



Tilapia (Chilapi) Fish Consumption and Its Possible Health Hazards on the Human Body: A Review

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Abstract-

Tilapia, commonly promoted as an affordable and widely available source of lean protein, is widely consumed globally — particularly in low- and middle-income countries. However, increasing evidence suggests that under certain aquaculture and environmental conditions, tilapia may carry health risks, including heavy metal contamination, unfavourable fatty acid composition, microbiological hazards, and chemical or antibiotic residues. This review synthesizes current scientific knowledge on tilapia's nutritional profile and the potential adverse health impacts associated with its consumption, with a focus on contaminant bioaccumulation, inflammatory risks, and public-health implications. We conclude with recommendations for safer consumption, aquaculture regulation, and further research.

Keywords- Tilapia (Chilapi) Fish, fatty acid, aquaculture, public-health, omega-3.

Introduction-

Fish is often regarded as a healthy dietary staple due to its high-quality protein and favourable fat composition, including omega-3 (n-3) fatty acids associated with cardiovascular and neurological benefits. In this context, tilapia stands out because of its affordability, rapid aquaculture growth, and mild flavor. As a result, tilapia — known locally in many places (e.g. as "Chilapi") — has become a mainstay in global aquaculture, especially in developing countries.

However, a growing body of research raises serious concerns about the safety and nutritional value of tilapia, especially farmed tilapia grown under suboptimal environmental and feeding conditions. Reported issues range from heavy metal accumulation and antibiotic residues to suboptimal fatty acid profiles and increased

inflammatory potential. Given the public-health implications, it is important to critically analyze the evidence regarding tilapia consumption and its risks.

This review examines the nutritional composition of tilapia, aquaculture practices, chemical and microbiological hazards, fatty acid balance and inflammatory risks, as well as potential long-term health implications, and offers recommendations for safer consumption and regulatory improvements.

Nutritional Composition of Tilapia-

Tilapia is often considered a “lean protein” — a source of high-quality protein with relatively low fat content. According to dietary-nutrition sources, a 100-gram cooked fillet of tilapia provides roughly 20–25 g of protein and only about 2–4 g of fat.

In addition to protein, tilapia provides essential micronutrients including selenium, vitamin B12, niacin, phosphorus, and vitamin D.

However, a critical aspect of tilapia’s nutritional profile concerns its fatty acid composition. Compared to fatty marine fish (e.g., salmon, mackerel, sardines) — which are rich in omega-3 polyunsaturated fatty acids linked to anti-inflammatory and cardioprotective effects — tilapia has a lower omega-3 content and a relatively higher omega-6 (n-6) content.

In a review analyzing multiple studies, the average n-6:n-3 ratio in tilapia was found to be elevated compared to the ideal omega-6/omega-3 balance recommended for human health.

This imbalance may raise concerns, especially for individuals whose overall diet is already high in omega-6 fats and low in omega-3s.

Aquaculture Practices and Associated Risks-

Feed, Rearing Conditions, and Contaminant Exposure-

The safety and nutritional profile of tilapia are heavily influenced by aquaculture practices. In many low-resource settings, tilapia is farmed in crowded ponds, often fed low-quality or inexpensive feed, and may be raised in water bodies exposed to pollution, industrial runoff, or sewage. Under such conditions, tilapia can accumulate harmful contaminants — including heavy metals (e.g., arsenic, chromium, cadmium, lead), and potentially pesticide or other chemical residues — in their tissues.

A recent risk-assessment study on tilapia sampled from polluted aquaculture indicated elevated levels of heavy metals (As, Cd, Cr, Pb), some of which exceeded safety thresholds for human consumption; the authors concluded that prolonged exposure via eating contaminated tilapia may pose carcinogenic risks.

Another study from a river system in India found significant accumulation of heavy metals in organs (e.g., liver) of tilapia, including some amounts in muscle tissue — suggesting potential for exposure even when only fillets are consumed.

Moreover, post-harvest contamination (e.g., during handling, transport, storage) has also been documented as a significant health risk. In an analysis of chemical and microbiological quality in tilapia supply chains, post-harvest contamination was identified as “the major health risk in the tilapia fish value chain.”

These observations underscore that tilapia — whether farmed or wild — cannot be assumed safe unless raised under strictly controlled, monitored, and clean aquaculture conditions.

Use of Antibiotics and Chemical Additives-

To control disease outbreaks in crowded and suboptimal aquaculture settings, antibiotics and chemical agents (e.g., disinfectants, growth promoters) are sometimes used. A global review on antibiotic residues in cultured fish raises significant public-health concerns: antibiotic residues in fish tissues may contribute to antimicrobial resistance (AMR), produce toxic effects, disrupt gut microbiota in consumers, and cause hypersensitivity or allergic reactions.

Particularly in low- and middle-income countries where aquaculture regulation and monitoring may be weak, the misuse or overuse of antibiotics increases the risk of residues entering the human food chain.

