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# A ASSESSMENT OF THE USE OF FEED INGREDIENTS TO SUPPLEMENT DIETS IN AQUACULTURE

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## ABSTRACT

Fishermen have relied on fish meal as a primary source of protein in their fish feed for a variety of reasons including its nutritive value, outstanding important arginine (EAA) characteristics, better nutrient nutritive value, lack of generally pro factors (ANFs), low cost, and ease of availability until recently. However, the perfect ingredient of fish feed for feedstuffs is now under jeopardy, putting feed formulators at danger of having to rely even more on it. This example also prompts feed formulators to explore for other feedstuffs that can, without a doubt, substitute fish meal in their formulations. Functional ingredients sources are widely recognised as the most effective means of replacing fish meal; nonetheless, they exhibit characteristics that are diametrically opposed to those of fish feed due to the following qualities: Plant components contain ANFs, are lacking in some EAA, have low nutritional digestibility, have lower nutrient bio-availability, and have a low nutrient bio-availability.

***Keywords: fish meal, arginine, ANF, Plant***

## INTRODUCTION

Even when viewed in light of other sectors of animal food production, aquaculture shows great promise (FAO, 2016) [1. Currently, aquaculture is the source of one out of every three fish consumed by humans. One of the most critical factors for long-term success in aquaculture is the availability and affordability of affordable feed. Due to the high cost of aquaculture feed, the industry's rapid expansion will be significantly impacted if new feed options can be developed that are more economical. Farmers using fish feed that is created at a lower cost will have a direct impact on their bottom line.

## EFFECT OF PLANT PROTEINS ON FEEDING, NUTRIENT UTILIZATION AND GROWTH PERFORMANCES IN FISH

In a prior study, it was shown that marine mammals fed diets low in fish meal had lower feed intake and lower growth rates. Numerous aquatic animals, such as rainbow trout, have proven that higher intakes of dietary plant proteins reduce their appetites and development  Several varieties of European sea bass are available for purchase  is a shrimp species  Steak a la plancha, turbot  (Salmon) from the Atlantic Ocean Gilded sea urchins (n.p.)

When particular dietary components, such as crystalline amino acids, are added to plant diets, it has been demonstrated that fish meal may be substituted with plant-based ingredients in fish diets. Specifically, this research is looking at the use of crystalline amino acids in plant diets as a replacement for the usage of fish meal in fish diets. This product includes 5% (fish meal), 5% (fish soluble), and 3% (squid hydrolysate) of fish meal, 5% (fish soluble), and 3% (squid hydrolysate), respectively. There are just a few amino acids included in this class, including histidine, histidine diphosphate, and threonine. Multi-EAA

Along with partial substitution of fish meal, the authors mentioned below claimed that fish could be fed exclusively on plant proteins without any detrimental effects on growth or intake, and that this could be done without any unfavourable effects on growth or intake. [21] Nile tilapia (Oreochromis niloticus) and tilapia galilae (Sarotherodon galilaeus) fed soybean and extruded full-fat soybean meal were shown to be totally successful in substituting dietary fish meal when provided DL-methionine and L-lysine. El-Saidy and colleagues [93] discovered that a plant protein mixture of 25 percent soybean meal, 25 percent cottonseed meal, 25 percent sunflower meal, and a 25 percent linseed meal with 0.5 percent methionine and lysine may be utilised to substitute fish meal in Nile tilapia diet.

After supplementing pea protein concentrate with crystalline amino acids such as lysine, methionine, and threonine, which mimic fish meal, it was shown that rainbow trout's protein synthesis was significantly enhanced. When the rate of nitrogen retention in fish is higher and the rate of ammonia excretion is lower, the amount of protein retained in fish increases. It was discovered that feeding tilapia palm kernel meal decreased ammonia excretion rates. Gilthead seabream fed an amino acid-balanced diet consisting of maize gluten meal, wheat gluten, extruded peas, and rapeseed meal deposited more protein than the control group.

## EFFECT OF PLANT PROTEINS ON NUTRIENT DIGESTIBILITY AND UTILISATION IN FISH

Ingesting plant proteins into aquatic organisms, such as fish, may have an effect on the fish's nutritional digestibility. Because plant proteins include ANFs, which inhibit nutrient absorption or change the flora of the colon when eaten, this can be explained. According to the utilisation of amino acids in plant components is lower than in fish meal. Plant proteins were shown to have a positive effect on the growth and development of black tiger shrimp contrary to popular belief, feeding fish plant-based protein had no negative effect on their capacity to absorb nutrients.

