dorsal fins adorned with an array of pronounced protuberances at the forefront (TOWER.2005) .

The pharynx, where the gills are attached, opens out through the gill slits. The gill rakers are reduced to small knob-like projections. Consequently, the fish cannot collect finer particles of food as a plankton feeder does. The pharynx bears dorsal and ventral teeth patches or apparatus which are bulged and cushion-like. The teeth of the pharyngeal patches are all alike. That gill rakers, pharyngeal and other teeth patches crush and masticate food in omnivorous and carnivorous fishes (PASHA., 1964).

Broad vertical striations are typically observed during the juvenile phase, occasionally persisting into the adult fish's corporeal form (MOHAMMAD., 2021).

The red Tilapia possesses a compressed body, exhibiting hues that range from gray to albino, pink, and red-orange (MORALEE et al., 2000).

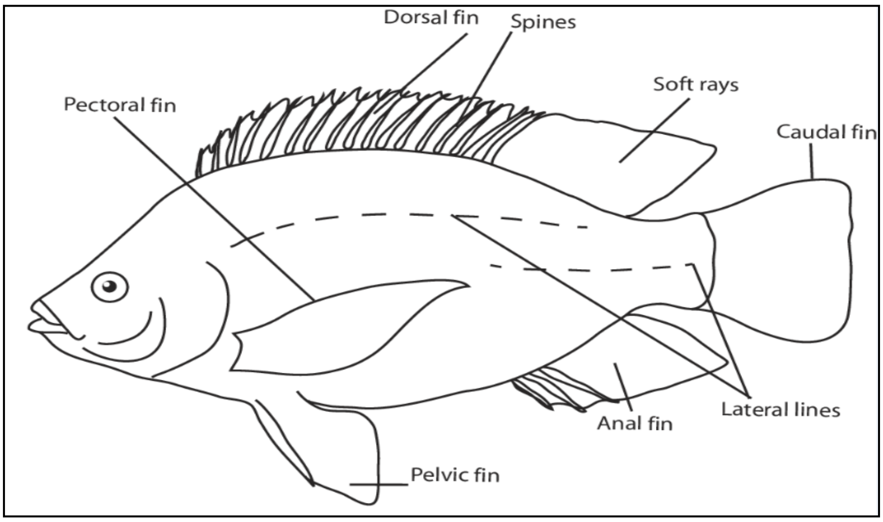


Figure 3. Anatomy of tilapia fish (*Oreochromis*)from (NANDLAL et PICKERING ., 2004)

I.7.8. Genetics

Studying the aspect of genetics should be put into consideration especially the aquaculture farmers

One notable aspect of *Oreochromis* genetics is the presence of sex determination systems. Both sex chromosomes and environmental factors play crucial roles in determining the sex of tilapia species (BRAWAND et al., 2018). This is particularly important for the aquaculture industry, as monosex populations are often desired to maximize growth and avoid undesired reproduction rates within fish farms.

MIREKUET et al. (2017) found higher genetic variation within populations than among populations in tilapia's . According to TAVE et al. (1982) The Auburn University strain of O.aureus revealed the stumpbody phenotype, a type of dwarfism, as the second qualitative phenotype discovered. This phenotype was determined to be a congenital defect that is not heritable and lacks a genetic foundation.

MCGINTY. (1983) proposed that red coloration in *O.niloticus* , O. *Mossambicus* hybrid population is controlled by a single gene. He stated that normally pigmented and and light pink fish were homozygous and that red fish were heterozygous. More over HALSTROM. (1984) proposed that body coloration in *O. Mossambicus* population is controlled by two genes with recessive epistasis : the R and M genes. Which that the R position controls red pigmentation and that the M position controls melanin production and is the epistasiclocis.

I.7.9. Systematic position and taxonomy

I.7.9.1. Classification

This classification of Red Tilapia (*Oreochromis sp*) is taken from MYERSD et *al*.(2023) and NINGRUM (2012)

Kingdom :*Animalia*

Phylum :*Chrodata*

Subphylum: *Vertebrata*

Superclass: *Gnathostomata*

Class: *Actinopterygii*

Order: *Perciformes*

Family : *Cichlid*

Subfamily :*Pseudocrenilabrinae*

Genus :*Oreochromis*

Species:*Oreochromis Sp*

I.7.9.2. Synonyms and Vernacular Names

In Algeria it’s known between fish farmers as Tilapia or in Arabic Balti

Synonyms :

- Nile tilapia (*Oreochromis niloticus*)
- Red Nile tilapia
- Red hybrid tilapia
- Red tilapia hybrid
- Red Stirling tilapia

- Red Mozambique tilapia
- Red Hawaiian tilapia
- Red GIFT tilapia (Genetically Improved Farmed Tilapia)
- Red tilapia strain

I.7.10. Diet of the tilapia

Because the gill arches of the tilapia have numerous, long, and fine branchiospines, as well as microbranchiospines, the water passing through them is effectively filtered of its plankton. Therefore, in their natural environment, this species is primarily herbivorous, feeding on various species of *Chlorophyta*, *Cyanophyta*, *Euglenophyta*, etc. However, they also consume zooplankton and even sediment rich in bacteria and diatoms. (TREWAVAS, 1983;HUCHETTE&BEVERIDGE, 2003; OUATTARA et al., 2009).

In an environment that is artificial, it takes an omnivorous act towards food, utilizing many agricultural Residue products such as oilseed cakes, brewery draff, tomato meal, etc. (OUEDRAOGO, 2000;AZAZA et al., 2006; BLE et al., 2011; BAMBA et al., 2015). It can also benefit from poultry excrement, household waste, etc. (MIKOLASEK et al., 2009). In aquaculture, this species readily accepts formulated feeds (LAZARD, 2009). Its particularly strong gastric acidity allows it to be among the few species capable of digesting *cyanobacteria* (IGA-IGA, 2008). This adaptability to various types of food underpins its significant potential for fish farming (pisciculture).

