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Effects of Supplementation of Heat or Un-heat Treated Histamine on Growth of Yellowtail

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Abstract: Effect of supplementation of histamine on yellowtail was examined by feeding for 107 days with heat (HT) or un-heat treated (H) histamine at levels of 500 and 2000 (mg/kg diet). During that feeding period, fish fed HT-2000 and H-2000 diet exhibited lower feed intake and growth rate than fish fed control diet. At end of the experiment, five fish from each dietary group were examined for gastric abnormalities, but there was no sign of gastric abnormality even the lowest growth of HT- and H-2000. These results suggest that yellowtail may have histamine effects different from rainbow trout, which showed gastric abnormalities without growth retardation.

Key words: yellowtail, fish meal, histamine, growth

Introduction

Fish meal is an ideal protein source due to its high content of ideal indispensable amino acids, high digestibility and absence of anti-nutritional factors that may be present in other protein sources. Grading of fish meal quality is depending on several factors. One of the criteria defining the fish meal quality is histamine content of fish meal. (Romero et al. 1994). Histamine produced as a consequence of microbial activity during post-catch storage of some marine fish, thus elevation of histamine content indicates improper handling of raw materials. Avian black vomit disease, characterized gizzard disease, ulceration and cellular necrosis, results from feeding diets containing fish meal manufactured degraded raw materials high in histamine which have been overheated during drying (Umemura et al., 1981; Wessels and Post, 1989 cited by Fairgrieve 1994). Gizzerosine [(2-amino-9-(4-imidazolyl)-7-azanonanoic acid)], the potent, ulcerogenic histamine derivative has also been studied (Mori et al., 1983; Sugahara et al., 1988). While the effects of dietary histamine and gizzerosine on the development of gastric abnormalities in chickens are well documented, information on their effects in fish is limited by two reports in rainbow trout (Watanabe et al., 1987; Fairgrieve et al., 1994) and no studies has been reported in marine fish species.

The present study was designed to examine if: 1) high histamine supplementation alone produce gastric abnormalities, or affected growth , feed intake and feed efficiency and 2) heat treated histamine hasten gastric abnormalities or deteriorate growth parameters.

Materials and Methods

Diet

There are five dietary treatments in this study and their dietary composition are shown in Table 1. All diets contained 700 g/kg dry diet of fish meal which purchased from commercial fish mills (Nissui Co., Tokyo, Japan). The reported histamine level of the fish meal was in the range of 200-500 ppm. In all dietary groups, 70 g of fish meal was blended with 70 g of a tap

Table 1. Dietary composition of feeding experiment (g/kg dry).

Ingredient	Diet		
	Control	H-500 or HT-500	H-2000 or HT-2000
Fish meal	700	700	700
α-Corn starch	110	110	110
Vitamin mix	30	30	30
Mineral mix	25	25	25
CMC-Na	25	25	25
Guar gum	5	5	5
α-Cellulose	5	4.5	3
Pollack liver oil	100	100	100
Histamine HCl	0	0.5	2
Total	1000	1000	1000

water and heated for 3 hrs at 130°C. Heat treated histamine diets (HT) were prepared by dissolving histamine hydrochloride (Tokyo kasei, Tokyo, Japan) either 500 or 2000 mg in 70 ml of a tap water and blended with 70 g of fish meal, then the resultant mixture was heated. Un-heat treated histamine diet (H) was prepared by mixing histamine hydrochloride with pre-heated fish meal which prepared same manner as HT except no histamine in a tap water. Control diet was prepared similar to H diet except histamine supplementation.

Fish and facilities

Juvenile yellowtail (*Seriola quinqueradiata*) obtained from commercial fish farmer in Usa and were maintained at Usa marine research laboratory Kochi university. The feeding experiment was conducted in 1.2 t FRP aquaria, each supplied with ambient temperature water (22.0-25.5°C) at a rate of 8 L/min. An aeration was supplied in each aquaria. After a week of acclimatization period, fish were selected for uniform size (mean weight 15.5 g) then randomly distributed among the aquaria until each contained 15 fish. The fish number was reduced to 10 after 36 days of feeding due to high density of fish. The five dietary treatments were assigned to the tanks two tanks per treatment. Fish were fed apparent satiation twice daily for 107 days. Fish were weighed 10, 20, 30, 67, 77, and 97 days after start of feeding. Feed was withheld the second feeding of the one day before the body weight sampling and the last sampling. Water temperature was in the range of 22.0-25.5°C during the feeding experiment.

Sampling

At end of the experiment, five fish were randomly sampled form each tank and used for the blood analysis and stomach inspection. The blood was withdrawn through caudal vessel punctured using 1-ml heparinized syringes, then centrifuged for 5 min at 10000 rpm. The resultant serum was used to measure hematocrit (Ht) value, blood urea nitrogen (BUN), asparagate transaminase (GOT), alanine aminotransaminase (GPT) and alkaline phosphatase (ALP) of each fish. After taking blood sampling, fish were dissected and stomach were preserved in 10% phosphate buffered formaldehyde solution.

Protein digestibility

After the final sampling, the remaining fish were fed the experimental diet with containing 0.5% chromic oxide diet (Table 2). Chromic oxide was determined following the method of Furukawa & Tsukahara (1966).

