

Review

Microalgae as source of polyunsaturated fatty acids for aquaculture

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ABSTRACT

The therapeutic significance of polyunsaturated fatty acid (PUFA) especially docosahexaenic acid (DHA), eicosapentaenoic acid (EPA) and arachidonic acid (AA) has been demonstrated by recent clinical and epidemiological studies. Fish oils are the major commercial source of long chained ω 3 PUFA. Global production of farmed fish and shell fish has more than doubled in the past two decades, trends toward intensification and greater control over nutritional input resulting in increased demand for wild fish for feed. Feed is the largest production cost for commercial aquaculture (e.g. most farming of salmon, other marine finfish, and shrimp), and thus improving feed efficiency in industrial systems is already a priority. Moreover, fishmeal prices have risen in real terms in the past three decades and are likely to increase further with continued growth in demand. The possible decline of commercial fish stocks calls for research in alternative sources of PUFA. Considerable evidence has indicated that ω 3 fatty acids in fish oils actually derive from zooplankton that consumes algae. Further the microalgae may have superior lipid stability compared to traditional PUFA because they are naturally rich in antioxidant carotenoids and vitamins and because lipids are microencapsulated by the algae cell wall.

KEYWORDS: aquaculture, feed, algae, mass production, polyunsaturated fatty acids (PUFA)

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INTRODUCTION

Modern nutritional theory is focusing on the numerous health benefits of maintaining sufficient levels of fatty acids and in particular the very long chain polyunsaturated fatty acids (PUFA) (i.e., C₂₀ and C₂₂) that belong to the omega (ω) 3 family. They are essential fatty acids for the development of marine organisms and important in a balanced human diet and as well have a number of nutraceutical and pharmaceutical applications ([1,2]). Eicosapentaenic acid (EPA, 20:5 ω 3) and docosahexaenoic acid (DHA, 22:6 ω 3) are the important ω 3 PUFA, while arachidonic acid (AA, 20:4 ω 6), is a vital ω 6 PUFA. EPA and DHA are important in treatment of atherosclerosis, cancer, rheumatoid arthritis, psoriasis and diseases of old age such as Alzheimer's and age-related macular degeneration ([3,4]). AA and DHA are of special importance in the brain and blood vessels, and are considered essential for pre- and post-natal brain and retinal development ([5]). The eicosanoids, such as prostaglandins, prostacyclins and leukotrienes, derived from ω 3 PUFA are also important in new-born and infant development, modulatory vascular resistance and wound healing ([4,6]).

The principal dietary source of DHA and EPA is marine fish ([7,8]). Fish oils are still the least expensive natural source of these PUFA, and several industries (e.g., Pronova Biocare, Sandefjord, Norway and Ocean Nutrition, Halifax, Canada) now specialize in their production and purification. Worldwide aquaculture production is growing at 8% p.a. especially in the Asia-Pacific region at 7.2% per annum; with trends toward