Digestible energy requirements range from 1.507 to 1.632 MJ for a 100g individual (LUQUET& MOREAU, 1989).

An investigation was conducted recently in Benin, focusing on the development of a cost-effective industry. The study explored integrated poultry-fish systems and indicated that it could be a promising strategy (DIOGO et al., 2018).

I.7.11. Growth

In general, red Tilapia is known for its rapid growth (MCCONNELL, 1982) and has a better growth index than other tilapia species (PAULY et al, 1988). It's lifespan is relatively short (4 to 7 years), and the growth rate is extremely variable depending on the environment.

Nile tilapia has a significant difference in growth rates between males and females, known as sexual dimorphism. Once they reach maturity, which typically takes between 1 to 3 years depending on the environment and sex, male tilapia tend to grow much faster and larger than females. For example, in Lake Itasy, male tilapia can live longer and reach a maximum size of 38 cm or 2000 g, while females usually do not exceed 28 cm or 950 g. However, in larger lakes with good growth conditions, males and females can reach similar sizes, according to McCONNEL (1982). The growth rate of this fish can be highly variable depending on the environment, suggesting that maximum size is more influenced by environmental conditions rather than potential genetic differences (TOGUYENI, 1996; TRINTIGNAC et al., 2013).

I.7.12. Ecological Requirement

Oreochromis is a species relatively eurytope. It can adapt to wide variation in ecological factors of the aquatic environment and can colonize extremely varied media. its natural habitat, this species can support temperatures between 14 and 31°C but extreme conditions of temperatures from 7 to 41°C for several hours. However, the best performances growth are observed between 24 and 28°C (LACROIX, 2004). The optimum breeding is between 28 and 32°C for *Oreochromis* (LAZARD 2009). It can survive in waters with salinity close to 11.5 g/l (MASHAII et al. 2016) and pH range from 8 to 11 (LACROIX 2004). This species can survive for several hours at very low levels of dissolved oxygen, 0.1 mg/l (LACROIX 2004).

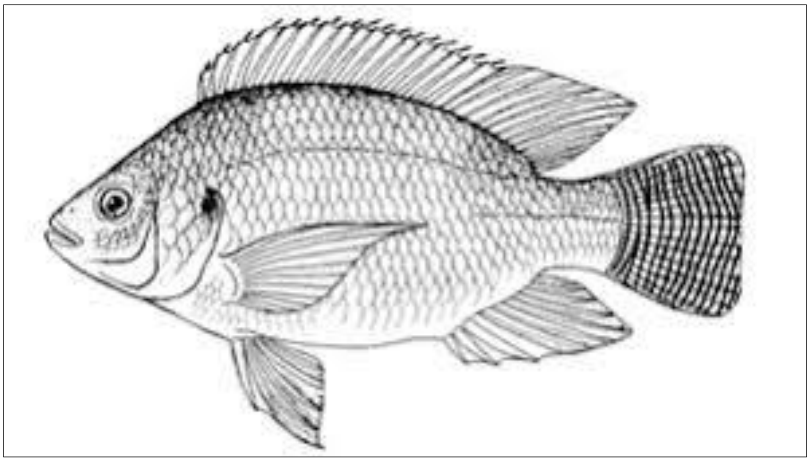


Figure 4. Adult drawing of tilapia (*oreochromis*)by (FAO, 2009)

I.7.13. Economic interest:

- Tilapia is the most sold fish on the planet.
- Tilapia is an exotic fish consumed abundantly worldwide.

- The term tilapia actually applies to different white fish belonging to the Cichlid family, including Nile tilapia, the most common being Sarotherodon and Tilapia.
- Tilapia is the quintessential farmed fish: it is one of the main aquaculture species in Asia, Africa, and South America. It is the 2nd most farmed fish globally, after carp. It is a highly profitable fish. (FAO, 2018)
- In 2009, tilapia was farmed in more than 75 countries.
- The largest producing countries are China, Thailand, the Philippines, Indonesia, Taiwan, Egypt, Colombia, Cuba, and Mexico.
- 40% to 50% of the world's tilapia production is said to come from China, which is not without problems given the number of frauds in this fish farming sector. Farms alone account for half of the world's production.

A particularly remarkable share given that tilapia, originally from Africa, was only introduced to China in 1978 in the central province of Hubei (FAO, 2018)."

Tilapia culturing offers direct employment to more than 500,000 individuals and indirectly carries over 2 million people whom are relatedto fishing accessory trade, processing, trading, supplying inputs, or providing related services (MUNGUTI., 2022).A study by ORINA et al. (2018) noted that tilapia cage culture in Lake Victoria directly provides jobs to over 500 people and indirect income opportunities to over 4000 people living in urban and rural areas.

The tilapia industry can be highly lucrative for farmers and fish farming producers, but it is not without problems, particularly in China, where there have been numerous frauds in the sector. Despite this, farms alone account for half of the world's production. It is noteworthy that tilapia, which is originally from Africa, was only introduced to China in 1978 in the central province of Hubei (FAO, 2018).

In Algeria, Tilapia farming is a relatively new activity; the introduction of this species is very recent (May 2001), and research on it is scarce, such as the studies conducted by BOUROUBI and ZEGHIMI (2004), BOUZID and FARAH (2004), and OULDMAAMAR and TIKARROUCHINE (2005).

I.7.14. Food security and nutrition

Food security is when consumers have the ability to access to safe and sufficient food, to meet their dietary requirements and for an active and healthy life. Poverty is one of the major contributors to food insecurity; therefore, its elimination is essential to ameliorate food access.(MUNGUTI., 2022). tilapia culture, which dominates the aquaculture sector, plays a key role in food security, not only for subsistence and small-scale fishers who rely on it for food, services and generation of income but also for those who prefer it as a source of cheap high-quality animal protein (OBIERO et al., 2014).OBIERO et al. (2019) Concluded that despite the huge issues with the fish supply chain remain, but many consumers saw the aquacultured fish beneficial in term of food security.

