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Effects of fish and bullfrog protein hydrolysates on the growth, amino acid transporter, amino acid composition of chyme and intestinal microbial communities in turbot

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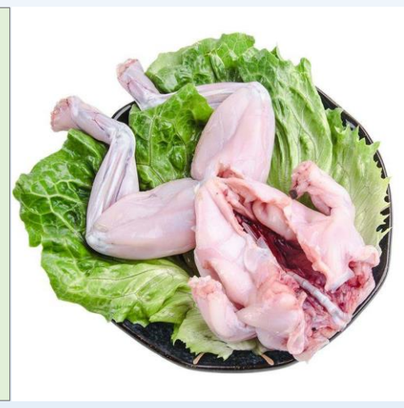
Introduction

Bullfrog (*Lithobates catesbeiana*) is an important breeding frog species that has become the largest amphibian farmed in China. It is the ingredient of hot pot, which is deeply loved by consumers. However, with the increase of bullfrog production, its by-products also increase. If not reasonably utilized, it will not only cause the waste of protein sources, but also cause environmental pollution. Enzymatic hydrolysis was an efficient way to recovery proteins from animal by‐products. Among them, fish protein hydrolysate obtained from fish by-products by this method has been widely proved to be a high-quality protein source. Therefore, this study was conducted to investigate effects of fish and bullfrog protein hydrolysates on the growth, amino acid transport, amino acid composition of chyme and intestinal microbial communities in turbot.



Materials and Methods

Fish and bullfrog by-products were hydrolyzed using enzymatic treatment. Positive and negative control diets contained 35% and 26.5% fish meal (LFM and HFM). Test diets contained 26.5% fish meal and 8.0% fish protein hydrolysate (FPH), and 26.5% fish meal and 9.5% bullfrog protein hydrolysate (BPH). A 56-day feeding trial was conducted at Huanghai Aquaculture Co. Ltd. 30 juvenile turbot (initial weight 8.00 ± 0.01 g) were stocked into each of 12 tanks and randomly assigned one of the three experimental diets for three replicate tanks per dietary treatment.

Tab.1 The proximate chemical composition and amino acid composition of fish protein hydrolysate and bullfrog protein hydrolyze (% Dry matter)

	Fish protein hydrolysate	Bullfrog protein hydrolyze
Chemical composition		
Crude protein	80.52	68.15
Crude lipid	0.17	1.72
Amino acid		
EAA		
Threonine	2.95	2.56
Valine	3.18	2.44
Methionine	1.94	1.03
Isoleucine	2.85	2.07
Leucine	4.91	3.68
Phenylalanine	2.62	2.38
Lysine	5.24	3.82
Histidine	1.34	1.25
Arg	4.18	4.26
NEAA		
Taurine	0.70	0.08
Aspartic acid	6.81	5.74
Serine	3.12	3.49
Glutamic acid	11.34	9.44
Glycine	4.61	10.32
Alanine	4.28	5.03
Cystine	0.56	0.42
Tyrosine	1.84	1.64