Thus, consumption of tilapia from unregulated or poorly regulated farms may pose a risk of antibiotic exposure and associated health issues.

Fatty Acid Balance and Inflammation-

As mentioned, tilapia’s fatty acid profile is skewed toward omega-6 fatty acids, which raises concerns about long-term inflammatory risk. A comprehensive review of tilapia’s n-6 and n-3 fatty acid content concludes that “too much arachidonic acid, an n-6 FA, promotes inflammation, which aggravates heart disease and other illnesses.”

Inflammation is a known contributing factor to many chronic diseases, including cardiovascular disease, arthritis, asthma, metabolic syndrome, and possibly some cancers. Diets with a high omega-6 to omega-3 ratio are thought to exacerbate inflammatory processes in susceptible individuals.

Therefore, while tilapia is low in saturated fat, the relative lack of omega-3s and higher omega-6 content may reduce — or even reverse — some of the cardioprotective and anti-inflammatory benefits typically associated with fish intake, especially when compared to oily fish.

In the context of a typical diet already heavy in omega-6 (from vegetable oils, processed foods, etc.), regular tilapia consumption may thus contribute to an inflammatory milieu — a point of concern for public health, especially for individuals with existing inflammatory conditions.

Contaminants: Heavy Metals, Chemical Pollutants, and Carcinogenic Risk

Heavy Metal Accumulation

Multiple studies across global aquaculture systems and natural water bodies have documented accumulation of toxic heavy metals in tilapia tissues. For example:

A recent study in 2024 from the Cauvery River (India) detected high levels of metals such as Fe, but also noted significant levels of other metals across fish organs, raising concern about bioaccumulation and transfer to humans via consumption.

Another study reported elevated concentrations of arsenic (As), cadmium (Cd), chromium (Cr), and lead (Pb) in farmed tilapia from contaminated sites; some of these values exceeded regulatory thresholds for safe fish consumption.

Research on tilapia from aquaculture in certain regions revealed hazard-index (HI) values greater than 1 — indicating potential health risk — especially due to As contamination during certain seasons.

These findings suggest that heavy-metal contamination in tilapia is not hypothetical but a documented phenomenon, especially in regions with industrial pollution, poor waste management, or inadequate water-quality control.

Chronic consumption of heavy-metal contaminated fish may contribute to neurological disorders, kidney disease, impaired development (in children), reproductive toxicity, and cancer risk, depending on the metals involved and exposure levels.

Chemical Pollutants, PCBs, and Organic Contaminants (Potential, Indirect Risk)

Although less frequently studied specifically in tilapia, fish from polluted or industrial areas may accumulate persistent organic pollutants (POPs) — such as polychlorinated biphenyls (PCBs), dioxins, pesticides, or other endocrine-disrupting chemicals — especially if the water or feed is contaminated. Reviews on contaminated fish consumption warn that such pollutants can increase risks for cancer, hormonal disruption, neurological damage, and immune dysfunction.

Given that tilapia is often farmed in ponds or water bodies near human habitation, agriculture, or industrial discharge, there is a real possibility of exposure to such pollutants — though specific data for tilapia remains limited and warrants further research.

Microbiological and Post-Harvest Risks-

Beyond chemical contamination, tilapia supply chains — especially in low-resource settings — often face microbiological hazards. Handling, transport, storage, and poor hygiene practices can introduce bacterial pathogens (e.g., Salmonella, E. coli, Vibrio, Aeromonas) or spoilage organisms, increasing the risk of foodborne illness.

According to a study that assessed chemical and microbiological quality throughout the entire tilapia value chain, post-harvest contamination emerges as “the major health risk” — sometimes more significant than aquaculture contamination itself.

Consumers who purchase tilapia from uncertified or informal markets — where cold chain, sanitation, and handling practices may be substandard — are particularly at risk. Improper cooking or cross-contamination can further exacerbate these dangers.

Antibiotic Residues and Antimicrobial Resistance (AMR)

To control contagious diseases common in intensive aquaculture, antibiotics are frequently used — often indiscriminately or without strict regulation — especially in lower- and middle-income countries. A 2024 global review highlighted this as a major public-health concern: antibiotic residues in cultured fish may lead to antimicrobial resistance, toxicity, disruption of human gut microbiota, allergic reactions, and other adverse effects.

The overuse or misuse of antibiotics in fish farming not only endangers consumers but also contributes to the broader crisis of AMR, which threatens the efficacy of critical antibiotics in human medicine.

Given that many tilapia-consuming regions lack robust regulatory oversight or routine residue monitoring, there is a tangible risk that antibiotic-contaminated tilapia could reach consumers.

Potential Health Impacts of Regular Tilapia Consumption

Inflammation & Chronic Diseases-

Given the elevated omega-6 to omega-3 ratio in tilapia, regular consumption — especially if not balanced by other omega-3-rich foods — may contribute to chronic systemic inflammation.

