SUPPLEMENTING A LOW-FISH MEAL DIET WITH FISH MEAL SOLUBLE FRACTION IMPROVES GROWTH PERFORMANCE AND DIGESTION IN YELLOWTAIL *Seriola quinqueradiata*

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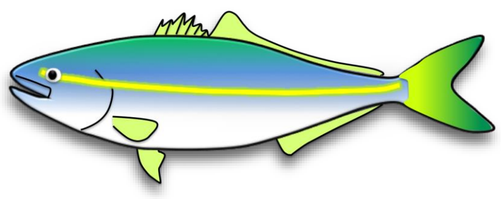
科研費 KAKENHI

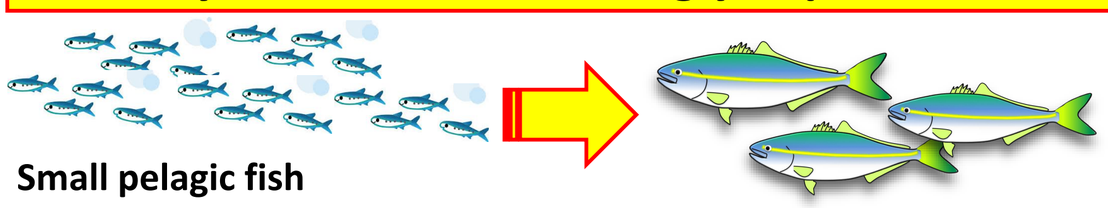
Introduction



Yellowtail (Japanese amberjack)
Seriola quinqueradiata

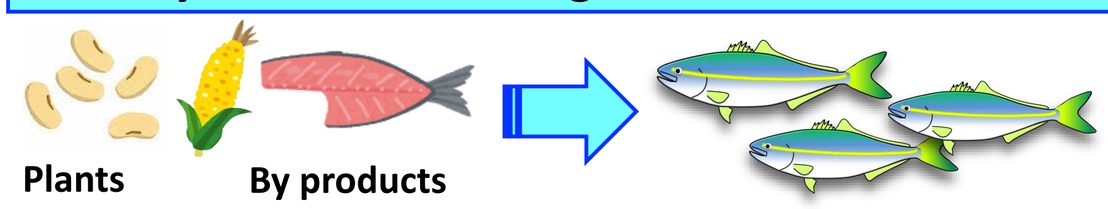
- A marine carnivorous fish
- The most popular aquaculture fish in Japan
- *Seriola* sp. are becoming important targets for aquaculture all over the world.
- Fish meal (FM) is a major dietary source (30-50% in diet) for yellowtail.

Current yellowtail feed: Strongly dependent on FM



Small pelagic fish

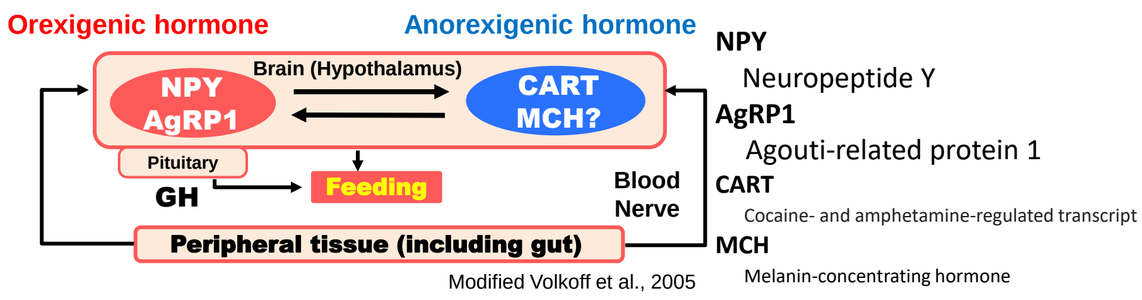
Future yellowtail feed: Significant reduction of FM



Plants By products

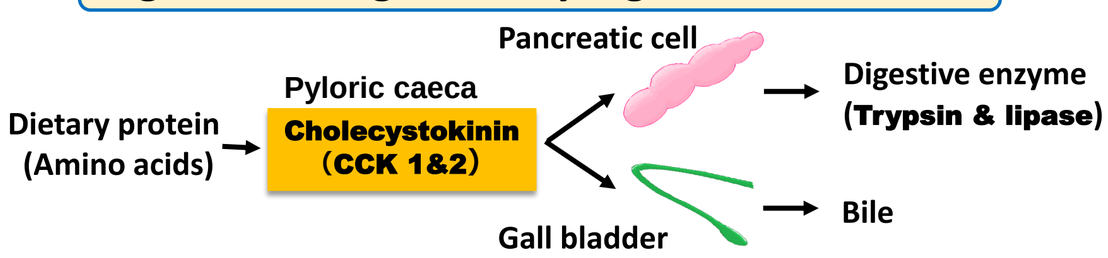
Need to reduce dependence on FM
⇒ But there are many problems (e.g., reduced feed intake).