## EFFECT OF PLANT PROTEINS ON BIO-AVAILABILITY AND UTILIZATION OF MICRONUTRIENTS IN FISH

Some vitamins, such niacin and pantothenic acid (as well as vitamin B12), are lost in fish fed plant protein. Vitamin B is absolutely essential for animals. Many B vitamins need be supplemented in vegan diets, according to Hansen and coworkers [139] since their availability in plant proteins is restricted. Because plant proteins have a limited bioavailability of phosphorus, they were shown to lower phosphorus levels in yellow catfish. The presence of ANF peptides in plant proteins, according to Welker and colleagues (2016) [43], makes zinc and other micronutrients unavailable to fish. According to the study, certain micronutrient bioavailability was unaffected by the addition of plant protein. If this is the case, the provided phytate may become insensitive to phytase due to the creation of a calcium-phytate insoluble combination found that feeding Nile tilapia microbial phytases increased their absorption of phosphorus in low-phosphorus plant diets. Animal performance is boosted by organic acids that enhance P absorption in the small intestine. Organic acids, as stated], increase P solubility and absorption in the small intestine because they lower pH, enhancing P's ability to interact with various cations and operate as a chelating agent conducted a research that suggested chelated and inorganic trace elements.

## EFFECT OF PLANT PROTEINS ON BIOCHEMICAL COMPOSITIONS IN FISH

According to Zhou and Yue (2010), the biochemical composition of aquatic animals varies based on their diet and nutritional content. The biochemical composition of fish was found to be affected by plant protein consumption in previous studies. Ammonium-nitrogen excretion was increased in trout fed an overabundance of plant protein in their diet, indicating an imbalance in the amino acid composition of plant proteins. [11] The liver size, plasma triacylglycerol concentration (TAG), and lipid productive value (LPV) of Atlantic cod were all reduced when the fish's diet included too much plant protein (Espe et al., 2010; Hansen et al., 2011) [158, 10]. When fed diets high in plant components, Atlantic salmon expanded in size, according to Tocher and colleagues (2003) [159].It is possible to find some documents on this topic online.

Hansen et al. (2011) [10] Atlantic cod fat buildup is reduced by lysine supplementation from plant sources, according to the research. Rainbow trout's intraperitoneal fat content decreased when methionine was added to their diet, as discovered by Gaylord et al. (2007) [167]. Diets strong in plant components with processed chicken or pork waste exhibited reduced liver triacylglycerol levels in Atlantic salmon, according to Liland et al. (2015) [168]. (TAG). In animal development, metabolism, and health, docosahexaenoic acid (DHA) is an important fatty acid. [169] The composition of DHA in sea cucumbers altered when fish meal was replaced with plant proteins, as demonstrated by Yu et al. (2015) [42]. Shrimp need cholesterol in their diet.

## EFFECT OF PLANT PROTEINS ON FLESH QUALITY IN FISH

Only a few studies have looked at fish's organoleptic qualities in relation to plant proteins as potential feed components in a range of fish diets. The quality of fish meat has been reported to be reduced by the inclusion of plant proteins in the diet (Alami-Durante et al., 2010; Valente et al., 2016). It was discovered by De Francesco et al. (2004) [6] that long-term feeding of rainbow trout with plant proteins alters the fillets and certain organoleptic properties of the flesh. Fish flesh quality has been shown to be negatively affected by plant proteins in certain studies, although others have found no evidence to support this.

