Effects of dietary astaxanthin on growth performance, antioxidant capacity, immune function and transcription level of *Gymnocypris przewalskii*

WANG Li-nan[1, 2], Li Chang-zhong[1, 2], Qi Hong-fang[3], LI Jin[3], Yang Ying[1, 2], Li Zhao-nan[1, 2], Yan Qing-qing[1, 2], Liang Tian-xiu[1, 2], Jin Wen-jie[1, 2], Chen Yan-xia [1,2], *
College of Eco-Environmental Engineering, Qinghai University

WHY STUDY THEM ?

Investigate the effects of astaxanthin in daily diet on the growth, antioxidant capacity, and immune response of *Gymnocypris przewalskii*, as well as its impact on the fish's ability to resist and respond to alkalinity stress.

Tab.1 Effects of different levels of astaxanthin on growth performance and physical indices of *Gymnocypris przewalskii*

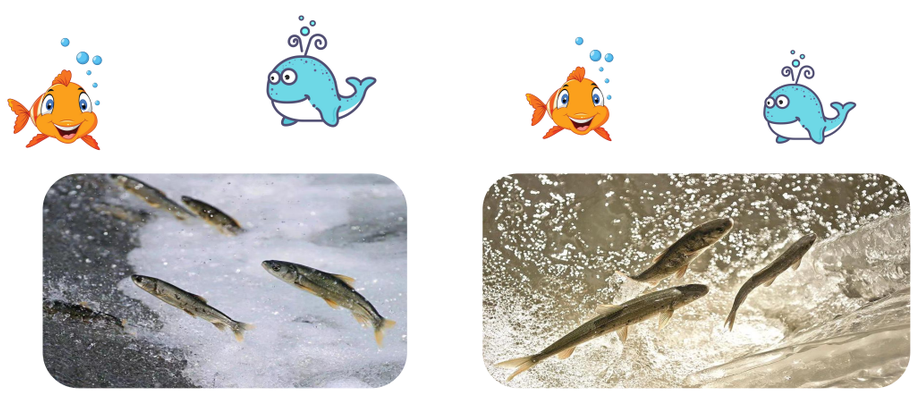
groups	AS0	AS25	AS50	AS100	AS200
initial body weight/g	20.84±2.60a	20.75±0.11a	20.67±0.71a	22.09±1.29a	20.75±1.06a
final body weightg/g	26.13±2.71a	26.41±0.28a	27.52±1.28a	28.43±1.97a	26.81±0.72a
Specific growth rate (%/d)	0.38±0.04b	0.40±0.03ab	0.48±0.02a	0.42±0.02ab	0.43±0.04ab
weight gain rate/%	2.64±1.87b	2.08±1.47ab	1.64±1.16a	1.36±0.96ab	3.11±2.20ab
hepatopancreas somatic indices/%	2.29±0.32b	2.45±0.34ab	2.82±0.51a	2.49±0.54ab	2.18±0.44b
viscerosomatic index/%	16.76±2.44a	17.27±2.09a	17.88±3.10a	17.48±3.71a	16.90±2.65a
condition factor/%	1.43±0.18b	1.51±0.20ab	1.68±0.6a	1.53±0.15ab	1.65±0.20a
specific growth rate/%	94.17±1.18a	92.50±5.89a	95.76±2.36a	96.67±2.36a	91.67±2.36a

Tab.2 Effects of dietary astaxanthin level on liver antioxidant indices of *Gymnocypris przewalskii*

groups	AS0	AS25	AS50	AS100	AS200
TP (gprot/L)	4.22±1.05a	4.16±0.23a	4.63±0.32a	4.44±0.82a	4.24±0.68a
T-SOD (U/mg)	651.18±62.47a	692.09±119.04a	798.73±184.63a	699.34±98.22a	757.8±43a
MDA (nmol/mg)	1.7±0.33a	1.74±0.13a	1.85±0.6a	1.83±0.12a	1.82±0.7a
GSH-PX (U/mg)	5.33±1.04a	6.9±2.11a	10.9±5.77a	7.06±3.48a	6.92±2.37a
CAT (U/mg)	4.51±1.32b	5.64±0.78b	9.46±2.11a	9.25±1.19a	6.13±2.26b
GR (U/g)	12.71±9.59a	11.36±9.95a	13.99±8.09a	24.46±18.15a	14.54±7.29a

