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A Review of Nutrition and Cultivation Studies for Common Carp *Cyprinus carpio* During the Last Ten Years in Iraq

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ABSTRACT

The common carp (*Cyprinus carpio* L., 1758) belongs to the class Osteichthyes, order Cypriniformes, and family Cyprinidae, which is considered the largest group of freshwater fish. Common carp are cultivated in over 100 countries worldwide, with a global production of approximately 4 million metric tons in 2020. This accounts for 8.6% of the annual global aquaculture output, ranking fourth after *Oreochromis niloticus* (The Nile tilapia), *Ctenopharyngodon idella* (grass carp), and *Hypophthalmichthys molitrix* (silver carp). The present article reviews research conducted over the past ten years on common carp nutrition and cultivation in Iraq. These studies include eleven investigations on cultivation systems and locations, six studies on stocking densities and fish size, and twenty studies focused on feeding practices. Additionally, ten studies addressed feed replacement strategies, forty explored the use of feed additives, and fourteen examined fish anesthesia, parasites, and diseases.

INTRODUCTION

The common carp (*Cyprinus carpio* L., 1758) belongs to the class Osteichthyes (bony fishes), order Cypriniformes, and family Cyprinidae, which is considered one of the largest families of freshwater fish **(He *et al.*, 2008; Xu *et al.*, 2016)**. Taxonomic and phylogenetic studies have identified four subspecies of common carp: *C. carpio viridiviolaceus*, *C. carpio haematopterus*, *C. carpio aralensis*, and *C. carpio carpio* **(Zhou & Irwin, 2004)**. Common carp typically inhabit freshwater environments such as rivers, lakes, and ponds, although they are occasionally found in brackish water. They are distributed globally and are especially widespread in Europe and Asia. In 2020, common carp were cultivated in more than 100 countries, producing approximately 4 million metric tons and contributing 8.6% of global aquaculture production. This ranks them fourth after the Nile tilapia (*Oreochromis niloticus*), silver carp (*Hypophthalmichthys molitrix*), and grass carp (*Ctenopharyngodon idella*) **(FAO, 2022)**.

Common carp are hardy and fast-growing fish that can tolerate adverse environmental conditions. They are easy to breed in confined waters and have widespread acceptance as a food source. Their global introduction has been driven by both nutritional value and ornamental importance **(Ram *et al.*, 2015; Xu *et al.*, 2016; Yaqoob, 2021)**. They are the third most frequently introduced fish species globally **(Welcomme, 1992; Al-Bayati *et al.*, 2024)**. Their high adaptability to diverse environmental and dietary conditions makes them a suitable candidate for commercial aquaculture in various regions of Europe and Asia **(Rahman, 2015)**. As a low-cost protein source, common carp aquaculture contributes significantly to food security, particularly in developing countries **(Miao & Yuan, 2007; Aljoburi *et al.*, 2024)**.

Adult common carp are omnivorous bottom feeders, consuming a diet rich in benthic invertebrates. Larvae and fry primarily consume zooplankton, with prey size increasing as they grow. They naturally inhabit bentho-pelagic zones of fresh to brackish waters within a temperature range of 3–32°C and a preferred pH of 7.0–7.5, typically found between 40° and 60° N latitude. Although stenohaline, they can tolerate salinity levels up to 15–17 PSU, though this results in slower growth and a higher feed conversion rate **(Al-Hamed, 1971; Alrudainy & Jumaa, 2016; Malik *et al.*, 2022; Dawood & Sewilam, 2023)**.

The present review aimed to classify and summarize studies conducted over the last ten years regarding the nutrition and cultivation of common carp in Iraq. The data were obtained from two main sources: published research articles and unpublished doctoral dissertations and master's theses focused on common carp aquaculture in Iraq.

LITERATURE REVIEW

Common carp introduction and aquaculture in Iraq

Common carp were first introduced to Iraq in 1955 from Indonesia and the Netherlands, arriving at the Al-Zaafaraniya fish farm in Baghdad **(Al-Hamed, 1960)**. The aquaculture sector in Iraq is predominantly operated by private farms, with only a few public operations, most of which are located in central Iraq, with fewer in the southern region. Aquaculture practices began in the 1970s and have traditionally involved extensive and semi-intensive pond systems. More recently, floating cage systems have become more prevalent **(Salman & Saleh, 2021)**. Commercial-scale cage culture was established in 2009 in western and central Iraq **(Taher, 2014; Salman *et al.*, 2022; Alshumary *et al.*, 2024)**. However, recirculating aquaculture systems (RAS) are not yet widely adopted **(Salman & Rasheed, 2017)**.