## EFFECT OF PLANT PROTEINS ON IMMUNE AND STRESS PARAMETERS IN FISH

The organoleptic properties of fish in relation to plant proteins as possible feed components in various fish diets have only been examined in a few studies. Adding plant protein to the diet has been linked to a decrease in fish flesh quality (Alami-Durante et al., 2010; Valente et al., 2016). Researchers found that long-term feeding of rainbow trout with plant proteins had an effect on the fillets and some organoleptic qualities of the meat. Plant proteins have been demonstrated to have a detrimental impact on the quality of fish flesh in certain investigations, however this has not been shown in others. To increase immune responses and disease resistance in Pacific white shrimp, nucleotides added to diets with less fish meal were tested using pathogenic bacteria (Vibrio parahaemolyticus). Haematological indicators can be used to diagnose fish illness. Hematological parameters were unaffected by feeding pacu corn gluten meal, according to Hisano et al. (2016) [178]. Fishery products such faba beans and fish meal exhibited no negative effect on belugas' survival, haematological, or serum biochemical indicators when replaced with fish meal at 10%. Haemato-immunological indicators were unaffected by supplementing fish diet with plant proteins, according to Kpundeh et al. (2015) [17]. Poly unsaturated fatty acids (PUFAs) are abundant in microalgae.

## RECOMMENDATIONS FOR FURTHER STUDIES

In the future, fish diets are likely to include more plant proteins, either as a supplement or as the only source of protein. This calls for more research in the relevant fields in the future: ANFs must be removed from diets containing considerable quantities of plant components using specialised processing methods. Many processing methods claim to get rid of the ANFs in plant feedstuffs, however results vary by component. As a result, all plant materials should be processed in the same way. Concerns about fish's greater consumption of plant proteins should also be examined in future studies, and appropriate solutions should be created to offset these effects. Fish consumption may raise fish, if that's what you believe.

## CONCLUSION

Fish's dietary plant-based components have been thoroughly examined in this review, using data from the scientific community. Fish meal should be replaced with plant-based protein components in the diets of commercially cultivated aquatic animals, according to a number of researchers in the area of fish feed. We may expect fish meal to be taken out of fish diets in the future, taking this into consideration. While increasing plant components is a major challenge, several authors suggest that fish may be given an excess of plant protein without incurring any adverse effects by utilising appropriate dietary techniques. Some vegetables might also be added to a fish dinner to make it more filling.

## REFERENCES

[1] FAO. The state of world fisheries and aquaculture. Report of the fisheries and aquaculture department, RomeItaly, 2016.

[2] Hardy RW. Utilization of plant proteins in fish diets: effects of global demand and supplies of fishmeal. Aquaculture Research. 2010; 41(5):770-776.

[3] Edwards P, Tuan Land Allan GL. A survey of marine trash fish and fish meal as aquaculture feed ingredients in Vietnam. Canberra, Australia, ACIAR© Australian Centre for International Agricultural Research, 2004, 1- 56.

[4] De Silva SS, Hasan MR. Feeds and fertilizers: the key to long-term sustainability of Asian aquaculture. FAO Fisheries Technical Paper. 2007; 497:19-47.

[5] Hung LT, Truc LTT, Huy HPV. Case study on the use of farm-made feeds and commercially formulated pellets for pangasiid catfish culture in the Mekong Delta, Viet Nam. FAO Fisheries Technical Paper. 2007; 497:363.

[6] De Francesco M, Parisi G, Médale F, Lupi P, Kaushik SJ and Poli BM. Effect of long-term feeding with a plant protein mixture based diet on growth and body/fillet quality traits of large rainbow trout (Oncorhynchus mykiss) Aquaculture. 2004; 236(1):413-429.

[7] Engin K and Carter CG. Fish meal replacement by plant and animal by-products in diets for the Australian short-finned eel, Anguilla australis australis (Richardson). Aquaculture Research. 2005; 36(5):445- 454.

[8] Bonaldo, Alessio, Luca Parma, Luciana Mandrioli, Rubina Sirri, Ramon Fontanillas et al. Increasing dietary plant proteins affects growth performance and ammonia excretion but not digestibility and gut histology in turbot (Psetta maxima) juveniles. Aquaculture. 2011; 318(1):101-108.

[9] Espe M, Lemme A, Petri A and El-Mowafi A. Assessment of lysine requirement for maximal protein accretion in Atlantic salmon using plant protein diets. Aquaculture. 2007; 263(1):168-178.

[10] Hansen AC, Hemre G, Karlsen Ø, Koppe W, Rosenlund

[11] G. Do plant-based diets for Atlantic cod (Gadus morhua L.) need additions of crystalline lysine or methionine? Aquaculture Nutrition. 2011; 17(2):362-371.