I.7.15. Tilapia diseases

The growth and progress of sustainable aquaculture are significantly constrained by diseases that affect aquatic organisms. On a global scale, a recurring trend in aquaculture is the emergence of previously unknown pathogens leading to new diseases, which spread quickly, even across national boundaries, and result in substantial production losses occurring approximately every 3 to 5 years (OLGA et al . 2023).

Farmers have encountered significant fish mortality rates, ranging from 40% to 100% of their stock, in both cages and ponds (Aura et al., 2018). While this is commonly attributed to water quality issues, it is important to note that the problem is health-related due to the absence of diagnostic procedures at the farm level to identify and rule out diseases.

Bacterial infections affecting Nile tilapia farming are attributed to various pathogens, including *Aeromonashydrophila, Pseudomonas fluorescens, P. aeruginosa*, *Edwardsiellatarda*, *Flavobacterium* column are, *Mycobacterium fortuitum*, and *Streptococcusiniae* (AKOLL and MWANJA, 2012). In cage systems, farmers have reported symptoms such as fin rot, cloudy eyes, and skin lesions, indicating the potential presence of bacterial and fungal infections (AURA et al., 2018).

Table 1. Major pathogen factors found in tilapia fish (*Oreochromis niloticus*) (ARRIGNON, 1993)

Factors	Localization	Manifestation
Virus Iridovirus *Lymphocystis*	Dermal connective tissue	Coetaneous neoplasms benign
Bacteria Cytophagacées *Flexibactercolumnaris*	Skin and Gills	necrotic infections
Pseudomonadaceae *Pseudomonas fluorescens*	Systemic infection	Hemorrhagic septicemia
Enterobacteria *Edwardsiellatarda*	Systemic infection	Sepsis hemorrhagic or Granulomatosis
Vibrio *Aeromonas hydrophile* Streptocoques *Streptococcus sp*	Systemic infection Systemic infection	Hemorrhagic septicemia Sepsis
Mycobacterium *Mycobacteriumfortuitum*	Systemic infection	Chronic granulomatosis
Rickettsia Agent de l'*Epitheliocystis*	Skin and gills	Epithelial hyperplasia
Fungia Saprolégniales *Saprolegniaspp* . *Aspergillus flavus* *A. niger*	Skin and gills Deep mycoses	Destruction of the skin Granulomatoses

CHAPTER II :

Materials and methods

II. Materials and methods

II. 1. Objective

The objective of this study was to evaluate the physicochemical properties of red tilapia (*Oreochromis sp*) from the *Cichlid* family , commonly known as Balti which is cultured in the Ain oussera – wilaya of Djelfa region . The assessment was established in PFE laboratory of Zian Achour University of Djelfa, and was based upon physicochemical criteria's and reliable methods.

II.2. Materials

- Metal containers
- Soxhelt extraction apparatus
- Filter paper
- Absorbance measuring device (UV-Vis spectrophotometer ; Beckman DU520)
- Conductimeter (ST3100C-OHAUS CORP)
- Ph meter (ST3100-OHAUS CORP)
- Precision balance (AXIS)
- Centrifuge (SORVALL RC 6+)
- Test tubes
- Micropipette (0.1,01) ml
- Standard tubes
- Refrigerator +4C°
- Muffle furnace (Linn High therm)
- Lab oven (Memmert 105°)
- Vortex (Stuart SA8)
- Beaker (small and large)
- Burette

II.3. Reagent

- Petroleum ether (petroleum spirit boils at 70C°-80C°)
- Copper sulfate pentahydrate (Cu So4: $5H_2O$)
- Sodium carbonate (Na_2 Co_3)
- Citrate de sodium ($Na_3C_6H_5O_7$)

- Sodium hydroxide (NaOH)
- Folin-Ciocalteu
- BSA (Bovine Serum Albumin)
- Buffer solutions

II.4. Fish sample

6 Red tilapia (*Oreochromi Sp*) was purchased from a fish farm located in Daira of Ain-Oussera ranging in length from 20 to 27 cm (See Annexe 7) and weighing between 255 g to 305g. After ensuring proper refrigeration by refrigerating at 4^0 Celsius then icing , the samples were transported to the PFE laboratory period. Fishes were transported to the laboratory within 24-hours post capture.

II.5. Methods

II.5.1. pH

Ph analysis was done according to AOAC (1995) method.

First we calibrate pH meter with buffers. As for the samples preparation weigh approximately 1 gram of the Tilapia samples using a precision balance and place them into a clean beaker. Add a sufficient amount of distilled water to the beaker to ensure proper blending of the samples. Rinse the pH meter electrode with distilled water to remove any residue or contaminants. Immerse the pH meter electrode into the sample solution, ensuring that it is fully submerged. Allow the pH reading on the meter to stabilize. Record the pH value displayed on the meter. The electrode must be cleaned each time

II.5.2. Total ash

Total was done according to method of KUMAR et al (2012).

Bring metal containers with muscles and fish numbers. Weight each one of the marked empty metal container and mark the Results (MCE). Weigh approximately 1 gram of the fish sample using a precision balance (WOS).Transfer the fish sample to the pre-weighed metal container. Make sure to record the weight of the metal container with the sample (MCWS) Place the metal container with the fish sample into the preheated muffle furnace. Allow the sample to ash by maintaining a temperature of 550^0C for a period of 4 hours. Once the metal container is cooled to room temperature, transfer it to a desiccator for further cooling. This step ensures the removal of any residual moisture. After cooling, weigh the metal container with the ash sample using the precision balance. Record the weight (MCAA)

Calculation:

Calculate the weight of Ash (WOA):

WOA = MCAA - MCE

Calculate the total ash content using the following formula:

$$Total\ ash\ (\%) = \frac{WOA}{WOS} \times 100$$

II.5.3. Dry matter and moisture

Dry matter and moisture were determined according to AOCO (1995).