Aquaculture contributed 0.23% to Iraq's gross domestic product (GDP) in 2014, with a total production of 26,625 tons **(FAO, 2017)**. By 2022, freshwater fish production reached 22,704 tons, with cyprinids—mainly common carp—constituting about 65% of the total output. Production is mostly dominated by small, family-owned farms **(FAO, 2023)**. While common carp remain the primary cultured species, there is limited cultivation of grass and silver carp. In northern Iraq, particularly in Sulaymaniyah, the rainbow trout (*Oncorhynchus mykiss*) farming began in 2006 **(Abdulrahman *et al.*,**

2017). Native fish species are not commonly cultured, except in a few experimental studies **(Al-Rudainy *et al.*, 1997; Mohamed *et al.*, 2001; Bashar *et al.*, 2025)**. In 2018, Iraq exported 172 tons of fish and imported 43,604 tons, resulting in a per capita fish availability of 3.4 kg per year **(Dickson, 2022; Hussein & Jumma, 2024)**.

Genetic research in Iraq has included studies on the association between polymorphisms in the insulin-like growth factor gene and various growth and physiological traits **(Aljuboory, 2018)**, as well as investigations into the relationship between growth hormone genes and production traits **(Al-Azzawy & Al-Khshali, 2018)**. Additionally, comprehensive assessments of Iraq's aquaculture past, present, and future have been published **(Salman & Saleh, 2021)**.

Studies on sites and cultivation systems

Over the past ten years, several studies in Iraq have focused on the cultivation systems and farming sites used for rearing common carp. **Rahman (2015)** investigated the role of common carp within integrated aquaculture production systems, highlighting its adaptability and productivity. **Salman and Rasheed (2017)** evaluated the economic feasibility of implementing recirculating aquaculture systems (RAS) in the Kurdistan Region of Iraq, finding them promising but underutilized due to high initial investment costs.

Jabar (2018) modified a small-scale aquaponics system to cultivate both common carp and basil (*Ocimum basilicum*), illustrating the potential for dual-purpose systems in urban or resource-limited settings. In southern Basrah, **Taher *et al.* (2018a)** assessed the growth performance of common carp reared in semi-closed aquaculture systems, emphasizing their suitability under local environmental conditions.

Mojer (2021) conducted a comparative study on the survival and growth rates of common carp larvae and juveniles across various cultivation and feeding systems, while **Mojer *et al.* (2021a)** compared larval growth in recirculating systems versus traditional earthen ponds. Their findings demonstrated that early-stage carp benefit significantly from the stable water quality and controlled feeding conditions in RAS environments.

In a study from northern Basrah, **Albahadly *et al.* (2021)** evaluated the effect of size class on growth variation in cage-reared carp, noting that class-based grading significantly improved uniformity and overall biomass gain. Similarly, **Taher *et al.* (2021)** compared the growth performance of grass carp and common carp in earthen pond systems, reporting higher feed efficiency in common carp.

Al-Dubakel *et al.* (2022) studied the growth differences of common carp reared inside and outside floating cages within earthen ponds in northern Basrah, highlighting how containment affects fish mobility and access to feed. **Taher *et al.* (2023a)** examined the influence of foreign aquatic organisms on the growth performance of pond-reared common carp, noting potential competitive or symbiotic effects.

Finally, **Taher (2024)** assessed the impact of two breeding modes—natural reproduction in earthen ponds during spring and autumn, versus artificial reproduction in

hatcheries—on the growth performance of common carp. The study concluded that while both methods are viable, hatchery-reared fish exhibited slightly higher initial growth rates under controlled conditions **(Oday *et al.*, 2024)**.

Studies on stocking density and fish size

Several studies conducted in Iraq over the past decade have examined the effects of stocking density and fish size on the growth performance and survival of common carp. These studies aimed to optimize production efficiency in various aquaculture systems, particularly in floating cages and earthen ponds.

Al-Janabi (2014) explored the combined effects of stocking density and dietary protein percentage on the growth performance of common carp reared in floating cages in Babylon. The results showed that both factors significantly influenced growth, with moderate densities and higher protein levels yielding the best performance.

