Effects of dietary peppermint on fry Caspian white fish

Traditional medicines usually involve the use of plant extracts. Among these plants, mint species have been exploited by man since more than two thousand years. *Mentha piperita* (also known as peppermint) is one of the world's oldest medicinal herbs and a native genus of the Mediterranean region. The ancient Egyptians, one of the most medically-advanced ancient cultures, cultivated and used peppermint leaves for indigestion while the ancient Romans and Greeks also took peppermint to soothe their stomachs. At present, peppermint is widely used besides of in traditional medicine in the food and beverage industry, perfumery and cosmetic and pharmacy. Among its professed benefits are many related to digestive complaints, it has a relaxing effect on the stomach, and can also be an appetite stimulant. Many of these peppermint's health and medicinal traditional uses have been recently verified by scientific trials. Interestingly, the wide range of demonstrated pharmacological properties (including antioxidant, antitumor, antiallergenic, antiviral, fungicide, insecticide and antibacterial activities) are present in the entire herb.

At present, aquaculturists need to develop technologies to induce fast growth fish larvae by feeding them on supplementary diets enriched with feed additives and growth promoters and multitude of them can be obtained from plant extracts. The widespread use of *M. piperita* in traditional medicines as well as its numerous beneficial effects on mammals has inspired us to explore its potential biological activities on fish. We studied the effects of dietary administration of peppermint on fry Caspian white fish (*Rutilus frisii kutum*). This fish species is native in Caspian Sea and commercially cultured in Iran, which was the main reason for using as a model for this work. Fish were divided into 4 groups before being fed diets supplemented with 0% (control), 1%, 2% and 3% of peppermint aqueous extracts for two months. Our results demonstrated many different positive effects of peppermint crude leaves extracts when administered on diet to fry Caspian white fish. Dose-dependent increases of growth parameters were recorded in fry fish fed supplemented diets. Furthermore, red and white blood cells, haemoglobin and haematocrit were also increased in a dose dependent manner in fry fish fed supplemented diets. These results can be considered as a very important for fish farmers, especially those related to increase of growth.

Our results also corroborated that the quantity of proteins present in mucus and its bactericidal activity (due to the participation of one enzyme able to kill bacteria, a protein called alkaline phosphatase) were increased on fish mucus fed peppermint diets. The mucosal surfaces of fishes (gill, skin, and gastrointestinal tract) form a thin physical barrier between the external environment and the internal milieu, and they are important sites of microbial exposure. Mucus in most fishes is continuously secreted and replaced, which prevents the stable colonization of potential infectious microorganisms and/or parasites. For these reasons, these results are also of great interest considering that mucus plays a key role in the survival of fish as a first barrier of defence. Furthermore in the blood serum of fish fed peppermint lysozyme (another protein able to lyse bacteria) and immunoglobulin M (main antibody molecule of fish) levels were also increased, respect to the values found on sera from fish fed commercial diet.

To conclude, this study corroborates that dietary administration of peppermint (especially at 3% of fed supplement) promotes growth performance, increases the main haematological parameters and improved the immune status of fry Caspian white fish. This study may provide new applications of peppermint and, at the same time, promote rational development and utilization of peppermint resources.

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