In order to prepare the sample, 1 gram from each muscle from the three fish were weighted (WOS) and placed on Their metal containers , Dry the samples using Heating oven with temperature of 115^0 during 24h, weight the Samples after the drying process ($WODS$)

$$Dry\ matter\ (\%) = \frac{WODS}{WOS} \times 100$$

Whereas (WODS=Weight Of Dry Sample) and (WOS= Weight Of Sample)

As for the moisture it’s merely induced from this formula

$$Moisture(\%) = 100 - Dry\ matter(\%)$$

II.5.4. Organic Matter

Organic matter was calculated according to AL-ARIF. (2017) using the following formula

$$Organic\ matter\ (\%) = \ Dry\ matter(\%) - Total\ ash\ (\%)$$

II.5.5. lipids content

The quantity of Crude lipids was obtained by Soxhlet extraction using petroleum ether (See Annexe 6), according to the Method NF EN ISO 734-1, 2000 described By AFNOR (1982).

Weight 6 round empty flasks and mark their results. 3 grams from each fish muscle were weighted then covered with filter paper then placed in the Thimble of the apparatus. 200ml of petroleum ether (petroleum spirit boiling point $60C^0$ -C 80^0) in round bottom flasks. Wait 6 hours then. Boil the petroleum ether with lipids contained in the flasks, weight the flasks with lipids, and determine the lipids weight by subtraction :

$$lipids\ (\%) = \frac{WOL}{WOS} \times 100$$

WOL=Weight of lipids

II.5.6. Crude protein content

The crude protein Content results was reached according to Lowry et al. (1951) method (colorimetric method by spectrophotometer) using BSA Standard (Bovine Serum Albumin)

First thing we prepared the Reagents:

Reagent A: Dissolve 0.5g of $CuSO_4 \cdot 5H_2O$ and 1g of Sodium Citrate in 100ml of distilled water.

Reagent B: Dissolve 20g of Na_2CO_3 and 4g of NaOH in 1L of distilled water.

Reagent C: Add 1ml of Reagent A to 50ml of Reagent B.

Reagent D: Dilute 1 volume of Folin-Ciocalteu reagent with 1 volume of distilled water.

BSA (Bovine Serum Albumin) : To prepare a stock standard solution, dissolve 50mg of BSA in 50mL of distilled water using a volumetric flask.

Pipette out 0.2, 0.4, 0.6, 0.8 and 1 ml of working standard (BSA) in to the series of Marked test Tubes. Pipette out 1mL of the samples in different labeled tubes. Make up the volume to 1 mL of distilled water in all the test tubes. A tube with 1 mL of distilled water Serves as the blank. Add 2.5 ml of Reagent **C** to all test tubes and incubate for 10 minutes , After incubation add 250 µl of reagent **D** and re-incubate for 30 minutes then Measure the absorbance at 750 nm with spectrophotometer and plot the standard graph of BSA (See annexe 2 and annexe 8). Determine the protein content of the samples by the replacing of the absorbance values of the samples in the graph equation

$$protein(\%) = \frac{P}{WOS} \times 100$$

P=protein content (mg/ml)

II.5.7. Water holding capacity

This method was based on measuring water loss from the muscles by centrifugation, this was done according to (KUDRYSHOV et OLGA. 2023 ; LIAN and CHENJI ., 1989)

II.5.8. Electric conductivity

A 3g of samples were taken then centrifuged. LIAN and CHENJI. (1989);, the extracted liquids were held in tubes and diluted with distilled water.the electrical conductivity then was measured by conductivity meter

II.5.9. Total carbohydrates and gross energy

Formulas were Induced from According to JABEEN. (2011)

$$Total\ carbohydrate = 100 - (F + CP + A)$$

F=Fats , CP=Crude Protein, A=Total Ash

$$Cloric\ value = (4CP + 9F + 4C)Kcal/100$$

Data analysis :

The analysis of the data was done by ANOVA followed by Denkin’s post hoc at p value < 0.05 using SPSS (statistical software suite developed by IBM for data management).

CHAPTER III :

Results and discussion

III. Results and discussion

III.1. Morphometric parameters

Morphometric parameters of red tilapia (*Oreochrmis Sp*) are presented in Table 2.

Weight of both dorsal and ventral mucles of red tilapia (*Oreochrmis Sp*) are preented in Table 3

Table 2. The Morphometric parameters of red tilapia (*Oreochromis sp*).

Parameters	Red tilapia (*Oreochromis sp*)
Length (cm)	27.10±0.75
Width (cm)	8.73±0.64
Whole fish Weight (g)	290±30.41
Eviscerated fish Weight (g)	232±23.62
Decapitated fish Weight (g)	160±13.20
Fillets fish Weight (g)	105±2.51

Values are expressed as means±SD.

Table 3. Proportion of the ventral and dorsal muscle in red tilapia (*Oreochromis sp*).

Parameters	Dorsal	ventral
Fillets fish Weight (%)	42.80±1.07 [a]	57.20±1.44 [b]

Values are expressed as means±SD.
[a,b]*Different letters in the same row indicate significant differences ($p<0.05$).*

The size and shape are unique to the species and the variations in its features are related to many conditions. The age of the fish is not as important as the size of it, as several aspects of taxonomy, ecology, and physiology are more reliant on size rather than age-dependent(YAKUBU and OKUNSEBOR., 2011).The morphometric study in fish examines the proportions between different body parts such as the length of the head, snout, eye, body, fin, and tail. (SAMARADIVAKARA et al., 2012).

The mean length found in the three fish was 27.10 cm and the width was 8.73 cm. The whole fish weight was represented as 100%.The eviscerated fish formed about 80% of the whole fish weight, This indicates that the guts forms 20% from the body weight. While the decapitated fish represent 75.17% of the whole body , that means the head covers 24.83% of the fish. The fish fillets counts as the edible portion of the fish, It takes about 36.20% of the fish.