Statistics

The body weight gain, blood analysis data were examined Duncan's new multiple range test, MRT) and significance was detected at 5%.

Results

Growth

The growth of yellowtail fed the experimental diet for 107 days is shown in Fig. 1 and growth performance is summarized in Table 3. The growth was retarded between day 36 and 47 because fish were starved due to bad water quality during that period. Other than those days, fish increased body weight proportionally and there were no mortalities. Result from 107 days feeding, in situ inspection of the stomach in fish from all dietary treatments revealed no inflammation or ulceration of gastric tissues. The hematological data result from the feeding experiment are shown in Table 4. Hematocrit value of HT-2000 was lower than that of control but there was no statistical difference. GOT values of H-500, HT-500 and HT-2000 were lower than that of control and among them H-500 was the lowest. Apparent protein digestibility values of control, H-500 and H-2000 were 77.4%, 77.1%, and 74.9%, respectively.

Table 2. Dietary composition of digestibility measurement (g/kg dry).

Ingredient	Diet		
	Control	H-500	H-2000
Fish meal	700	700	700
α-Corn starch	110	110	110
Vitamin mix	30	30	30
Mineral mix	25	25	25
CMC-Na	25	25	25
Guar gum	5	5	5
α-Cellulose	5	4.5	3
Pollack liver oil	100	100	100
Histamine HCl	0	0.5	2
Cr_2O_3	5	5	5
Total	1000	1000	1000

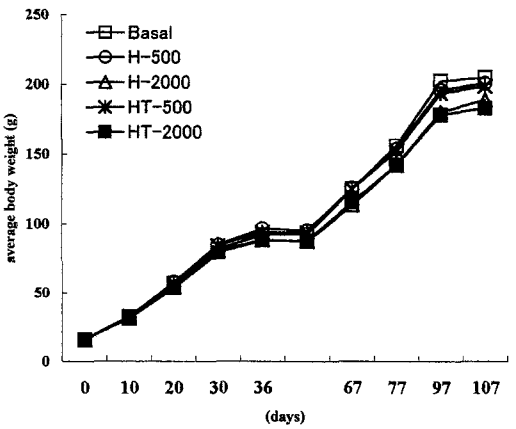

Fig. 1. Growth of yellowtail fed test diets for 107 days.

Table 3. Growth, feed intake, feed efficiency of yellowtail fed experimental diets for 107 days.

	Control	H-500	H-2000	HT-500	HT-2000
Weight gain (g)	189	187	175	183	167
Feed intake (g)	366	364	346	354	351
Feed efficiency	0.516	0.514	0.506	0.517	0.476
Daily feeding rate (%)					
0-36	2.4	2.4	2.3	2.3	2.2
37-68	2.6	2.5	2.5	2.5	2.4
68-107	5.0	5.0	4.7	4.8	4.9

Feed efficiency calculated as wet weight gain (g) / dry feed intake (g)

Table 4. Hematological paramerters of yellowtail fed experimental diets for 107 days.

	Control	H-500	H-2000	HT-500	HT-2000
Hematocrit (%)	52.5±8.4	47.5±5.3	50.7±10.2	49.3±7.5	46.2±1.9
BUN (mg/ml)	17.5±2.8	16.2±2.2	17.5±2.6	14.5±2.1	15.1±1.7
GOT (IU/l)	13.2±4.6	6.0±3.4	17.6±7.4	6.3±2.7	10.6±2.8
GPT (IU/l)	2.6±1.6	2.2±0.8	2.4±1.2	2.4±1.9	3.0±1.0
ALP (μmole/ml)	0.13±0.03	0.14±0.02	0.13±0.03	0.14±0.01	0.12±0.03

Discussion

Growth of HT- and H-2000 diet fed fish were lowest among the dietary treatments though, appearance of stomach was normal in all diets fed fish. Physiological functions of the digestive system appeared to be unaffected. This conclusion is based on the result from protein digestibility coefficient values, which were similar between control and H-2000 fed fish. In rainbow trout, Watanabe et al. (1987) and Fairgrieve et al. (1884) reported that gastric abnormalities but no growth impairment was observed resulted from feeding high histamine diets. Watanabe et al. (1987) found gastric erosion in 40% of rainbow trout after 8 weeks of feeding diets containing sardine meal and supplemented with 2000 mg histamine/kg diet. Fairgrieve et al. (1994) found flaccid, extended stomach, although did not fond any histological abnormalities such as gastric lesions, ulcerations. The differences in results between our study and those of two previous reports are likely due to the fish species (marine vs fresh water fish species) used and/or source of fish meal. Moreover, yellowtail maybe more tolerate to gastric acid secretion by histamine stimulation compared to rainbow trout. Regardless the heat treatment of histamine, growth of yellowtail fed histamine 2000 ppm reduced (H-2000 and HT-2000). It has been suggested that ill-effect of histamine shows as histamine derivative, gizzerosine, and this has a role in the development of gastric abnormalities. Gastric abnormalities have confirmed at high incidence in fish fed with heat treated histamine diets (Watanabe et al. 1984; Fairgrieve et al. 1994). These results suggest that histamine itself has no ill-effects for rainbow trout but it may have for yellowtail.

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