

Introduction

General

Duckweed is a perennial aquatic plant, growing free-floating on the water surface while utilizing nutrients from various sources in the water.

Duckweed can grow, depending on the species, in temperatures ranging from 5 to 33 °C. The duckweed family *Lemnaceae* and its genera, *Wolffiella*, *Spirodela*, *Lemna*, *Landoltia*, and *Wolffia*, can double every 48 h and can cover the surface of standing water bodies or in a slight water flow. Duckweed is rich in beneficial amino acids and protein, ranging from 25 and 45% compared with soybean, which has 36 % protein.

Duckweed's expected crop potential is 3.6 tons dry matter, per hectare per year compared with 2.2 tons per hectare per year for alfalfa.

Duckweed can be seen as a kind of tiny pump that efficiently draws from the water a variety of dissolved substances for its own needs, and in this way, it cleans the water.

Duckweed can purify water coming from fish growth systems, which is highly saturated with fish metabolic secretions that stress the fish at all stages, reduce their growth rate, and, at high concentrations, cause fish mortality.

Cleaning fish effluent, via growing duckweed on it, allows the same water to be reused for fish culture again and again. In this way, the farmer obtains double benefits, first, by reusing the same water, after cost-free purification, for growing fish, and second, by producing duckweed, a high-quality nutritious food, for the fish and other farmed animals at very low cost.

Duckweed has been used, although on relatively small scale, as feed for livestock, biofuel for ethanol production, and food for human nutrition, mostly in Asian countries.

The use of brine for growing duckweed and other succulent plants

Desalination of inland brackish ground water provides an important useful means of easing water shortages worldwide. However, the disposal of the brine, formed as a byproduct of the desalination process, is a major environmental issue. Our preliminary experiments indicate an economically viable and environmentally friendly solution for the brine disposal issue.

Duckweed can grow on the brine, constituting one link in a chain of users of the same brine. An additional link in the chain could be brine-tolerant fish, either edible or ornamental species. The fish are to be cultured in ponds positioned prior to the duckweed ponds. Through this setup, the duckweed obtain fish-excreted metabolites, using them as nutrients for their own growth, without the need for additional nutrients

Furthermore, the same duckweed can be used as an additional nutritious fish feed, either fresh or incorporated after drying into pelleted fish feed, for both omnivorous and herbivorous fish, such as carp and tilapia, which are the most cultured and consumed fish worldwide.

Additional links in the same user chain can include succulent plants, saline lovers, such as *Salicornia* (pickleweed glasswort), a popular plant used with seafood.

Finally, at the end of the user chain, the remaining brine, provided no more brine is added, would become, via continuous evaporation, highly saline and can then be used for growing planktonic "saline lovers," such as the small brine shrimp *Artemia salina*, which is used in fish and shrimp hatcheries worldwide as a basic feed in the early life stages of the cultured fish/shrimp.

The remaining crystalized salt, at the end of the user chain, can be used for different aquacultural purposes.