The muscle mass on each side of the fish makes up the fillet, of which the upper part is termed the dorsal muscle and the lower part the ventral muscle (FAO., 1988).

There was a significant difference (P<0.05) in proportion of the dorsal and ventral muscle to the fillets and hole body weight of the fish , the ventral muscle represents approximately 57.20% of the fish fillets and 20.69% of the total body weight. while the dorsal muscle represents lesser proportions, 42.80% of the fish fillets and 15.51% of the total body weight, the condensation differences in the muscles might be due the lack of bones and spinal column in the ventral muscle which it takes a large space in fish body, also the ventral muscle major role is to protect the vital organs of the fish. which it leads to a need of a thick meat presence. The cells were Widest on the ventral side (FAO., 1988).

III.2. Proximate composition

Proximate composition of dorsal and ventral muscles of red tilapia (*Oreochromis sp*), which included crude lipid, crude protein, moisture, ash, dry matter, organic matter, total carbohydrates, and gross energy are presented in Table 4.

Table 4. Proximate composition of dorsal and ventral muscles from red tilapia (*Oreochromis sp*).

Parameters	Ventral muscle	Dorsal muscle
Crude lipid (%)	1.58±0.55 [a]	0.56±0.13 [b]
Crude protein (%)	17.06±1.80 [a]	15.03±1.99 [a]
Moisture (%)	78.35±0.59 [a]	78.63±0.31 [a]
Ash (%)	1.03±0.04 [a]	0.97±0.04 [a]
Dry matter (%)	21.64±0.82 [a]	21.36±0.24 [a]
Organic matter (%)	20.63±0.85 [a]	20.48±0.15 [a]
Total carbohydrates (%)	1.98±0.08 [a]	4.81±0.06 [b]
Energy value (kcal/100 g DM)	90.38±12.47[a]	84.40±9.37[b]

Values are expressed as means±SD.
[a,b]*Different letters in the same row indicate significant differences (p<0.05).*

III.2.1.Crude lipid

The lipid content of fish muscle is a determining parameter to assess the nutritional condition and can be affected by several factors such as season, environment, source of food, growth phase, spawning, activity, and muscle type (MAHALIYANA et al., 2015 ; BLIGH et al., 1988).

In our study, both dorsal and ventral muscles from red tilapia contained less than 2% crude lipid, thus this fish is classified as a low-fat fish (CLUCAS and WARD, 1996 ;MAHALIYANA et al., 2015). Statistical analysis of data revealed a significant difference ($p<0.05$) in crude lipid. Crude lipid content in dorsal muscle of red tilapia was significantly lower ($p<0.05$) than that of ventral muscle.

Similar findings have been reported by several researchers who state that the dorsal region usually contains less crude lipid than the ventral region in fish (CORTEGANO et al., 2017 ; THAMMAPAT et al., 2010 ; WEIL et al., 2013). This fact suggests that lipids are not spread evenly in the fish body. As shown in Table 4, the ventral muscle contained about 3 times more lipids than the dorsal muscle. Similar patterns were observed by CABLING et al. (1982) and KINSELIA et al. (1975).

III.2.2. Crude protein

Fish is a highly nutritious source of protein with exceptional biological value. Its use can play an important role in resolving protein deficiency due to its nutritional importance (WASEEM., 2007). Crude protein proportion varies in rage of 1-24 % knowing that it also relying on the fish species (SPINELLI AND DASSOW., 1982 ; VAN RUTH et al., 2014).

The average proportion of protein in meat varies from 20 to 30% (AHMAD et IMRAN. 2018). No significant difference ($p<0.05$) was reported in crude protein between dorsal and ventral muscles.

SAHLI et al. (2020), OLOPADE et al. (2016), and DAUDPOTA et al. (2016) stated similar results of crude protein for dorsal muscle portion (15.80, 16.14, and 16.33%) for Nile, hybrid, and cultured Red Tilapia (*Oreochromis Sp*), respectively. PREMARATHNA et al. (2018) reported a lower protein value (7.85%) for Nile tilapia (*Oreochromi sniloticus*). While, AMADOU (2011) and JABEEN and CHAUDHRY (2011) found a higher protein proportion

56.93 and 39.84 % for Nile tilapia (*Oreochromis niloticus*) and mossambica tilapia (*Oreochromis mossambicus*).

III.2.3. Moisture

The moisture content can have a direct effect on the yield and sensory perception of fish meat (CHENG and SUN, 2008). However, to maintain the quality and security of fish product, accurate moisture content measurement is crucial. High moisture levels can encourage bacterial growth, which can lead to food spoilage and contribute to food borne illness (XIONG, 2014; LOVE. 1980).

According to VAN RUTH et al. (2014), the water content of fish muscles is about 77% and may vary due to several factors such as season. This is supported by RODRIGUEZ et al. (2013) whom reported that water content in muscles peaks in the spring while decreases in the winter.

The result has shown no significant difference ($p<0.05$) in moisture content between dorsal and ventral muscles of red tilapia.

Similar values were reported by KYANA et al.(2022), GEREMEW et al. (2020), AYANDA et al. (2019), and YARNPAKDE et al. (2014) for Nile tilapia (*Oreochromis niloticus*) whom found values ranged between 77 and 79 %. Lower values were reported by HUSSAIN et al. (2016), SAHLI et al. (2020) and DAUDPOTA et al. (2016) for Tilapia Mossambica (*Oreochromis mossambicus*), Nile tilapia (*Oreochromis niloticus*) and Red tilapia (*Oreochromis Sp*) (73.10, 72.02, and 72.07 %, respectively). However, OLOPADE et al. (2016) and PREMARATHNA et al. (2018) reported higher moisture content for hybrid and Nile tilapia (81.39 and 89.51 %).

III.2.4. Ash content

Ash, also known as mineral matter, represent a considerable nutrients source in the most times in case of fishes (NDOME et al ., 2010). Mineral matter has an important role in maintaining body functions such as acid-base balance and composition (DURAN et al., 2010).

