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Are Prawns Healthy to Consume? A Comprehensive Review of Nutritional Benefits and Heavy Metal Concerns

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Abstract: *Prawns form an essential part of human diets in many coastal and inland regions due to their high nutritional value, affordability, and cultural acceptance. Alongside their dietary importance, increasing environmental pollution has raised concerns about the accumulation of heavy metals in aquatic organisms, including prawns. This has led to ongoing debate regarding the safety of prawn consumption. The present review critically examines published scientific literature to evaluate the nutritional significance of prawns in relation to potential health risks associated with heavy metal exposure. Evidence from previous studies suggests that prawns remain a safe and healthy food source when harvested from environmentally monitored ecosystems, and that the nutritional benefits generally outweigh the potential risks (FAO/WHO, 2011; Tuzen, 2009; Ahmed et al., 2016).*

Keywords: Prawns form an essential part of human diets in many coastal and inland regions due to their high nutritional value, affordability, and cultural acceptance

I. INTRODUCTION

Seafood has long been an essential component of human nutrition, supporting health and wellbeing across diverse cultures and geographical regions. It is widely valued for providing high-quality, easily digestible protein along with essential amino acids, vitamins, and minerals that are often present in lower quantities in terrestrial food sources. Among the wide range of seafood consumed globally, prawns hold a particularly prominent position due to their palatability, widespread availability, and strong consumer preference. In many developing as well as developed countries, prawns contribute significantly to local economies through capture fisheries and aquaculture, supporting livelihoods, employment, and trade (Béné et al., 2015).

Freshwater prawns, especially species belonging to the genus *Macrobrachium*, are of particular importance in inland fisheries. These prawns are widely distributed in rivers, reservoirs, lakes, and dams, and are often harvested by small-scale fishers as a readily accessible protein source. Several studies have highlighted their role in enhancing food security and improving nutritional intake in rural and semi-urban communities, where alternative animal protein sources may be limited or expensive (De Grave et al., 2015). In addition to their economic value, freshwater prawns are nutritionally rich, containing substantial amounts of protein and essential micronutrients that contribute to balanced diets.

In recent decades, however, growing environmental contamination has raised serious concerns regarding the safety of aquatic food resources. Rapid industrialization, agricultural runoff, urbanization, and improper waste disposal have led to increased inputs of heavy metals into aquatic ecosystems. Unlike many organic pollutants, heavy metals are persistent in nature and tend to accumulate in sediments, where they remain available for uptake by aquatic organisms

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over long periods (Förstner & Wittmann, 2012). This persistence makes them particularly relevant from both ecological and public health perspectives.

Prawns frequently attract attention in food safety discussions because of their benthic or near-bottom dwelling habits and omnivorous feeding behavior. By interacting closely with sediments and detrital food sources, prawns may accumulate trace metals present in their environment more readily than some pelagic species (Rainbow, 2002). Consequently, the detection of heavy metals in prawn tissues often raises concern among consumers, leading to questions about whether regular consumption could pose long-term health risks.

The presence of heavy metals alone does not necessarily indicate a threat to human health. The actual risk depends on several interacting factors, including the type of metal, its chemical form, the level and duration of exposure, consumption frequency, and individual susceptibility. Importantly, essential metals such as iron, zinc, and copper are required for normal physiological functions, while non-essential metals become harmful primarily when exposure exceeds safe limits (EFSA, 2012).

Therefore, evaluating the safety of prawn consumption requires a balanced and scientifically grounded approach. Such an assessment must consider not only contaminant presence but also nutritional benefits, dietary exposure pathways, and internationally accepted risk assessment frameworks developed by organizations such as FAO and WHO. When viewed through this broader lens, scientific evidence increasingly suggests that prawns harvested from environmentally monitored and regulated ecosystems remain a safe and valuable component of the human diet, highlighting the need for continued monitoring rather than avoidance of seafood consumption (FAO/WHO, 2011; EFSA, 2012).