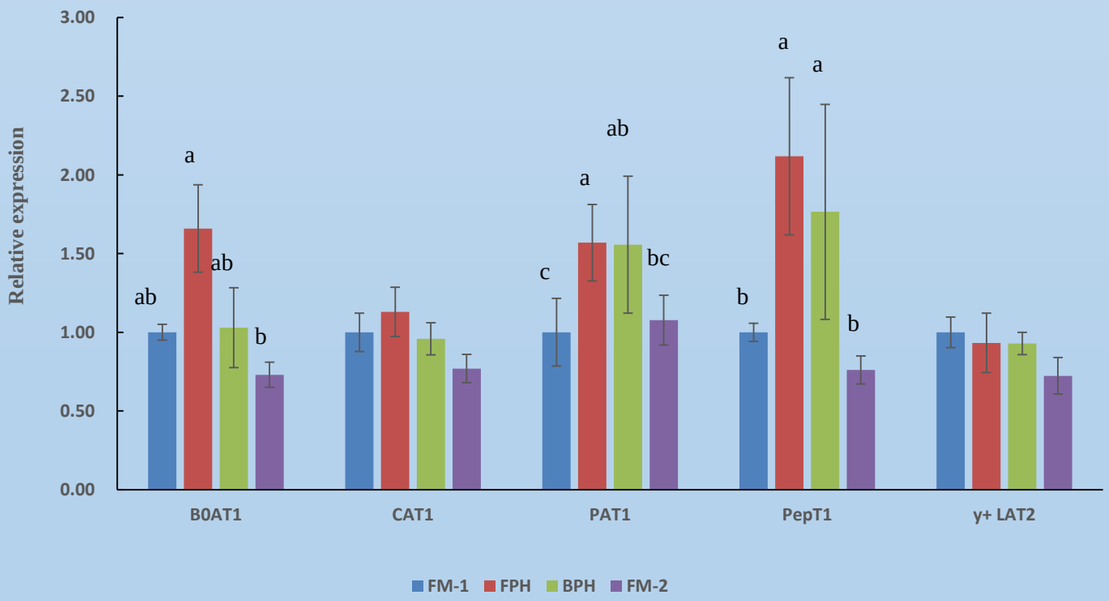


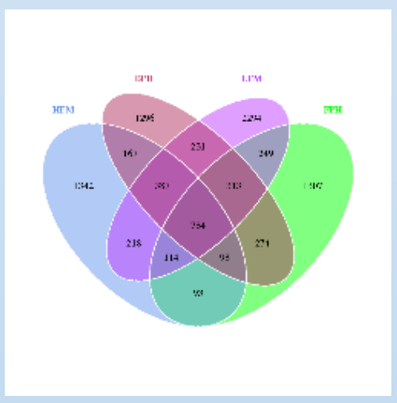
Fig.1 Intestinal mRNA expressions of peptide and amino acid transporters

Tab. 2 Growth performance and feed utilization of juvenile turbot

Items	LFM	FPH	BPH	HFM
Initial body weight(g)	8.01±0.01	7.99±0.01	7.97±0.00	8.00±0.03
Final body weight(g)	43.87±1.65^{ab}	48.01±1.13^{a}	38.40±1.68^{bc}	35.82±0.49^{c}
Survival rate （%）	84.62±8.88	93.38±1.40	88.46±11.54	74.23±8.22
Weight gain rate（%）	448.32±20.68^{ab}	500.18±14.18^{a}	379.96±20.97^{b}	347.74±6.07^{b}
Special growth rate（%/d）	2.83±0.06^{ab}	2.99±0.04^{a}	2.62±0.07^{bc}	2.49±0.01^{c}
Feed intake（%/d）	2.00±0.08	1.91±0.05	1.94±0.08	2.03±0.11
Feed efficiency ratio	1.16±0.06	1.25±0.05	1.13±0.07	1.04±0.06
Protein efficiency ratio	2.31±0.12	2.50±0.09	2.28±0.14	2.11±0.12
Protein productive value（%）	38.91±5.02	38.81±1.87	35.67±1.91	33.47±0.47

Tab. 3 The effects of fish and bullfrog protein hydrolysate on chyme amino acid composition of turbot

