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Short Communication

Taurine or Sodium Diformate Supplementation to a Low Fishmeal Plant-Based Diet Enhanced Immunity and Muscle Cellularity of European Sea-Bass *(Dicentrarchus labrax)*

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Abstract: A feeding trial was carried out to investigate the effects of either Taurine (T) or Sodium Diformate (NDF) supplementation to a low Fish Meal (FM) plant-based diet on growth, health status, immunity and muscle cellularity of European seabass, *Dicentrarchus labrax*. Four diets contained either 46% FM as the control (CTRL), or 20% FM and a mixture of plant proteins (PMX), complemented or not with 1% T (PMX+T) or 0.3% NDF (PMX+NDF) were fed to juvenile seabass (~14.0 g) for 13 weeks. Major findings suggest that the low-FM/plant-mix diet enriched with either T or NDF can promote growth, normalize physiological conditions and improve the striated muscle structure of fish.

Keywords: Taurine; Sodium diformate; Muscle ultrastructure

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Description

European seabass (D.labrax) is a strictly carnivorous fish and its aquaculture is wellestablished and widely practiced in the Mediterranean region. Recently, Fish Meal (FM) inclusion levels in commercial aquaculture feeds have decreased substantially, and sustainable, eco-friendly and less expensive plant proteins are increasingly used as substitutes. However, FM replacement is not only about compensating and balancing all thecritical nutrients taken out, but also managing the negative impact of the alternative plants used, particularly for carnivorous fish. FM is rich in Taurine (T), a sulphur-containing free amino acid, which plant proteins lack. T has been researched as a functional feed additive for its positive effects on growth, immunity and general and gut intestinal health of fish including seabass [1,2]. Similarly, NDF is another widely applied feed supplement for aquafeeds and for seabass [3]. NDF possesses antibacterial activity against fish bacterial pathogens and supplementation can enhance growth performance, immune status and disease resistance in many fish species including seabass [3,4]. However, there is a limited knowledge about the effects of either dietary T or NDF enrichment on seabass muscle cellularity.

Prior studies have shown that the optimal inclusion level of dietary T, in FM-based diets, for juvenile seabass was 1% [5], whereas that of NDF was 0.3% [3] to promote growth and improve overall health status. Based on these findings, the effects of T or NDF addition to a plant protein-based diet on seabass grow performance, feed utilization, basal health status, immunity biomarkers and ultrastructure of muscle myofibrils were researched in the present feeding trial.

Results have emphasized that the addition of 1% T to the PMX diet for seabass (ca 14 g) has a potential to reduce the