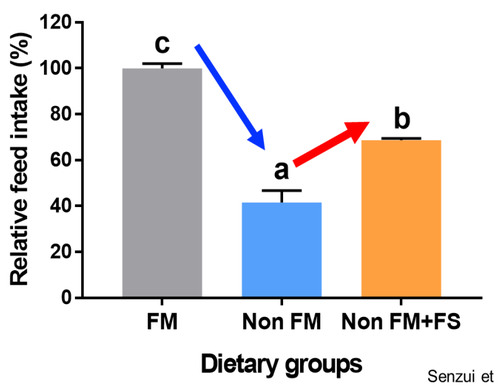
Appetite is regulated by appetite-related hormones.



Modified Volkoff et al., 2005

Digestion is regulated by digestive hormones.





Senzui et al., 2020

Our previous study (Senzui et al., 2020)
Supplementation of feeding stimulant (FS) improved feed intake in yellowtail!

How about FM soluble fraction (FMS)?

Purpose of this study

Growth performance in feeding trials and the gene expression of appetite-related hormones, digestive hormones, and digestive enzymes with **supplementation** of **FS** and **FMS** to **low-FM diet** were evaluated.

Materials & Methods

Preparation

■Feeding stimulant (FS) for yellowtail

Alanine	1.1 g
Proline	1.8 g
IMP	2.1 g

⇒ **Included in 1 kg of diet**

*IMP= Inosine 5'-monophosphate disodium salt

■FM soluble fraction (FMS)

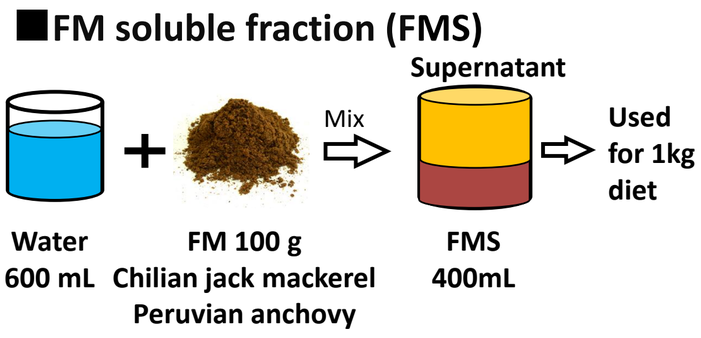


Table 1. Composition of experimental diets

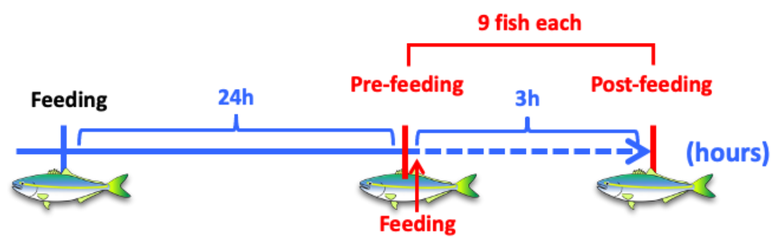
	FM	SPC	S+JM	S+A
Anchovy meal	650	150	150	150
Soy protein concentrate	0	560	560	560
Algae meal	0	20	20	20
Krill meal	50	50	50	50
Pollock oil	50	80	80	80
Taurine	0	40	40	40
Methionine	0	10	10	10
Others	250	90	90	90
Total	1000	1000	1000	1000
Solution for making diet (400mL)	water	water	FMS (Chilian jack mackerel)	FMS (Peruvian anchovy)
Crude protein (%)	55.0	57.1	57.7	57.0
Crude lipid (%)	10.4	11.7	11.6	11.4
Free Ala (mg/kg)	670.4	209.0	228.1	239.7
Free Pro (mg/kg)	227.8	126.9	129.0	146.6
IMP (mg/100 g)	37	53	56	58

Experimental condition

- Yellowtail (initial average weight=40.0 g)
- Rearing condition
  15 fish/1,100 L FRP tank
  4 dietary group × 3 replication = 12 tanks
- Feeding Once/day (Satiation), 6 days/week
- Duration Dec 18th – Feb 18th (9 weeks)
- Water temperature 19.7°C ⇒ 16.4 °C