Chronic inflammation is implicated in a range of diseases, including cardiovascular disease, atherosclerosis, arthritis, asthma, metabolic disorders, and even some cancers.

Thus, while tilapia provides lean protein and essential micronutrients, it may be a poor substitute for oily marine fish if one’s dietary goal is to support anti-inflammatory or heart-protective benefits.

Toxicity from Heavy Metals and Pollutants

Consumption of tilapia contaminated with heavy metals (As, Cd, Cr, Pb) or other pollutants over time can pose serious health risks. Documented risks include kidney dysfunction, neurotoxicity, impaired development, reproductive harm, and carcinogenesis — especially with chronic exposure.

Particularly concerning is that heavy metals accumulate in fish tissues — and some may concentrate in organs (e.g., liver, kidneys), which in some cultures may also be consumed, increasing exposure.

Antibiotic Residue & AMR Risk-

Eating tilapia with antibiotic residues may contribute to antibiotic - associated side effects (e.g., hypersensitivity, toxicity), disruption of gut microbiota, and may facilitate the transfer of antibiotic-resistant bacteria or resistance genes to humans.

Given global concern about rising antimicrobial resistance, this risk extends beyond individual health — potentially affecting community health and complicating treatment of bacterial infections.

Foodborne Illness from Microbiological Contamination

Poor handling, inadequate storage, or unhygienic post-harvest practices may lead to contamination with pathogens (bacteria, parasites), increasing risk of food poisoning, gastrointestinal illness, or systemic infections if fish is undercooked or improperly stored.

Long-term Public Health Concerns

When consumption of tilapia is frequent and sourcing, water-quality, and food-safety standards are lax, these combined risks — of contaminants, poor fatty acid profile, and microbiological hazards — may contribute to a higher burden of chronic diseases in populations reliant on tilapia as a primary protein source. Observational data suggests that contaminated fish intake correlates with increased risk of kidney disease, cancers, neurological disorders, and other non-communicable diseases.

Balancing the Risks and Benefits: When Can Tilapia Be “Safe”?

It would be inaccurate to assert that tilapia is always dangerous or always healthy — the risks depend heavily on source, aquaculture practices, environmental conditions, and post-harvest handling.

Several sources highlight situations in which tilapia can be a reasonable dietary choice: when raised in clean water, under regulated aquaculture conditions, fed high-quality feed, and handled with proper hygiene and cold-chain management. Under such circumstances, tilapia remains a low-fat, high-protein, nutrient-rich food.

Nevertheless, given the documented risks, many experts recommend limiting tilapia consumption — or at least ensuring diversified fish intake including oily fish rich in omega-3 — rather than using tilapia as the sole fish source.

Recommendations-

Based on the evidence reviewed, the following recommendations are proposed for consumers, public-health authorities, and aquaculture stakeholders:

1. **Traceability & Certification:** Consumers should prefer tilapia from certified farms with known water-quality standards, responsible feed use, and minimal contamination risk.
2. **Diversify Fish Intake:** Instead of relying solely on tilapia, dietary plans should include oily fish (e.g., salmon, sardines, mackerel) — rich in omega-3 — to maintain a healthier fatty-acid balance.

3. **Regulation & Monitoring:** Governments and regulatory bodies should enforce stringent monitoring of heavy metal levels, antibiotic residues, chemical contaminants, and water quality in aquaculture operations; routine testing and certification should be mandatory.
4. **Safe Handling & Cooking Practices:** Proper post-harvest handling, cold-chain maintenance, and thorough cooking can minimize microbiological risks.
5. **Public Awareness & Education:** Consumers need to be educated about the potential risks of tilapia consumption — especially farmed tilapia from unknown or unregulated sources — so they can make informed dietary choices.
6. **Further Research:** More peer-reviewed studies are needed, especially from diverse geographical regions (including South Asia, Africa, Latin America), to better quantify contaminant levels, long-term exposure risks, and to compare farmed vs. wild tilapia under realistic dietary patterns.

Conclusion

Tilapia (Chilapi) fish remains a globally popular and affordable source of protein. However, the assumption that all tilapia consumption is healthy — simply because it is “fish” — is flawed. Scientific evidence demonstrates that under certain aquaculture and environmental conditions, tilapia can accumulate heavy metals, carry antibiotic residues, harbor microbiological contaminants, and present an unfavorable omega-6 to omega-3 fatty acid balance.

These factors — alone or in combination — may contribute to chronic inflammation, increased risk of kidney or neurological toxicity, antibiotic-related health effects, foodborne disease, and possibly cancer, especially with long-term and frequent consumption.

Thus, while tilapia itself is not inherently harmful, its safety depends heavily on how and where it is farmed, processed, and handled. Consumers, regulators, and aquaculture stakeholders must work together to ensure safe production and supply, and to promote diversified, nutritionally optimal fish consumption.

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