Journal of Fisheries & Livestock Production

Sampels, J Fisheries Livest Prod 2014, 2:2
DOI: 10.4172/2332-2608.1000119

Opinion Open Access

Towards a More Sustainable Production of Fish as an Important Protein Source for Human Nutrition

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Fish and seafood products, including aquatic plants are not only tasty constituents of meals and food products, but they also have a high nutritional valuable and contain beneficial amounts of protein, lipids as well as essential minerals and vitamins. Nowadays, aquaculture is the fastest growing sector in livestock production around the world. An annual increase of production during last 30 years is ± 8% [1]. In a recent review it has also been shown that fish and seafood have a major impact on global food supply [2]. Already today, the internationally traded amount of aquatic animal food products is higher than the total traded amount of beef, pork and poultry combined (26.85-27.45 compared to 20.38-21.99 million tons in 2009 respectively) [3,4]. In addition in several Asian and African countries the major animal protein source are aquatic animals [3,5].

Generally, aquatic animal foods have higher protein content than most terrestrial meats. In addition aquatic protein is highly digestible and rich in several essential amino acids that are limited in terrestrial meat proteins, as for example methionine (6.5% compared to 5.7% of total essential amino acids in fish compared to terrestrial meat respectively) and lysine (19.6% compared to 19.0% of total essential amino acids in fish compared to terrestrial meat respectively) [2]. Fish and seafood consumption has been connected to beneficial health effects, especially with the prevention of cancer, decreased risk of coronary heart and cardiovascular diseases, decreased inflammatory disease as arthritis. Historically the main effects of fish consumption have been attributed to the high content of long chain omega 3 (n-3) polyunsaturated fatty acids (PUFA). However it gets more and more clear that also other nutrients from fish have positive effects on human health. Beside the n-3 PUFA, fish and other seafood are a significant source of a well-balanced amino acid composition, taurine and choline, the Vitamins D and B12 as well as calcium, phosphorus, iodine and selenium. Depending on the general nutrition of a population, fish and seafood also might provide significant proportions of Vitamin A, iron and zinc. Another important aspect is that fish in general has a significantly lower feed conversion rate (FCR) than land living animals. For example beef cattle can have a FCR varying from 5-20 (National Research Council 2000) [6] while Masilko [7] reported for example a FCR for carp from 2.08-2.62 while a FCR from 1.6-1.8 was reported for tilapia [8] and salmonids usually have a FCR at around 1 [9]. This means more protein can be produced with a lower amount of feed with all included factors concerning feed production as energy and water use as well.

This combination makes fish an interesting object of research with a focus on an economical and easy as well as sustainable production in order to secure protein supply for human diet in the future. There has been some discussion however about the sustainability of aquaculture, where the main issues are the high use of fish meal and fish oil as well as the leakage of nutrients to the environment leading to an eutrophication of aquatic systems. There has been some research going on about substituting the more and more scarce and expensive fish-meal and fish oil from the fish feeds for carnivore fishes [10]. A second object towards a more sustainable production has been to produce feeds with a reduced FCR. For example it was shown that a simple pre-treatment of the used feed as for example pressing of cereals could reduce the FCR in carp as well as reduce the leakage of phosphorus to the pond water [7]. In combination with other techniques and systems as for example aquaponics, where vegetables or flowers are grown in the nutrient rich flow out water from aquaculture recirculation systems [11]. The plants act as a bio filter and clean the water from execs nitrogen and other nutrients and provide additional food in form of vegetables or herbs. These systems also decreases the load of phosphorus, nitrogen and other nutrients from the waste water and have hence a positive effect on the environment [12]. Aquaponic systems can function already on a small base and could be hence a good solution for small or family businesses in rural areas. Therefore research should also focus on establishing simple, easy to operate and sustainable aquaculture/aquaponic systems, which can function with a minimum of technical support, and which have a low proportion of waste water. There is no doubt that aquaculture has still a big potential to grow and to be a major contributor to feed the world of tomorrow.

Acknowledgments

This work was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic - projects "CENAKVA" (No. CZ.1.05/2.1.00/01.0024), "CENAKVA II" (No. LO1205 under the NPU I program) and GAJU 074/2013/Z.

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Received October 01, 2014; **Accepted** October 04, 2014; **Published** October 14, 2014

Citation: Sampels S (2014) Towards a More Sustainable Production of Fish as an Important Protein Source for Human Nutrition. J Fisheries Livest Prod 2: 119. doi: 10.4172/2332-2608.1000119

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