Referring to Ahmed et al. (2022), ash content in fish ranged from 0.5 to 5% of total body weight. The results obtained in this study fall within this range for both dorsal and ventral muscles of red Tilapia.

No significant difference ($p<0.05$) was recorded between ash content in dorsal and ventral muscles.

Similar results have been reported previously by GHASSEM et al. (2009) and OLOPADE et al. (2016) who reported ash contents of 1.10 and 1.36 for Nile tilapia (*Oreochromis niloticus*) and hybrid tilapia respectively without mentioning the muscles region. While, PREMARATHNA et al. (2018) found lower values of 0.46% for Nile tilapia (*Oreochromis niloticus*). In contrast, SAHLI et al. (2020), JABEEN and CHAUDHARY (2011) found a higher percentage of the total ash of Nile tilapia (*Oreochromis niloticus*), (*Oreochromis mossambicus*) equals to 2.11 and 11.4 %, respectively.

III.2.5. Dry matter

The final form of substance excluding water is referred to as dry matter (NENNICH et CHASE, 2007). This parameter has been developed for assessing maturity as a low technology alternative (RANNEY et al., 1992).

No statistically significant difference ($p<0.05$) was observed in dry matter between both dorsal and ventral muscles of red tilapia. Our findings agree with those founded by BLE et al. (2007) whom reported that dry matter content in Nile tilapia (*Oreochromis niloticus*) muscle is about 21.8 %. However, BOYD et al. (1998) and EDEA et al. (2018) reported higher dry matter content (26.5 %) for tilapia. While, PREMARATHN et al (2018) reported lower dry matter content in Nile tilapia (10.49 %).

III.2.6. Organic matter

The qualitative evaluation of organic compounds has the potential to identify microorganisms present in meat, such as *E. coli, Enterobacteriaceae, Pseudomonassp*., and lactic acid bacteria (LAB) (SENTER et al., 2000; MADDULA et al., 2009).

Organic matter of both muscles showed no significant difference ($p<0.05$).

Researches reported by JIMENEZ et al. (2001), ADEFEMI (2011), and BOWEN (1981) showed higher values of organic matter proportion contained in Tilapia (*Oreochromis spp*) and Tilapia mossambica (*Oreochromis mossambicus*).

III.2.7. Total carbohydrates

The main source of carbohydrate in the body of fish is contained in the liver, which have about ½ of the total carbohydrates stored in the form of "glycogen" (Jensen et al .,2011).Ante-mortem stress may affect the level of glycogen storage and consequently loss of carbohydrate.

Statistical analysis of data showed a significant difference ($p<0.05$) in total carbohydrate contents between dorsal and ventral muscles of red tilapia as ventral muscle had higher amount of carbohydrate than dorsal muscle.

JOB et al. (2015) and ADEFEMI (2011) observed lower (0.20 and 1.20 %) results for wild and cultured of Nile tilapia (*Oreochromis niloticus*). While, OLOPADE et al. (2016) observed similar results in the ventral muscle which they enrolled that the carbohydrate from Nile tilapia and hybrid Tilapia are ranged between 1-3%.

Similar results of were founded by SHAMIM et al. (2011) and RAFFIC et al.(2017) whom reported that the contained total carbohydrate in ventral muscles of HILSA **(***Tenualosa Ilisha***)** and **(***Lutjanus quinquelineatus*,*Mugilcephalus, Lutjanus Lineolatus***)** are lower than that of dorsal muscle.

III.2.8. Energy

Studying the types and amounts of reserved energy in fish, specifically analyzing differences in energy usage over time, can serve as a robust indicator of the physicochemical properties for the populations(TYEDMERS. 2004).

Increased muscle activity does Reduce energy reserves and affecting the development of rigor Mortis (LAMBOOIJ et al., 2006; BAGNI et al., 2007);

Similar results founded by researchers XIE et al. (1997) which it's been marked that the gross energy in Nile tilapia (*Oreochromis niloticus*) equals 95 Kcal/100g. While Higher energy result in tilapia zilli (*Oreochromis zili*) and (*Oreochromis niloticus*) were obtained by SCHARMA et al. (2018),TAKEUCHI et al. (2002), et al.(1978) and CLEMENT ET LOVELL. (1994) whom found the nutritional energy budget in tilapia zilli equals 478 Kcal/100g ,477 kcal/100g ,350 Kcal /100g and 140 Kcal/100g respectively

III.3. Physical proprieties of red tilapia muscles

Physical proprieties of both dorsal and ventral muscles from red tilapia are shown in table 3.

Table 5. Physical proprieties of dorsal and ventral muscles from red tilapia (*Oreochromis sp*).

Parameters	Dorsal muscle	Ventral muscle
Ph	6.77±0.03 [a]	6.73±0.02 [a]
Electric conductivity (mS/cm)	1.06± 0.10 [a]	0.52 ± 0.10 [b]
Water holding capacity (%)	12.61± 0.11 [a]	11.85±0.93 [a]

Values are expressed as means±SD.
[a,b]*Different letters in the same row indicate significant differences (p<0.05).*

III. 3.1. pH

Measuring pH in fish analysis can provide important information about the quality and safety of fish samples (VYNCKE.,1981). The pH can be used as an indicator of freshness (liu et al ., 2022) , and firmness state in the fish tissue (CONNELL.,1980).

The pH of freshwater fish muscle is 7. When capturing, fish are subjected to stress and extreme physical activity due to vigorous swimming resulting in lactic acid accumulation from the depletion of glycogen that occurs in fish muscle under anaerobic conditions leading to a decline in the pH value of muscle (LAHRECHE et al., 2022; ROQUES et al., 2020; GOES et al., 2019).

The pH values recorded in both dorsal and ventral muscles in our study were slightly higher than the recommended value which could be due to the effect of icing (CHAIJAN et al., 2013). No significant difference (p<0.05) was observed between dorsal and ventral muscles.