Taher (2014) assessed the impact of stocking density and feeding rate on growth in floating cages located in the Shatt al-Arab River in northern Basrah. Findings indicated that lower densities with adjusted feeding schedules produced better weight gain and feed conversion ratios.

Abu-elheni *et al.* (2015) investigated the influence of varying stocking densities and segmentation of the rearing period on survival and growth of common carp in floating cages. Their results demonstrated that moderate segmentation improved survival rates and allowed for more precise feed management.

Similarly, **Abbas *et al.* (2016)** studied how different densities and rearing period partitions affected feed utilization, growth, and overall production in floating cages. They reported that dividing the rearing period into stages, coupled with optimized density management, enhanced feed efficiency and minimized waste.

Al-Dubakel *et al.* (2018) conducted a study examining the relationship between fish mortality and body weight during periods of elevated water temperature in the summer. Conducted in floating cages along the Shatt Al-Arab River, the research revealed that larger fish were more susceptible to thermal stress under high-density conditions, leading to increased mortality.

Taher and Al-Dubakel (2020) further investigated the impact of different stocking densities on growth performance in pond-based systems in northern Basrah. Their study confirmed that lower densities resulted in improved growth and better water quality, emphasizing the importance of density regulation in pond aquaculture.

These studies collectively emphasize that optimal stocking density and size management are critical for maximizing growth, reducing stress, improving survival, and enhancing overall aquaculture productivity under Iraqi conditions.

Studies on Fish Feeding

Over the last ten years, numerous studies in Iraq have focused on the feeding practices of common carp, aiming to improve growth performance, feed conversion efficiency, and cost-effectiveness in aquaculture operations.

Al-Dubakel *et al.* (2014) evaluated the use of gelatin as a dietary binder in feeds for common carp fingerlings. Their findings indicated improved feed stability and intake. Similarly, **Al-Jboury (2014)** incorporated by-products from oyster mushrooms (*Pleurotus ostreatus*) into the diet of fingerlings, demonstrating positive effects on growth performance and a reduction in feed costs.

Taher *et al.* (2014) studied the impact of feeding frequency and ration size on the growth and feed conversion ratio (FCR) of common carp reared in floating cages along the Shatt al-Arab River. Their results showed that adjusting feeding schedules significantly improved both growth rate and FCR.

In a comparative evaluation of commercial feeds, **Al-Tameemi (2015)** assessed five fish feed products available in Basrah Governorate. The study provided practical recommendations for selecting high-quality commercial diets based on nutritional composition and performance metrics.

Al-Lamy and Taher (2016) analyzed the feeding behavior and dietary preferences of juvenile and larval carp released into earthen ponds at the University of Basrah. Their work highlighted natural feeding tendencies and supported the use of supplemental feeding in early developmental stages.

Al-Hassoon (2017) studied the effects of various ratios of fish protein concentrates in the diets of fingerlings, reporting a direct correlation between protein levels and growth rate. Similarly, **Mahmmod *et al.* (2017)** investigated the influence of different crude protein levels on the growth of common carp in floating cages, demonstrating that optimal protein content was essential for maximizing biomass gain.

Albahadly (2019) examined the effects of pellet type (sinking vs. floating) and feed grading on the production of cage-cultured carp in Basrah. The study found that floating pellets combined with regular feed grading enhanced feed intake and growth uniformity.

Taher (2020a) tested unconventional feed ingredients such as bread and dried fish in floating cages in the Shatt Al-Arab River. His results supported the feasibility of integrating locally available by-products into carp diets. In a related study, **Taher (2020b)** conducted an economic evaluation of four imported floating feeds, helping identify cost-effective feeding options for local farmers.

Abdulazeez (2023) investigated the effects of heat treatment on various feed ingredients to improve digestibility and nutritional value. **Dawod (2023)** calculated the thermal-unit growth coefficient for both common and grass carp at different water temperatures, offering insights into feeding efficiency across seasonal conditions.

Taher (2023a) studied the effects of four imported floating feeds on daily intake and feeding rate in a controlled laboratory setting. In another experiment, he evaluated the effect of different protein concentrations on the survival and growth of carp larvae **(Taher, 2023b)**.

Several field studies have also been conducted. **Taher *et al.* (2023b)** evaluated the impact of feeding ratios on carp growth in earthen ponds in northern Basrah, while **Taher *et al.* (2023c)** compared the effects of floating versus sinking diets on growth performance. Their findings reinforced the importance of feed type and rationing for optimal production.