Amino acid	PC	FPH	BPH	NC
Threonine	1.06±0.06^{b}	1.13±0.03^{b}	1.36±0.04^{a}	1.23±0.03^{ab}
Valine	1.28±0.06^{b}	1.39±0.03^{b}	1.61±0.01^{a}	1.69±0.00^{a}
Methionine	0.98±0.18	0.72±0.18	0.92±0.16	0.69±0.25
Isoleucine	1.09±0.07	1.07±0.19	1.39±0.14	1.19±0.23
Leucine	2.39±0.18	2.49±0.29	2.79±0.01	3.11±0.23
Phenylalanine	0.95±0.05^{b}	1.19±0.07^{ab}	1.33±0.04^{a}	1.44±0.13^{a}
Lysine	0.89±0.07^{b}	0.92±0.10^{b}	1.51±0.05^{a}	0.89±0.01^{b}
Histidine	0.57±0.02	0.63±0.03	0.69±0.05	0.60±0.02
Threonine	0.94±0.03^{b}	1.03±0.04^{b}	1.36±0.04^{a}	0.99±0.07^{b}
EAA	10.14±0.57	10.56±0.48	12.96±0.14	11.84±0.78
Taurine	1.40±0.18	1.30±0.11	1.05±0.03	1.53±0.13
Aspartic acid	2.40±0.14^{b}	2.63±0.15^{ab}	3.02±0.11^{a}	2.71±0.04^{ab}
Serine	1.19±0.07^{b}	1.30±0.02^{ab}	1.46±0.04^{a}	1.46±0.05^{a}
Glutamic acid	4.09±0.23^{b}	4.95±0.06^{ab}	5.31±0.11^{a}	5.41±0.29^{a}
Glycine	0.81±0.09^{b}	0.97±0.03^{ab}	1.15±0.03^{a}	1.12±0.10^{a}
Alanine	1.44±0.06^{b}	1.58±0.10^{b}	2.06±0.00^{a}	1.54±0.06^{b}
Cystine	4.40±0.15^{b}	4.91±0.16^{ab}	5.46±0.11^{ab}	5.88±0.43^{a}
Tyrosine	1.10±0.16	1.03±0.13	1.22±0.03	1.19±0.07
NEAA	16.81±1.02^{b}	18.66±0.15^{ab}	20.75±0.45^{a}	20.83±1.05^{a}



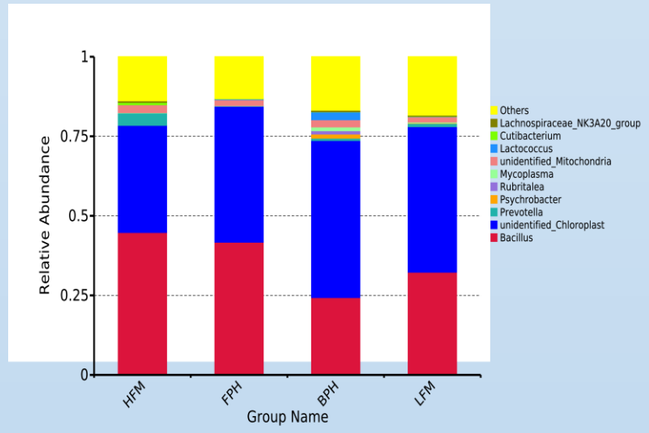
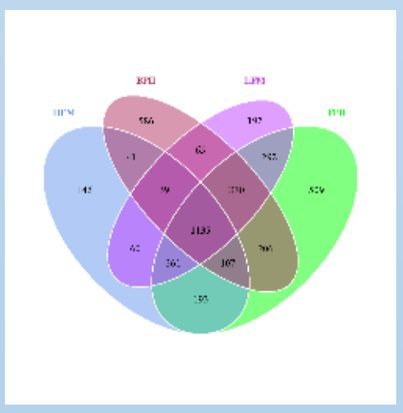


Fig. 2 the microbial diversity of intestinal chyme



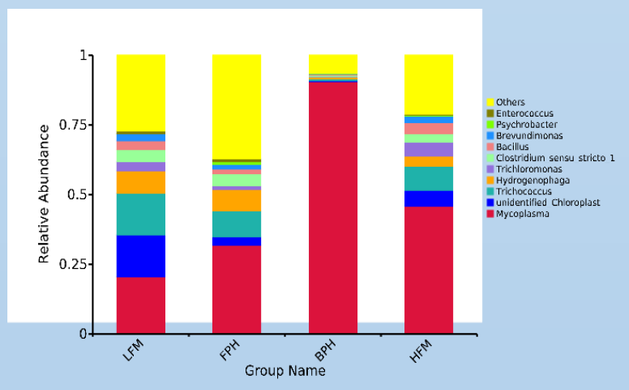


Fig. 3 the microbial diversity of intestinal mucosa

Conclusion

Fish protein hydrolysate showed more beneficial effects on the growth than that of bullfrog protein hydrolysate. The responses of amino acid concentrations in chyme, the expressions of amino acid and small peptide transporters, and intestinal microbial communities also indicated that feed utilization efficiency of turbot supplemented with fish protein hydrolysate was higher than that of bullfrog protein hydrolysate.

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