II. NUTRITIONAL SIGNIFICANCE OF PRAWNS

Prawns are widely regarded as an excellent source of high-quality animal protein and have long been valued for their nutritional contribution to human diets. The muscle tissue of prawns contains a well-balanced amino acid profile, providing all the essential amino acids required for normal growth, tissue maintenance, and the proper functioning of metabolic and enzymatic systems (Venugopal, 2009). Because of this, prawns serve as an important dietary protein source, particularly in regions where access to meat, poultry, or dairy products may be limited by economic or geographic factors. Their relatively easy digestibility further enhances their suitability for people across different age groups, including children and the elderly.

In addition to their protein content, prawns supply a range of essential micronutrients that play critical roles in maintaining human health. Minerals such as iron are vital for haemoglobin formation and efficient oxygen transport in the blood, while zinc is involved in immune function, wound healing, and numerous enzymatic reactions within the body. Selenium, another key element found in prawns, contributes to antioxidant defence mechanisms and helps protect cells from oxidative damage (Huss, 1998; Gbogbo et al., 2018). The presence of calcium and phosphorus further adds to their nutritional value, as these minerals are essential for bone development, skeletal strength, and normal metabolic activity.

The lipid profile of prawns also contributes positively to their reputation as a healthy food choice. Several studies have reported that prawns contain relatively low levels of saturated fat while providing beneficial fatty acids that support cardiovascular health (Mozaffarian & Rimm, 2006). This characteristic makes prawns particularly attractive to individuals seeking to manage cholesterol levels or reduce the risk of heart-related disorders without compromising protein intake. Unlike many terrestrial animal foods, prawns offer a nutrient-dense option with a favorable balance between protein and fat.

Regular consumption of seafood, including prawns, has been consistently linked with improved overall dietary quality. Nutritional assessments suggest that incorporating prawns into the diet can help address micronutrient deficiencies,

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especially in populations where dietary diversity is limited (FAO, 2014). Moreover, the inclusion of prawns in daily or weekly meals contributes to balanced nutrition by supplying a combination of protein, minerals, and health-promoting fats. For these reasons, prawns are increasingly recognized not only as a valuable food resource but also as a component of dietary strategies aimed at improving public health and nutritional security (Béné et al., 2015).

III. HEAVY METALS IN AQUATIC ECOSYSTEMS

Heavy metals are naturally present in aquatic environments as a consequence of geological processes such as rock weathering and soil erosion. Under natural conditions, these elements occur at low concentrations and are generally integrated into ecological cycles without causing harm. However, over the past several decades, human activities have substantially altered both the distribution and concentration of heavy metals in many freshwater and marine ecosystems (Förstner & Wittmann, 2012). Rapid industrialization, intensified agriculture, expanding urban settlements, and mining operations have increased the release of metal-containing wastes into rivers, lakes, reservoirs, estuaries, and coastal waters.

Agricultural runoff introduces metals through the use of fertilizers, pesticides, and livestock waste, while industrial effluents often contain metals released during manufacturing, metal processing, and energy production. Domestic sewage and improper waste disposal further contribute to the metal load in aquatic systems, especially in regions lacking adequate wastewater treatment facilities. Mining and smelting activities are particularly significant sources, as they can release large quantities of metals directly into surrounding water bodies, often leading to long-term contamination (Förstner & Wittmann, 2012).

Once heavy metals enter aquatic ecosystems, they tend to bind strongly to suspended particles and sediments. Unlike many organic pollutants, metals are not degraded or broken down over time; instead, they persist in the environment and may remain biologically available for extended periods (Rainbow, 2002). Sediments therefore act as both sinks and secondary sources of contamination, releasing metals back into the water column under changing environmental conditions such as pH shifts, temperature fluctuations, or physical disturbance.

Aquatic organisms take up heavy metals through multiple pathways, including direct absorption from water, ingestion of contaminated food, and contact with metal-enriched sediments. This uptake leads to bioaccumulation, with metal concentrations varying widely among species depending on feeding habits, habitat preferences, physiological characteristics, and trophic position (Tuzen, 2009). Over time, metals may also be transferred through food webs, raising concerns about their potential impact on higher trophic levels, including humans.