Al-Muslmawy *et al.* (2024a, b) tested alternative feeding strategies, including varying protein content and feeding ratios, to reduce production costs without compromising fish growth. **Hammadi *et al.* (2024a)** explored the role of phytoplankton availability in enhancing the growth of carp larvae, and **Hammadi *et al.* (2024b)** studied how different zooplankton densities affected larval survival and growth in earthen ponds.

In a recent study, **Mojer and Al-Dubakel (2024)** evaluated the impact of different feed types on the survival and growth of carp larvae. **Sabah *et al.* (2024)** along with **Shaalan (2024)** assessed the use of alternative feeding methods to improve growth performance while minimizing costs.

These studies reflect a broad and active research effort in Iraq aimed at improving feed formulations, optimizing feeding strategies, and integrating cost-saving measures to enhance the sustainability and efficiency of common carp aquaculture.

Studies on fish feed replacement

In the last decade, numerous studies in Iraq have explored the use of alternative feed ingredients to partially or completely replace conventional components in the diet of common carp. These studies aim to reduce production costs, utilize local agro-industrial by-products, and maintain or improve fish growth and health.

Al-Daffai and Al-Obaydi (2014) examined the replacement of various levels of animal protein concentrates with dried *Artemia* in the diet of fingerlings. Their results showed that partial replacement maintained acceptable growth performance and feed utilization. In a similar study, **Al-Noor *et al.* (2014)** evaluated the use of fish biosilage as a partial substitute for fish meal in the diet of carp fry. The findings suggested that biosilage could effectively enhance feeding efficiency and reduce costs.

Aljuboury (2017) used dried *Atriplex halimus* (qataf) and *Eichhornia crassipes* (water hyacinth) leaves as alternative plant-based ingredients in common carp diets. His results indicated that both materials had potential as partial replacements with minimal impact on growth. **Oliewi (2018)** studied the partial replacement of soybean meal with safflower meal, reporting positive effects on growth performance and feed conversion.

Ali (2019) used treated water hyacinth leaves in carp diets under well water conditions and observed improved digestibility and reasonable growth rates. **Farnar (2019)** tested eggplant peels and potato waste as replacements for soybean meal in juvenile carp diets. Both ingredients contributed to reduced feed costs with limited impact on growth.

Al-Dubakel and Taher (2020) investigated the partial replacement of soybean meal with *Moringa oleifera* leaves in fish feed. Their findings supported the nutritional value and affordability of *Moringa* as a sustainable protein source. Similarly, **Abdul**

Sada (2021) studied the inclusion of shrimp waste to replace fish and soybean meals in carp diets. The study also assessed histological effects and concluded that shrimp waste is a viable alternative protein source.

Kareem (2023) explored the use of sesame cake as a substitute for soybean meal in artificial breeding operations, reporting notable cost savings with acceptable growth parameters. **Al-Zahiri (2024)** investigated the use of fish offal as an animal protein source in carp diets, analyzing its effects on both fish health and growth performance. The results indicated that fish offal can be utilized effectively without adverse effects.

These studies collectively demonstrate the potential of a wide range of plant-based, animal-based, and agro-industrial by-products to replace conventional feed ingredients in common carp aquaculture. They highlight Iraq's growing interest in developing cost-effective and environmentally sustainable feeding practices for aquaculture.

Studies on feed additives

Over the past decade, extensive research in Iraq has focused on the inclusion of various feed additives in the diets of common carp to enhance growth performance, immune response, digestive efficiency, and overall fish health. These additives include probiotics, prebiotics, enzymes, plant extracts, oils, organic acids, and other functional ingredients.

Abed (2014) investigated the effects of garlic powder and garlic oil (*Allium sativum*) on growth parameters, hematological profiles, and liver enzyme activity in common carp, reporting improved immune and growth responses. **Ahmed (2014)** compared the effects of prebiotic (Fructooligosaccharide, FOS), probiotic (*Saccharomyces cerevisiae*), and their combination, revealing synergistic benefits on blood indices and performance.

Al-Asha'ab *et al.* (2014) tested the combined use of probiotics and prebiotics in fingerlings, finding notable improvements in physiological characteristics. **Al-Kanaani (2014)** incorporated fermented fish silage with date fruit residue, observing positive histological and physiological outcomes.

Mustafa *et al.* (2014) assessed chitosan's effect on immune status and survival rate, highlighting its potential as an immunostimulant. Similarly, **Abdulrahman and Ahmed (2015)** evaluated the combined effect of prebiotics and probiotics on the white blood cell profile of juvenile carp, confirming immune-enhancing properties.