Sampling

- **Collecting blood and hypothalamus**



Results

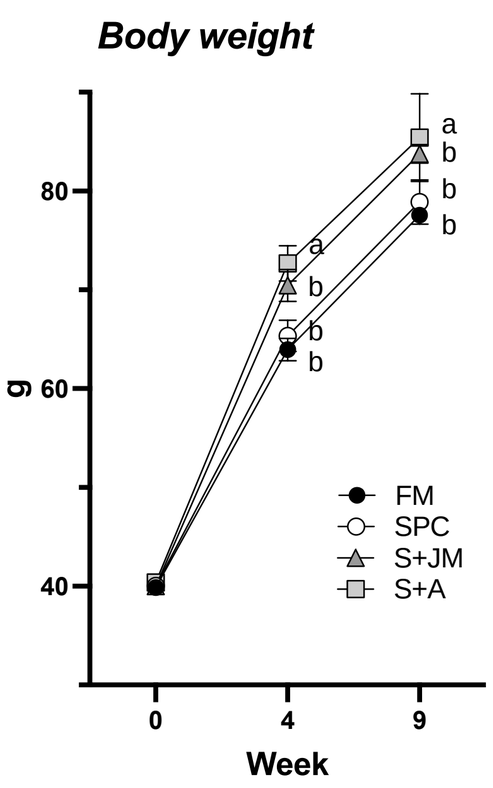


Fig. 1. Changes in average body weight (mean ± standard error, n = 3). Different letters indicate significant differences in two-way ANOVA followed by Tukey's multiple comparisons test (P < 0.05).

Growth performance

	FM	SPC	S+JM	S+A
Feed efficiency (%)	42.1	50.0	54.2	52.9
Feed intake (g/fish)	89.7	77.7	82.3	86.6

