



Fish oil and alternative oil sources-based diets supplemented with bile salts: effects on growth, bile acid content and histology in Rainbow trout (*Oncorhynchus mykiss*)

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Introduction

Alternative oil sources to supplement fish feeds are required as fish oil is a finite resource (1,2). Here, we compare fish performance when they are fed vegetable and fat powder as alternative sources of oil in a bile acid supplemented diet, and aim to elucidate its effect on fish growth, bile acid content and liver and intestine histology.

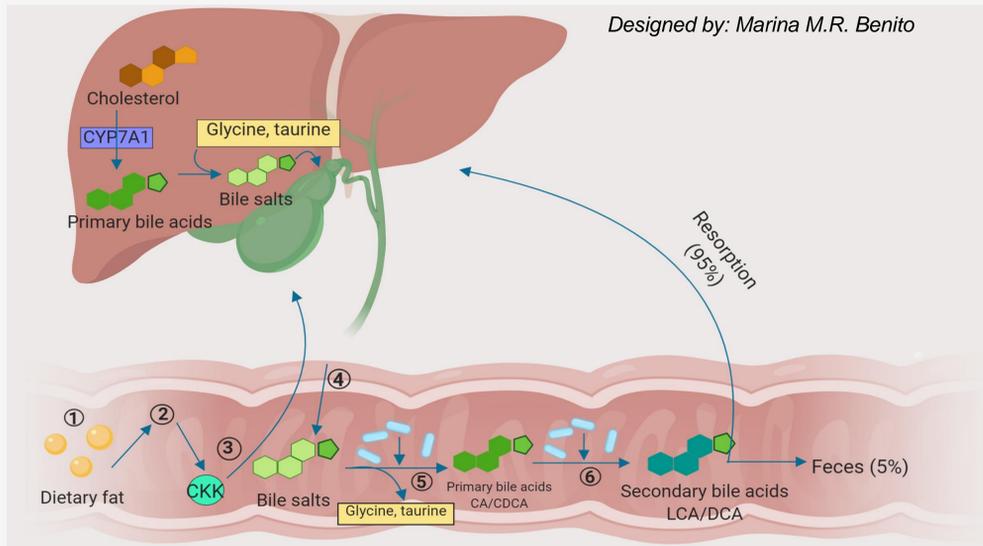


Fig. 1. Overview of hepatic synthesis and intestinal resorption of bile acids.

Overall goal was to utilize alternative lipid sources via dietary supplementation of bile salts. Specific objectives are to evaluate the effects of dietary bile salts on:

- ✧ Growth performance and feed efficiency in rainbow trout
- ✧ Bile acid content in digesta and histology of liver and intestine

Materials and Methods

- ✧ Experimental design: 3 X 3 factorial design
- ✧ Total 9 diets (3 tanks /diet, 20 fish/tank, initial fish wt. 24g) were fed for 9 weeks at satiation level
- ✧ Experiment was done in flow through system (13°C)

Determination of bile acid content in digesta: digesta was collected from proximal and distal intestine 24 hours after the last feeding.

Histology analysis of liver and intestine: tissues were dehydrated using a graded series of alcohol baths and cross sections were cut at 5 µm. H/E staining was used.

Statistical analysis: each mean values for all data were tested for normality and homogeneity of variance prior to one-way Analysis of Variance (ANOVA).

Table 1. Feed formulation expressed as (%) for rainbow trout.

	Fish Oil (FO)			Plant Oil (PO)			Fat Powder (FP)		
	Control	Low	High	Control	Low	High	Control	Low	High
Bile acid	0	1	3	0	1	3	0	1	3
Fish oil	14.5	14.5	14.5	2.3	2.3	2.3	2.3	2.3	2.3
Plant oil	-	-	-	12	12	12	-	-	-
Fat powder	-	-	-	-	-	-	12	12	12

Results

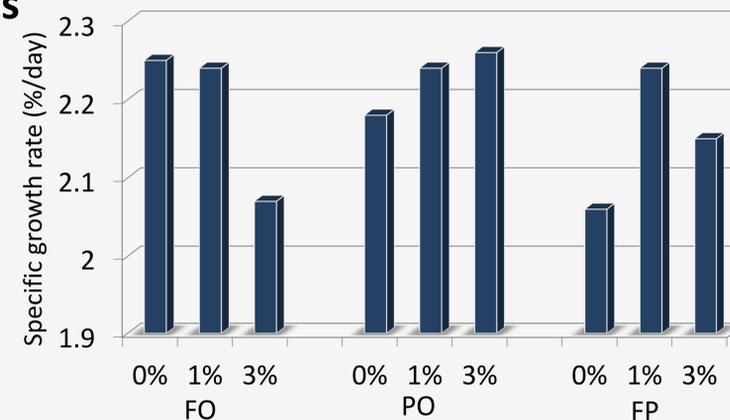


Fig. 2. Specific growth rate of trout fed experimental diets (p=0.22).