DULCE et al. (2022), LALY et al. (2016), and SOCCOL et al. (2005) reported lower pH values of 6.05, 6.34, and 6.50, respectively for Nile Tilapia (*Oreochromisniloticus*) without mentioning the muscle region. RONG et al. (2009) found higher pH value of 6.90 for dorsal muscle from Tilapia (*Oreochromis niloticus*). While, LI et al. (2006) and JIANG et al.(2023) reported similar pH values of 6.7 and 7 for ventral and dorsal muscles from fresh Nile Tilapia (*Oreochromisniloticus*), respectively.

The pH of fish muscle can vary widely depending on various factors, such as species, sex, age, season of capture, environment, fish diet, storage temperature, and buffering capacity of meat (CHAIJAN et al., 2013 ; RONG et al., 2009 ; OZOGUL et al., 2007).

III. 3. 2. Electrical conductivity

Conductivity is a measure of a material's ability to transport electrical charge across its volume under the influence of an electric field.(MIKLAVC and PAVSELJ. 2006). The electrical conductivity measurement could serve as a monitoring tool of fi storage and preparation history (BODAKIAN and HART. 1994).

As the temperature rises, the electrical conductivity of the samples exhibits an increase (MUKOLU et ADULOJU, 2005). Also a research conducted by CEVIK and ICIER., (2018) said that the Electrical conductivity decreases when the Fat content increases which explain the inverse relation of our results between the crude lipids and Electrical conductivity.

Statistical analysis of data revealed a significant difference ($p<0.05$) in electrical conductivity between both muscles of red tilapia as dorsal muscle showed a higher significant value than that of dorsal muscle. Study of Electrical conductivity of tuna shown that the Electrical conductivity in the Dorsal is much higher value than to the ventral muscle reported by LIU et al (2017).CHEN et al., (2022) stated that dorsal muscle contributed to higher EC value than that of the ventral muscle.

NOGUEIRA et al.(2013) and GITHUKIA et al.(2015) found similar result for tilapia (0.6 and 0.8 mS/cm).While ELSABAGH et al.(2018) reported a lower value of EC in Nile tilapia (*Oreochromis niloticus*) (0.000253 mS/cm).

III. 3. 3. Water holding capacity

The water holding capacity (WHC) plays a crucial role in determining how consumers perceive and accept the texture and flavor of a product (PELICANO et al., 2003; IWAMA et al., 2004). Water, which is present in ample quantities in fish muscle, plays a crucial part in enhancing the juiciness and tenderness of the meat (CHENG and SUN, 2008).

Statistical data showed no significant difference ($p<0.05$) in WHC between both dorsal and ventral muscles of red tilapia.

SILVA et al. (2019) and GOES (2015) founded higher WHC values of Nile tilapia (*Oreochromis niloticus*) (57.40 and 57.90 %, respectively without mentioning the region of the muscles). The variations of WHC values are probably due to the stress of fish when capturing. This is supported by SOUZA et al. (2019) whom reported that less stressed tilapia produces meat with higher WHC.

Conclusion

Conclusion

Both dorsal and ventral muscles of red tilapia (*Oreochromis sp*) contains moisture as a major constituent, a slightly higher amount of protein, dry and organic matters as well as lower lipid, ash, and carbohydrates contents suggesting that red tilapia is a good source of amino acids and is considered as a low-fat fish (fat less than 5%) which are highly recommended by nutritionists for the human consumption. However, fish is a highly perishable food due to its neutral pH and high moisture content, which increases fish spoilage during storage by simultaneous high microbial and enzymatic activities.

The obtained result showed significant differences between dorsal and ventral muscles of red tilapia in term of crud lipids, total carbohydrates, and gross energy This result is very interesting for nutritionists, food processors, and technologists. However, further research must be conducted to determine if factors such us season, species, sex, age, catch location, stages of sexual maturity, and feeding can affect the fish composition.

ANNEXES

Annexe 1. results of physicochemical parameters red tilapa samples

Samples	Dorsal 1		Ventral 1		Dorsal 2		Ventral 2		Dorsal 3		Ventral 3	
pH	6.75		6.73		6.75		6.74		6.80		6.71	
Total ash (%)	0.87		1.064		1.052		0.965		1.005		1.047	
Organic Matter (%)	20.54		19.706		20.298		20.795		20.595		21.393	
Dry matter (%)	21.41		20.77		21.035		21.76		21.66		22.41	
Moisture(%)	78.59		79.23		78.96		78.24		78.34		77.59	
Electrical conductivity (Ms/cm)	0.954		0.594		1.152		0.396		1.098		0.576	
Water holding capacity (%)	11.47		12.74		12.38		12.34		10.71		12.75	
Lipides(%)	0.42		1.14		0.58		1.39		0.67		2.2	
Protein(%)	25.7	31	37.16	28.09	37.68	35.80	36.56	27.64	24.03	26.19	34.84	42.37

Annexe 2. results of the absorbance measurment done by spectrophotmeter to bovin Serum albumine (BSA)

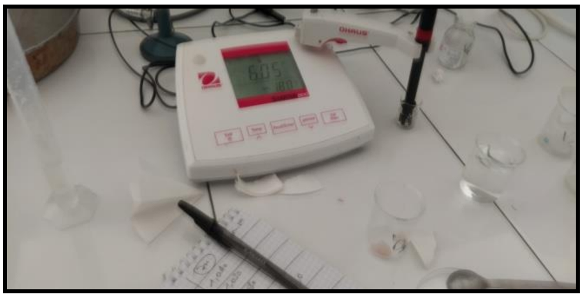
BSA	0	0,2	0,4	0,6	0,8	1
Optic density (750nm)	0	0,424	0,6	0,683	0,782	1,03