[12] Lund I, Dalsgaard J, Rasmussen HT, Holm J, Jokumsen

[13] Replacement of fish meal with a matrix of organic plant proteins in organic trout (Oncorhynchus mykiss) feed, and the effects on nutrient utilization and fish performance. Aquaculture. 2011; 321(3):259-266.

[14] Yun B, Ai Q, Mai K, Xu W, Qi G, Luo Y. Synergistic effects of dietary cholesterol and taurine on

growth performance and cholesterol metabolism in juvenile turbot (Scophthalmus maximus L.) fed high plant protein diets. Aquaculture. 2012; 324:85-91.

[15] Valente LM, Cabral EM, Sousa V, Cunha LM, Fernandes JM. Plant protein blends in diets for Senegalese sole affect skeletal muscle growth, flesh texture and the expression of related genes. Aquaculture. 2016; 453:77- 85.

[16] Daniel N. Status of aquaculture with respect to nutrition and feed. International Journal of Fisheries and Aquatic Studies. 2017; 5(1):333-345.

[17] Merrifield DL, Bradley G, Baker RTM, Davies SJ. Probiotic applications for rainbow trout (Oncorhynchus mykiss Walbaum) II. Effects on growth performance,

[18] feed utilization, intestinal microbiota and related health criteria post antibiotic treatment. Aquaculture Nutrition. 2010; 16(5):496-503.

[19] Sheikhzadeh N, Tayefi-Nasrabadi H, Oushani AK, Enferadi MHN. Effects of Haematococcus pluvialis supplementation on antioxidant system and metabolism in rainbow trout (Oncorhynchus mykiss). Fish Physiology and Biochemistry. 2012; 38(2):413-419.

[20] Kpundeh MD, Qiang J, He J, Yang H, Xu P. Effects of dietary protein levels on growth performance and haemato-immunological parameters of juvenile genetically improved farmed tilapia (GIFT), Oreochromis niloticus. Aquaculture International. 2015; 23(5):1189-1201.

[21] Guo J, Guo B, Zhang H, Xu W, Zhang W, Mai K. Effects of nucleotides on growth performance, immune response, disease resistance and intestinal morphology in shrimp Litopenaeus vannamei fed with a Low Fish Meal Diet. Aquaculture International. 2016; 24(4):1007-1023.

[22] Li M, Lai H, Li Q, Gong S, Wang R. Effects of dietary taurine on growth, immunity and hyperammonemia in juvenile yellow catfish Pelteobagrus fulvidraco fed all- plant protein diets. Aquaculture. 2016; 450:349-355.

[23] Gatlin DM, Barrows FT, Brown P, Dabrowski K, Gaylord TG, Hardy RW et al. Expanding the utilization of sustainable plant products in aquafeeds: A review. Aquaculture Research. 2007; 38(6):551-579.

[24] Goda AM, El-Haroun ER, Chowdhury K. Effect of totally or partially replacing fish meal by alternative protein sources on growth of African catfish Clarias gariepinus (Burchell, 1822) reared in concrete tanks. Aquaculture Research. 2007; 38(3):279-287.

[25] Liti DM, Waidbacher H, Straif M, Mbaluka RK, Munguti JM, Kyenze MM. Effects of partial and complete replacement of freshwater shrimp meal (Caridinea niloticus Roux) with a mixture of plant protein sources on growth performance of Nile tilapia (Oreochromis niloticus L.) in fertilized ponds. Aquaculture Research. 2006; 37(5):477-483.

[26] Jiang TT, Feng L, Liu Y, Jiang WD, Jiang J, Li SH et al. Effects of exogenous xylanase supplementation in plant protein-enriched diets on growth performance, intestinal enzyme activities and microflora of juvenile Jian carp (Cyprinus carpio var. Jian). Aquaculture Nutrition. 2014; 20(6):632-645.

[27] Nandeesha MC, Gangadhra B, Manissery JK. Further studies on the use of mixed feeding schedules with plant and animal based diets for common carp Cyprinus carpio. Aquaculture Research. 2002; 33:1157-1162.

[28] Overland M, Granli T, Kjos NP, Fjetland O, Steien SH, Stokstad M. Effect of dietary formates on growth performance, carcass traits, sensory quality, intestinal microflora, and stomach alterations in growing-finishing pigs. Animal Science. 2000; 78(7):1875-1884.