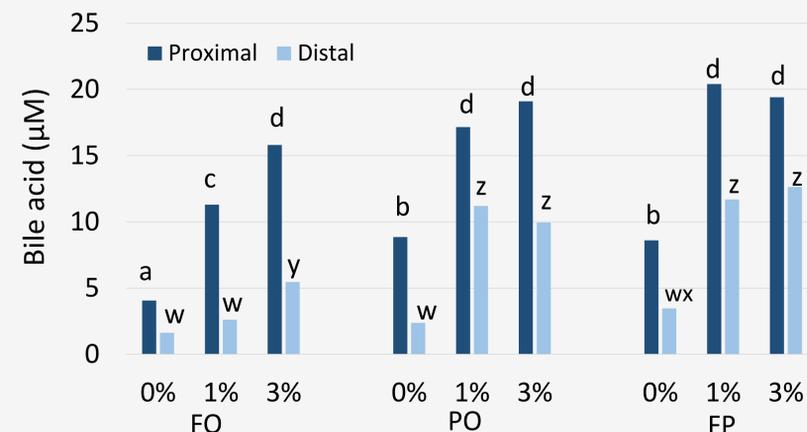


Fig. 3. Bile acid concentration in proximal and distal intestine of trout.

Conclusion

- No significant differences in growth and feed efficiency
- Supplemented diets increased the bile acid in intestine that could increase the digestibility of alternative oils such as plant oil and fat powder
- Histology data reveals no major organ damage

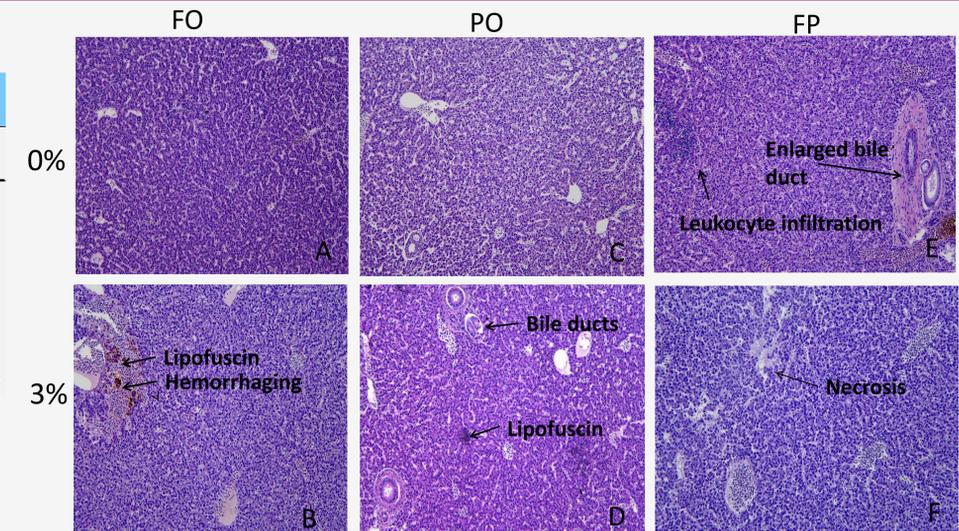


Fig.4a. Liver histology: A) liver looks healthy; B) liver showed hemorrhaging due to increased bile acid concentration which becomes toxic; C) healthy liver; D) liver showed increased number of bile ducts at 3%; E) Leukocyte infiltration and enlarged bile ducts are indicative of certain inflammation occurring; F) Liver starts showing some necrotic cells possibly due to toxins. (Magnification: 40X).

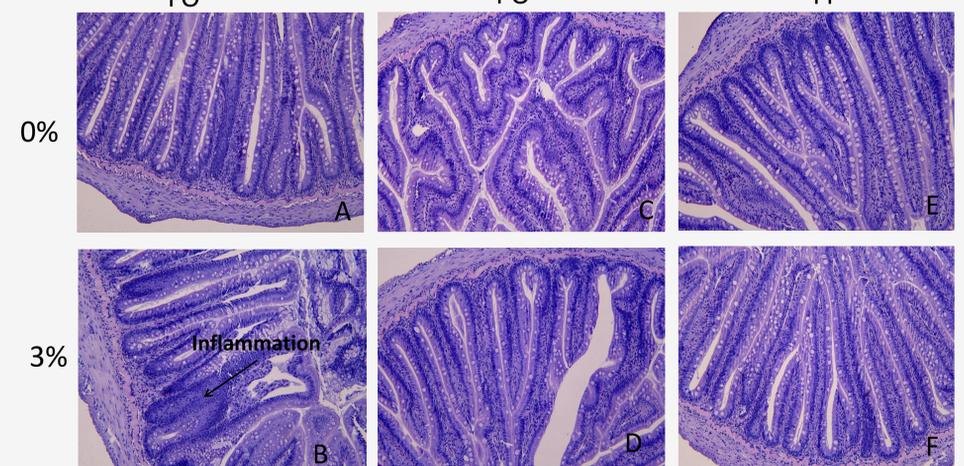


Fig.4b. Distal intestine histology: A) intestine appears healthy and normal; B) Some inflammation detected probably due to overly increased bile acid concentration; C-D) Distal intestine looked healthy in all plant oil diets; E-F) Distal intestine looked healthy in all fat powder diets. (Magnification: 40X).

References

- Chiang, J. Y. L. (2009) 'Bile acids: regulation of synthesis', *Journal of Lipid Research*, 50(10), pp. 1955–1966.
- Murashita, K. et al. (2018) 'Effects of dietary soybean meal on the bile physiology in rainbow trout, *Oncorhynchus mykiss*', *Aquaculture*. Elsevier, 490(February), pp. 303–310.

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