Prawns are particularly relevant in this context because of their close association with bottom sediments and their omnivorous feeding behavior. As benthic or near-bottom dwelling organisms, prawns frequently interact with sediment-bound contaminants, making them effective bioindicators of metal pollution in aquatic ecosystems (Abdel-Khalek et al., 2016). However, it is important to note that accumulation patterns are not uniform. Essential metals such as iron, zinc, and copper are regulated by biological mechanisms and play vital physiological roles, whereas non-essential metals may accumulate differently depending on species, tissue type, and environmental conditions (EFSA, 2012). These variations highlight the need for species-specific and site-specific assessments when evaluating contamination levels.

IV. HUMAN HEALTH RISK PERSPECTIVE

From a human health perspective, the detection of heavy metals in prawn tissues does not automatically indicate a food safety concern. Modern food safety and toxicological frameworks emphasize the importance of exposure assessment rather than the mere presence of contaminants (FAO/WHO, 2011). Health risk is determined by several interacting factors, including the frequency and quantity of consumption, duration of exposure, chemical form and bioavailability of the metal, and individual susceptibility related to age, health status, and nutritional background.

A growing body of scientific literature assessing seafood safety suggests that prawns harvested from regulated and environmentally monitored systems generally do not pose significant health risks to consumers. Studies applying established human health risk assessment models consistently report low-risk outcomes for prawn consumption under typical dietary patterns (Ahmed et al., 2016; Gbogbo et al., 2018). These findings reinforce the importance of regulatory oversight and routine monitoring in maintaining food safety standards.

Special consideration is often given to sensitive population groups, including children, pregnant women, and individuals with compromised health, as they may be more vulnerable to prolonged exposure to certain metals (Storelli, 2008). Nevertheless, scientific consensus indicates that precautionary strategies should focus on improving environmental management, pollution control, and monitoring programs rather than discouraging seafood consumption altogether. In fact, eliminating seafood from the diet may inadvertently reduce intake of essential nutrients that support overall health (Mozaffarian & Rimm, 2006).

V. DISCUSSION

Public concern regarding heavy metals in prawns frequently arises from confusion between environmental contamination and actual human health risk. Scientific evidence consistently demonstrates that risk assessment must consider the context of exposure, including consumption patterns and regulatory thresholds, rather than isolated detection of contaminants (Rainbow, 2002; EFSA, 2012). Without this broader perspective, the presence of metals may be misinterpreted as inherently dangerous, leading to unnecessary fear and avoidance of nutritionally valuable foods.

When evaluated in a holistic manner, the nutritional benefits of prawn consumption clearly outweigh the potential risks under normal environmental and dietary conditions. Prawns provide high-quality protein, essential minerals, and beneficial fatty acids, all of which contribute positively to human health. At the same time, studies indicate that metal exposure from prawn consumption remains within acceptable safety margins when environmental conditions are monitored and regulated (FAO/WHO, 2011; Ahmed et al., 2016).

Researchers therefore emphasize the importance of sustainable fisheries management, effective pollution control, and continuous environmental monitoring as the most practical and scientifically sound approaches to ensuring consumer safety. These measures not only protect public health but also support the long-term sustainability of aquatic ecosystems and the livelihoods that depend on them (Béné et al., 2015). Rather than excluding prawns from the diet, informed consumption supported by scientific evidence and regulatory oversight is widely recommended.

VI. CONCLUSION

Based on extensive scientific evidence, prawns can be regarded as a healthy and valuable food source when harvested from environmentally monitored and well-managed ecosystems. Although heavy metals remain an important ecological and environmental concern, current research indicates that prawn consumption does not pose significant health risks to humans under normal dietary practices (FAO, 2014; EFSA, 2012). Continued surveillance of aquatic environments, combined with sustainable resource management and pollution control, is essential for maintaining food safety while preserving the nutritional, economic, and cultural importance of prawns.

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