Annexe 3. Morphometric parameters of red tilapa samples

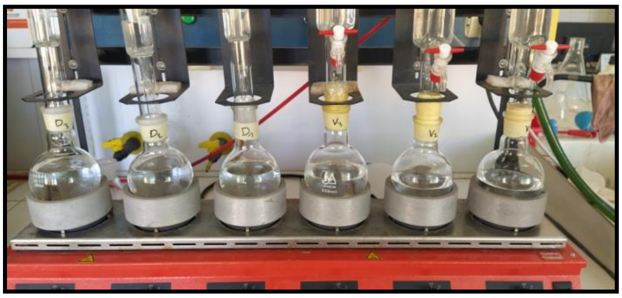
Samples	Fish 1	Fish 2	Fish 3
Legnth(cm)	27.8	27.2	26.3
Width (cm)	9	9.2	8
Whole fish body weight (g)	305	310	255
Eviscerated fish weight (g)	240	250	205
Decapitation fish weight (g)	165	170	145
Fillets of fish weight (g)	105	108	103

Annexe 4. Dry matter determination with lab oven

Annexe 5 : Measuring pH

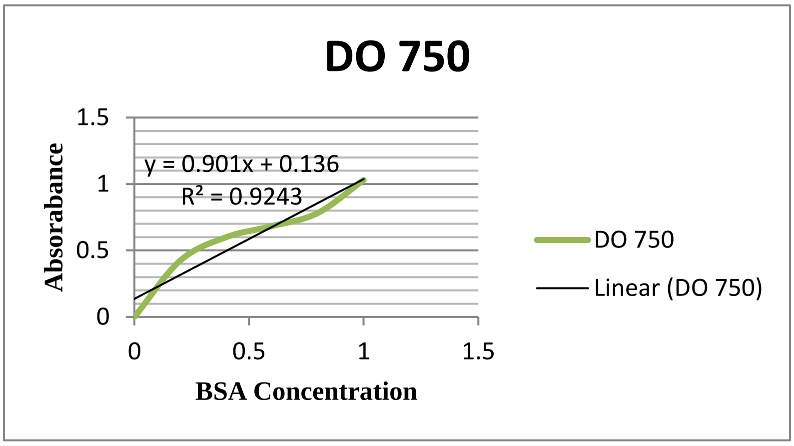


Annexe 6. Lipids extraction by soxhelt apparatus

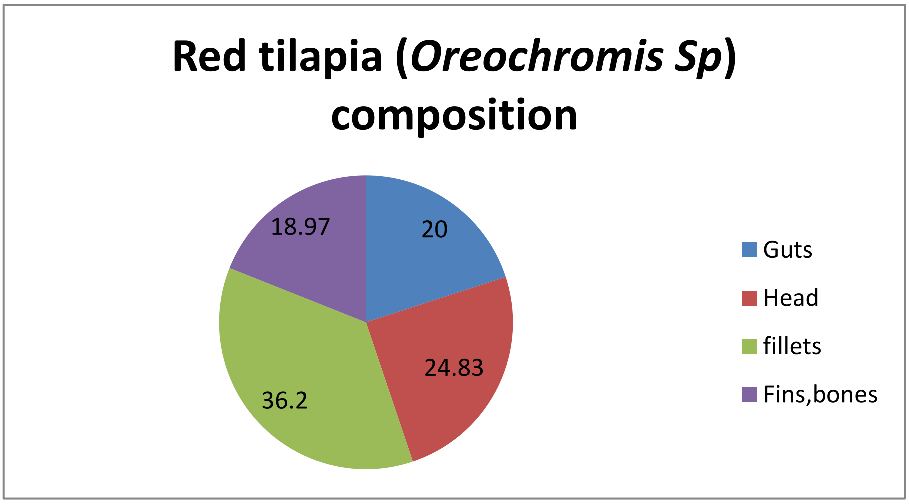


Annexe 7. Morphometric parametres

Annexe 8. linear graphic follwed with equation of BSA absorbance



Annexe 9. Red tilapia (*Oreochromis Sp*) composition



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ABSTRACT

The objective of this study was to evaluate the physicochemical properties of both dorsal and ventral muscles from red tilapia (*Oreochromis sp*), morphometric parameters, proximate compositions, and some physical properties were assessed. The obtained result showed significant differences between dorsal and ventral muscles of red tilapia in term of crud lipids, total carbohydrates, and gross energy This result is very interesting or nutritionist , food processors , and technologists .

Keywords : red tilapia, morphometric, proximate composition , physical properties , chemical properties , dorsal ,ventral

ملخص

هدفت هذه الدراسة إلى تقييم الخصائص الفيزيو-كيميائية لعضلات الظهر والبطن من سمكة البلطي الحمراء (*Oreochromis sp*)، وتم تقييم بعض المعلمات المورفومترية والتركيب الغذائي التقريبي وبعض الخصائص الفيزيائية. أظهرت النتائج المتحصل عليها اختلافات ملحوظة بين عضلات الظهر والبطن من سمكة البلطي الأحمر فيما يتعلق بمحتوى الدهون الخام و الكربوهيدرات الكلية والطاقة الإجمالية. هذه النتائج مهمة جداً للمتخصصين في التغذية وصناعة الأغذية والتقنيين.

الكلمات المفتاحية : البلطي الأحمر، التشكل، تركيب داخلي ، خصائص الفيزيائية، خصائص الكيميائية، الظهر، البطن

RÉSUMÉ

L'objectif de cette étude était d'évaluer les propriétés physico-chimiques des muscles dorsaux et ventraux du tilapia rouge (*Oreochromis sp*), en évaluant les paramètres morphométriques, la composition proximale, ainsi que certaines propriétés physiques. Les résultats obtenus ont révélé des différences significatives entre les muscles dorsaux et ventraux du tilapia rouge en termes de teneur en lipides bruts, de glucides totaux et d'énergie brute. Ces résultats sont très intéressants pour les nutritionnistes, les transformateurs alimentaires et les technologues.

Mots clés : Tilapia rouge, morphométrique, composition immédiate, propriétés physiques, propriétés chimiques, dorsale, ventrale