[29] Aksnes A, Hope B, Albrektsen S. Size-fractionated fish hydrolysate as feed ingredient for rainbow trout (Oncorhynchus mykiss) fed high plant protein diets. II: Flesh quality, absorption, retention and fillet levels of taurine and anserine. Aquaculture. 2006a; 261(1):318- 326.

[30] Sarker MSA, Satoh S, Kiron V. Inclusion of citric acid and/or amino acid-chelated trace elements in alternate plant protein source diets affects growth and excretion of nitrogen and phosphorus in red sea bream Pagrusmajor. Aquaculture. 2007; 262(2):436-443.

[31] Johnson RB, Kim SK, Watson AM, Barrows FT, Kroeger EL, Nicklason PM et al. Effects of dietary taurine supplementation on growth, feed efficiency, and nutrient composition of juvenile sablefish (Anoplopoma fimbria) fed plant based feeds. Aquaculture. 2015; 445:79-85.

[32] Lee KJ, Rahimnejad S, Powell MS, Barrows FT, Smiley S, Bechtel et al. Salmon testes meal as a functional feed additive in fish meal and plant protein-based diets for rainbow trout (Oncorhynchus mykiss Walbaum) and Nile tilapia (Oreochromis niloticus L.) fry. Aquaculture Research. 2015; 46(7):1590-1596.

[33] Gomes EF, Rema P, Kaushik SJ. Replacement of fish meal by plant proteins in the diet of rainbow trout (Oncorhynchus mykiss): digestibility and growth performance. Aquaculture. 1995; 130(2):177-186.

[34] Adelizi PD, Rosati RR, Warner K, Wu YV, Muench TR, White MR et al. Evaluation of fish-meal free diets for rainbow trout, Oncorhynchus mykiss. Aquaculture Nutrition. 1998; 4(4):255-62.

[35] Snyder GS, Gaylord TG, Barrows FT, Overturf K, Cain KD, Hill RA et al. Effects of carnosine supplementation to an all-plant protein diet for rainbow trout (Oncorhynchus mykiss). Aquaculture. 2012; 338:72-81.

[36] Dias J, Gomes EF, Kaushik SJ. Improvement of feed intake through supplementation with an attractant mix in European seabass fed plant-protein rich diets. Aquatic Living Resources. 1997; 10(6):385-389.

[37] Sudaryono A, Tsvetnenko E, Evans LH. Evaluation of potential of lupin meal as an alternative to fish meal in juvenile Penaeus monodon diets. Aquaculture Nutrition. 1999; 5(4):277-285.

[38] Fournier V, Huelvan C, Desbruyeres E. Incorporation of a mixture of plant feedstuffs as substitute for fish meal in diets of juvenile turbot (Psetta maxima). Aquaculture. 2004; 236(1):451-465.

[39] Berge GE, Sveier H, Lied E. Nutrition of Atlantic salmon (Salmo saalr); the requirement and metabolic effect of lysine. Comparative Biochemistry and Physiology - Part A: Molecular and Integrative Physiology. 1998; 120(3):477-485.

[40] Sveier H, Nordas H, Berge GE, Lied E. Dietary inclusion of crystalline D-and L-methionine: effects on growth, feed and protein utilisation, and digestibility in small and large Atlantic salmon (Salmon salar L.). Aquaculture Nutrition. 2001; 7(3):169-82.

[41] Gómez-Requeni P, Mingarro M, Calduch-Giner JA, Médale F, Martin SA, Houlihan DF et al. Protein growth performance, amino acid utilisation and somatotropic axis responsiveness to fish meal replacement by plant protein sources in gilthead sea bream (Sparus aurata). Aquaculture. 2004; 232(1):493-510.

[42] Richard L, Surget A, Rigolet V, Kaushik SJ, Geurden I. Availability of essential amino acids, nutrient utilisation and growth in juvenile black tiger shrimp, Penaeus monodon, following fishmeal replacement by plant protein. Aquaculture. 2011; 322:109-16.

[43] Bautista-Teruel MN, Fermin AC, Koshio SS. Diet development and evaluation for juvenile abalone, Haliotis asinina: animal and plant protein sources. Aquaculture. 2003; 219(1):645-653.