Al-Doori (2015) developed laboratory-formulated probiotics and prebiotics, comparing them with commercial versions, antibiotics, and organic acids. The study provided comprehensive data on their effects on physiological and histological traits. Al-**Dubakel *et al.* (2015)** demonstrated the growth-promoting impact of a native Iraqi probiotic on common carp juveniles.

Al-Muslimawi (2015) evaluated niacin and L-carnitine supplementation, showing favorable changes in blood markers and growth. **Mahmoud *et al.* (2015)** explored

probiotic effects on blood chemistry and liver enzyme activity (ALP, AST, ALT), reporting positive outcomes.

Muhsan (2015) tested organic acid salts, demonstrating beneficial effects on hematological and growth parameters. **Abdulsamad *et al.* (2016)** and **Albassam *et al.* (2016)** assessed growth hormone and commercial enzyme mixtures, respectively, reporting improved nutrient digestibility and feed evacuation.

Farhan (2016) added enzyme-treated rumen contents to diets, observing enhanced growth. **Nader (2016)** examined black grape by-products, noting improvements in chemical composition and biological traits.

Albadran (2017) utilized vegetable waste as a prebiotic, reporting significant nutritional and health benefits. **Al-Jubory and Saleh (2017)** tested an enzymatic-bacterial mixture (Thepax and yeast) in floating cage systems, confirming productivity enhancements.

Almosawi (2017) studied the addition of safflower oil (*Carthamus tinctorius*), while **Al Saad (2017)** tested bay laurel (*Laurus nobilis*) as a prebiotic. Both studies showed positive effects on growth and immunity. Haichal (2017) experimented with polyethylene glycol, and **Albadran *et al.* (2018)** studied vegetable waste prebiotics on intestinal microflora and serum biochemistry.

Al-Hamadany (2018) tested onion powder, while **Taher *et al.* (2018b)** studied *Laurus nobilis* extract, both showing enhancements in growth and feed conversion. **Almaini (2019)** used phytase and citric acid to improve digestibility. **Al-Niaeem (2019)** evaluated the use of Biogen, a commercial probiotic, confirming its health-promoting effects.

Al-Shamary (2019) assessed nanoselenium and other dietary additives, linking them to improved health and growth. **Albassam (2020)** used enzymatically and acid-treated protein residues, and **Fadhil (2020)** added grape seed oil, both reporting health improvements.

Albassam *et al.* (2021) added organic acids to enhance digestion and growth. **Al-Hamdany *et al.* (2021)** explored the use of basil (*Ocimum basilicum*) mucilage as a functional ingredient. **Al-Musawi (2021)** included extracted fish waste oil, supporting sustainable feed practices.

Mojer *et al.* (2021b) evaluated various dietary additives on growth and feed efficiency. **Al-Janabi (2022)** focused on unconventional additives and their influence on hematological profiles. **Al-Mahnawy (2022)** assessed nutritional, histological, and health responses to diverse feed additives.

Al-Qudsi and Alamili (2022) used different levels of canola oil, showing favorable biochemical responses. **Kadhim (2022)** tested *Brassica oleracea* and *Origanum majorana* for antimicrobial and health effects. **Al-Noori (2023)** used zinc oxide nanoparticles to enhance nutritional value.

Othman *et al.* (2023) investigated betaine hydrochloride, and **Sayed-Lafi (2023)** tested pomegranate (*Punica granatum*) peels, both improving physiological responses. **Alogali (2024)** compared local and imported probiotics on bacteriological and nutritional parameters. **Al-Juhaishi *et al.* (2025)** further explored probiotic impacts on health status.

(2024a) tested onion meal and commercial prebiotics, and in another study, **Taher *et al.* (2024b)** examined garlic as a prebiotic. Both treatments enhanced growth and survival in pond-cultured carp.

Collectively, these studies reflect Iraq's dynamic and diverse efforts to improve aquaculture productivity using natural, sustainable, and innovative feed additives.

Studies on fish anesthetizing and diseases (Parasites)

In the past decade, several Iraqi studies have addressed anesthetizing practices and disease prevalence in common carp, particularly focusing on alternatives to synthetic chemicals and monitoring parasite infestations and bacterial pathogens under aquaculture conditions.