Gene expressions

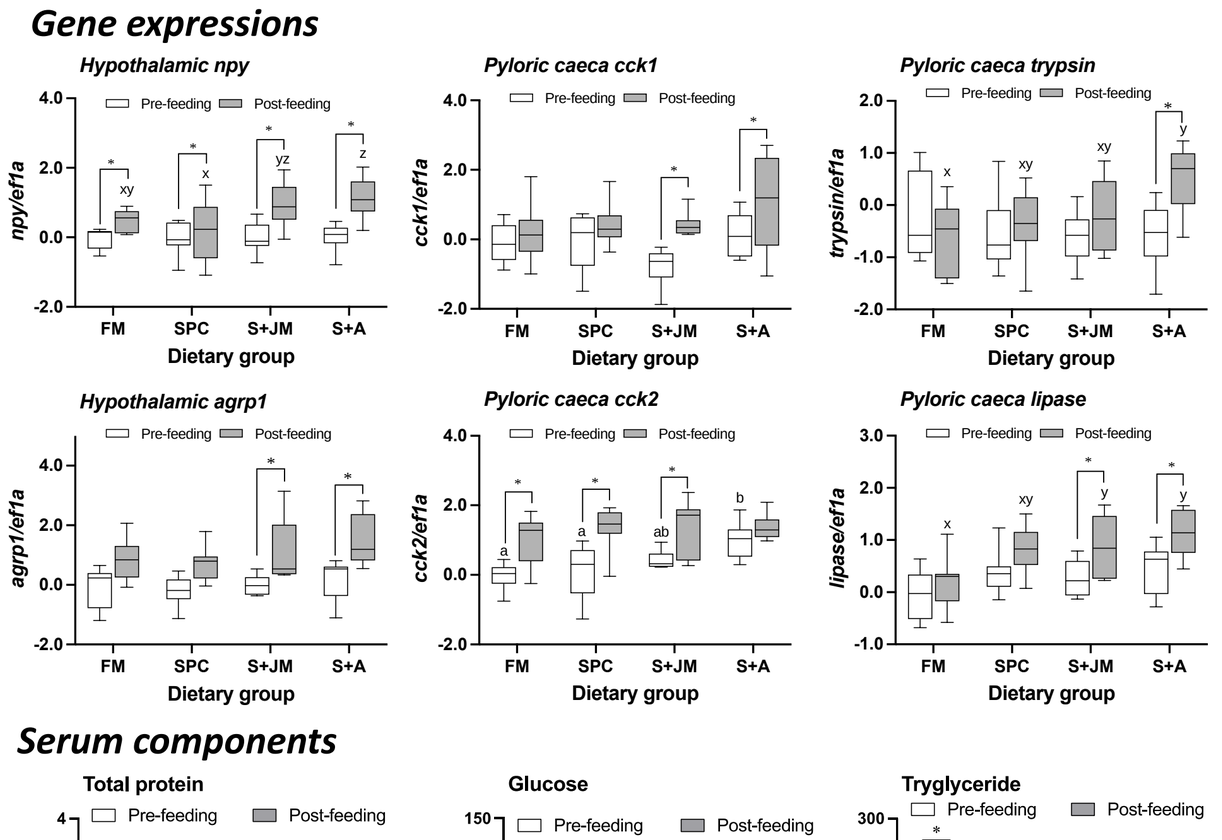


Fig. 2. Relative expression of target genes before and after feeding (n=7–9). Boxes indicate the 1st and 3rd quartiles. The vertical lines (whiskers) represent the maximum and minimum values. The central line marks the median. All measurements were standardized using *ef1a* expression levels. Different letters indicate significant difference (P < 0.05). Lowercase x, y, and z indicate significant difference in post-fed fish using two-way ANOVA followed by Tukey's multiple comparison test (P <0.05). Asterisks indicate significant differences between pre-feeding and post-feeding of same dietary group using two-way ANOVA followed by Sidak's multiple comparison test (P <0.05).

Serum components

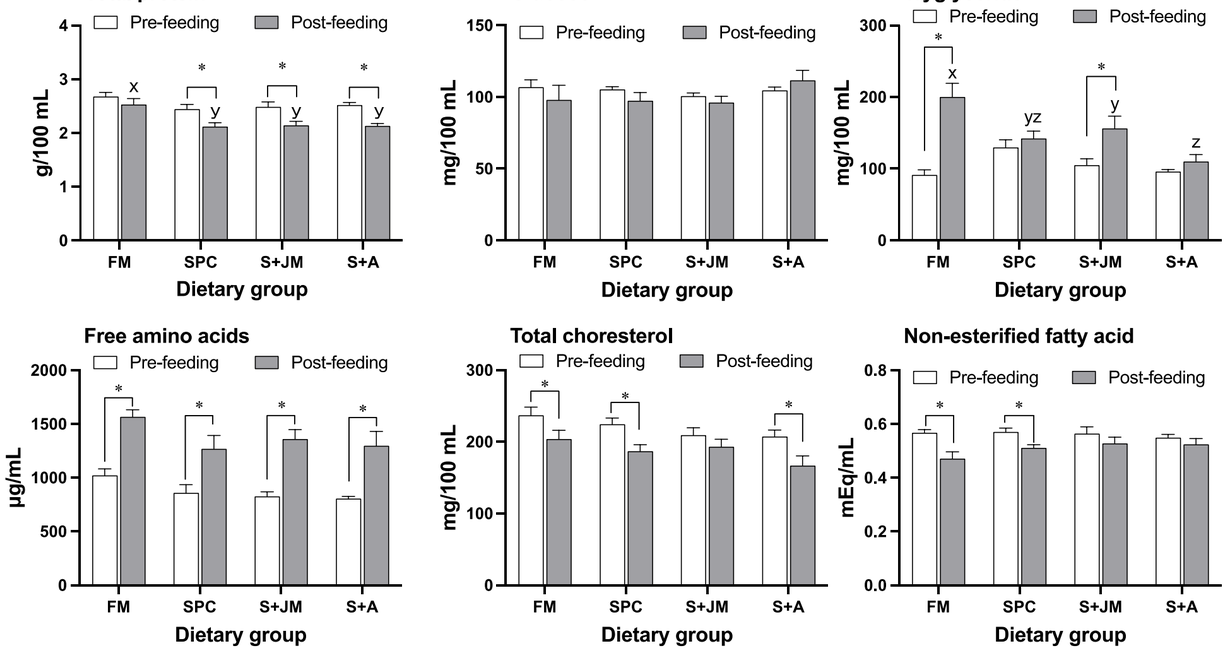


Fig. 3. Serum concentrations of total protein, glucose, triglyceride, free amino acids, total cholesterol, and non-esterified fatty acid after one week. Vertical lines represent standard error of the mean (SEM; n = 9). Lowercase x, y, and z indicate significant difference in post-fed fish using two-way ANOVA followed by Tukey's multiple comparison test (P <0.05). Asterisks indicate significant differences between pre-feeding and post-feeding of same dietary group using two-way ANOVA followed by Sidak's multiple comparison test (P <0.05).

Conclusion

- FMS supplementation of the low FM diet improved growth performance.
- FMS supplementation improved response of orexigenic hormones, but opposite response compared to our previous studies.
- FMS supplementation improved response of digestive hormones and digestive enzymes.
- FMS contains important substances that stimulate physiological responses (appetite and digestion) in fish.
- By determining important substances in FMS, better fish diets, including low-FM or non-FM diets for carnivorous fishes, can be developed.

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