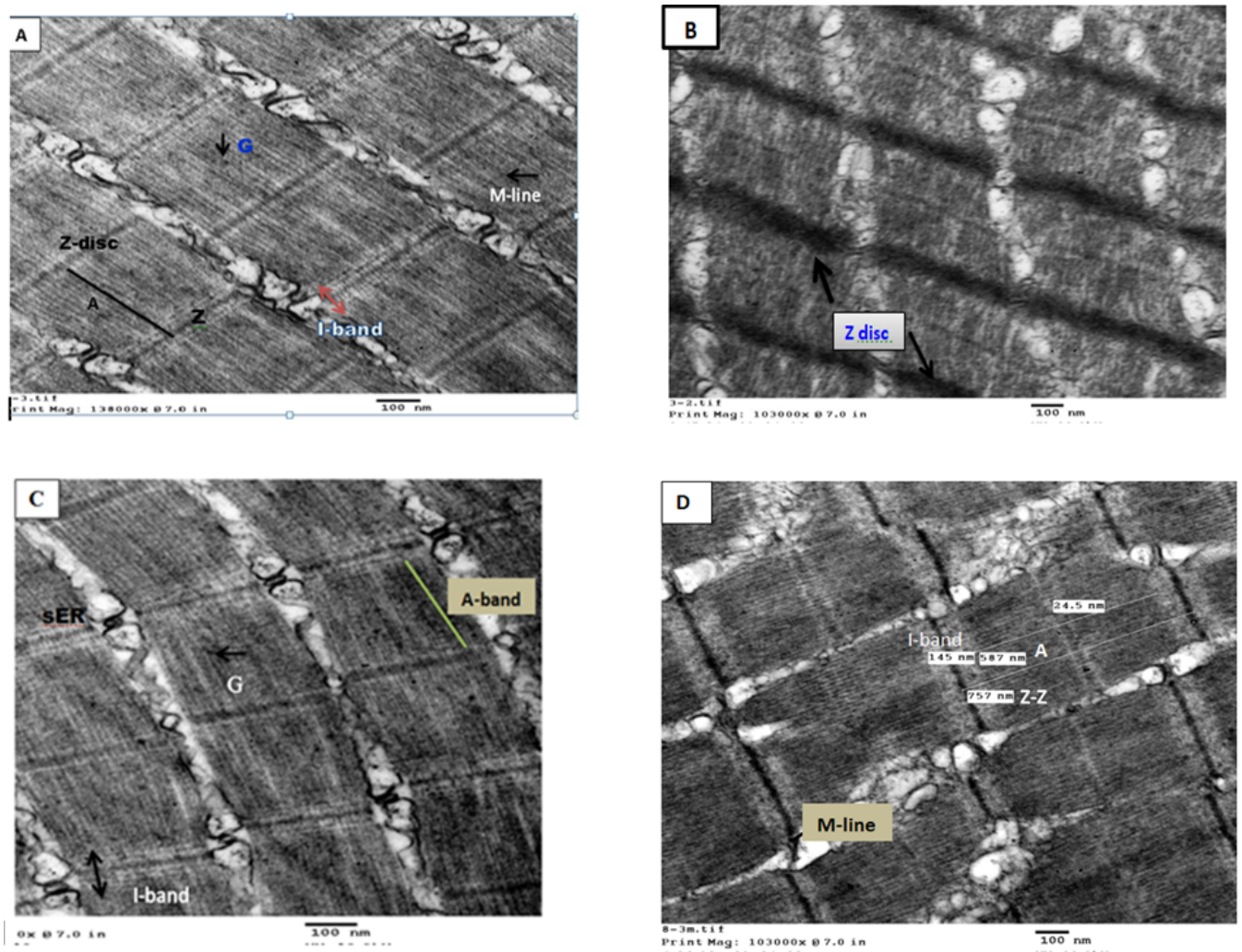

Figure 1: Transmission Electron Micrographs (TEM) depicting longitudinal sections of striated muscles of seabass fed: CTRL diet (A), PMX diet (B), T-added diet (C), and NDF-added diet (D), illustrating the ultrastructural organization of myofibrils. Sarcomeres (Z-Z); actin myofilaments or Anisotrope-band (A-band); isotropic myofilaments (I-band); Z-disc; M-line; glycogen granules (G); sarcoplasmic reticulum (sER); [Specimen fixed in 4F1G, post fixed in OsO4 stained with uranyl acetate and lead citrate].

FM ingredient down to 20% without compromising overall fish performance or quality. These findings suggest that T is an essential nutrient for this size of fish, [6] showed that T-enriched diets significantly increased amino acids uptake, accelerated collagen production and improved muscle quality of fish [7] illustrated that 0.2% dietary T had some mitigating effects on the inflammatory processes of the distal intestine of seabass developed after being fed a diet that contained 30% soy-protein. In the meantime, NDF can be easily absorbed and utilized as a source of energy by fish, and has the potential to enhance the digestion and absorption of ingested nutrients [4]. The most important modes of action of acidifiers such as NDF are the antimicrobial effect and the activation of digestive enzymes [4], therefore improve health status and immunity competence of seabass [3]. Interestingly, in the present study, T or NDF complementation to the PMX dietre-established the values of major blood constituents as comparable to those of the FM diet (CTRL). This suggests that T and/or NDF have immune-regulatory properties in juvenile seabass when provided at the appropriate nutritional levels.

Furthermore, the Electron Microscopy (ETM) photomicrographs of seabass dorsal muscles (Figures 1a-1d) illustrated an obvious myosin band (I-band) in the myocytes, and I-band, A-band and other muscle zones were clearly distinguishable in CTRL fish (Figure 1a). Similarly, the typical striations of muscle fibers of T-fed or NDF-fed fish (Figures 1b and 1c), were comparable to that of CTRL fish. Notably, the inclusion of high levels of plant proteins in seabass diet (~58%) significantly altered the skeletal muscle cellularity, and negatively affected the myofibril protein organization of the A and I-bands, which became poorly defined (Figure 1d). Accordingly, both supplements affect myocytes cell multiplication, therefore, improved muscle structure, growth, quality and firmness as compared to the non-supplemented PMX-fed fish. This particular result is important for processing facilities, storage and shelf life of the seabass.

Conclusion

Complementation of 1% T or 0.3% NDF to a low-FM/ high-PMX diet has a great potentialas a growth promoter, health booster, immunity modulator and muscle cellularity enhancerin Juvenile seabass.

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