Al-Saadi (2014) investigated the potential of natural polymers for *in vitro* immunostimulation in common carp, laying the groundwork for disease prevention through immune enhancement. **Al-Janae'e (2017)** explored the use of plant extracts as an alternative to malachite green for treating *Saprolegnia parasitica*, a common fungal infection in aquaculture. The results showed effective antifungal properties while improving blood health indicators and parasite resistance.

Al-Jubouri *et al.* (2017) clinically diagnosed parasitic infections in common carp cultivated in floating cages in Babylon province. The study provided important diagnostic data on common parasites affecting carp under local aquaculture practices.

Al-Niaeem *et al.* (2017a) tested aqueous extracts of *Myristica fragrans* (nutmeg) for anesthetizing carp fry and reported effective sedation with minimal side effects. A related study by **Al-Niaeem *et al.* (2017b)** assessed nutmeg powder's anesthetic effects, again confirming its potential as a natural alternative to synthetic anesthetics.

Hamzah *et al.* (2017) studied parasitic diseases in carp cultured in cages near Al-Furat River Bridge in Mussayab (Babylon), identifying species and examining their impact on fish health and water conditions. **Rasool (2017)** documented blood and biochemical changes associated with parasitic infestations in common carp in southern Iraq, linking water quality to disease severity.

Al-Haider (2019) conducted a bacterial survey of fish raised in floating cages in Babylon, correlating water quality parameters with infection rates. This study highlighted the importance of environmental monitoring to prevent outbreaks.

Al-Niaeem *et al.* (2019) evaluated the anesthetic potential of powdered *Pimpinella anisum* (anise) and *Matricaria chamomilla* (chamomile), showing safe and effective sedation for common carp. These plant-based anesthetics were recommended for use in field applications and small-scale hatcheries.

Ababneha *et al.* (2020) reported a mass mortality event in Iraq associated with Koi Herpesvirus (KHV) infection in common carp. This study was crucial in raising awareness of viral threats in local aquaculture systems, emphasizing the need for disease surveillance and biosecurity.

Resen *et al.* (2020) tested *Melissa officinalis* (lemon balm) as an anesthetic and confirmed its effectiveness and minimal side effects. **Taher and Al-Niaeem (2020)** evaluated *Nerium indicum* leaf extracts for their effects on carp health, reporting antimicrobial activity and immune enhancement.

Al-Niaeem *et al.* (2022) continued their investigation into plant-based anesthetics, finding *Ruta montana* to be an effective sedative in juvenile common carp. This study added to the growing body of research supporting botanical anesthetics in fish handling and transport.

Al-Shammari (2024) investigated *Aeromonas hydrophila*, a bacterial pathogen common in aquaculture, and its impact on antioxidant enzymes in both common carp and the Nile tilapia. The research provided insights into bacterial infection dynamics and host responses at the biochemical level.

These studies demonstrate Iraq's strong focus on environmentally friendly approaches to disease management and anesthesia in aquaculture. They also highlight the growing concern for biosecurity and sustainable practices in common carp farming.

CONCLUSION

The common carp (*Cyprinus carpio*) remains one of the most significant freshwater fish species in global aquaculture and plays a particularly vital role in the aquaculture sector of Iraq. Its popularity stems from its high adaptability, tolerance to a broad range of environmental conditions, and suitability for diverse culture systems ranging from extensive pond farming to more intensive methods such as floating cages and recirculating aquaculture systems. Over the past decade, substantial research efforts in Iraq have focused on optimizing the cultivation, nutrition, and health management of common carp. Studies have covered various aspects, including suitable cultivation systems, optimal stocking densities, feed formulation strategies, alternative protein sources, and the application of feed additives to enhance growth and immunity. The findings from these studies indicate a growing emphasis on improving feed efficiency, reducing production costs, and maintaining fish health through natural and sustainable practices. Research has also addressed challenges in fish anesthetizing and disease management, especially concerning bacterial and parasitic infections. The shift toward using plant-based anesthetics and immunostimulants highlights the country’s movement toward more eco-friendly and safer aquaculture interventions. Additionally, the documentation of major pathogens and their impact on fish health has underscored the importance of regular disease surveillance and water quality management. Common carp continues to be a cornerstone species in Iraqi aquaculture, not only because of its

economic importance but also due to its potential to contribute significantly to national food security. Continued investment in research and development—especially in genetic improvement, disease prevention, feed innovation, and sustainable farming systems—is crucial for enhancing productivity and ensuring the long-term viability of the aquaculture industry in Iraq.

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