Tab.3 Effect of dietary astaxanthin level on liver immune indices of *Gymnocypris przewalskii*

groups	AS0	AS25	AS50	AS100	AS200
IL-1β (pg/mL)	8.7±0.57a	6.84±0.88ab	5.77±1.35b	7.15±0.8ab	8.29±2.45ab
IL-6 (pg/mL)	2.52±0.2b	2.01±0.37ab	1.44±0.49a	1.91±0.70a	1.96±0.44a
IL-8 (pg/mL)	12.48±0.49b	9.18±0.99a	7.70±1.55a	10.82±1.04ab	10.38±2.02ab
IL-10 (pg/mL)	9.84±1.14a	10.76±3.93a	12.65±2.59b	11.57±3.20ab	11.75±2.50ab
TGF-β (ng/mL)	9.48±0.25a	8.87±2.62a	11.15±0.43b	10.00±0.32a	9.78±2.74a
TNF-α (ng/mL)	4.82±3.02a	5.40±1.15a	3.36±1.88a	5.70±0.38b	5.28±1.47a
IgM (μg/mL)	0.81±0.48a	0.91±0.49a	1.10±0.76a	1.47±1.42a	1.49±0.46a



CONCLUSIONS

- Astaxanthin may regulate the response of *G.przewalskii* to alkalinity stress by altering metabolic and immune-related pathways. Our results could provide a reference for the optimization of the diet formula of *G.przewalskii* and the conservation and recovery of *G.przewalskii* .

METHODS

A total of 900 juvenile *G.przewalskii* with an initial average body weight of 21.02 ± 1.15 g were divided into 5 groups with 3 replicates per group and 60 fish per replicate. The control group (AS0) was fed a basal diet, and the experimental diets were supplemented with 25 mg/kg (AS25), 50 mg/kg (AS50), 100 mg/kg (AS100), or 200 mg/kg astaxanthin (AS200). After 8 weeks of culture, the effects of dietary astaxanthin on the growth performance, antioxidant capacity, and immune function of *G.przewalskii* were analyzed.Subsequently, we conducted an alkaline stress experiment on *G.przewalskii* supplemented with astaxanthin to analyze the impact of astaxanthin on the alkaline stress resistance of *G.przewalskii* at the transcriptome level.

Result

Experiments have shown that astaxanthin not only improves the growth performance, antioxidant capacity, and immune ability of *G.przewalskii*. It can also enhance the response ability of *G.przewalskii* to alkalinity stress. Transcriptome sequencing revealed that astaxanthin may play a role in response of *G.przewalskii* to alkalinity stress through differentially expressed genes in the liver such as *acsl4b*, *acsl1b*, *tfr1b*, *gpx4a*, and *hsd17b7*.

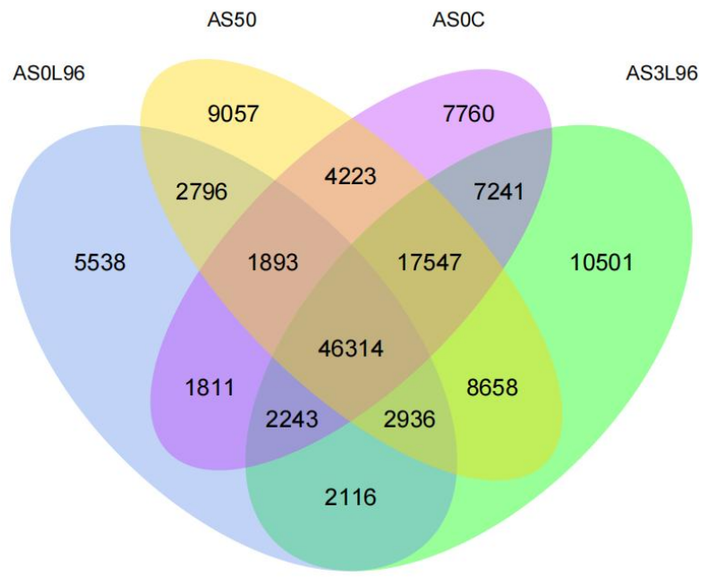


Fig.1 Venn diagram of gene expression levels in each group

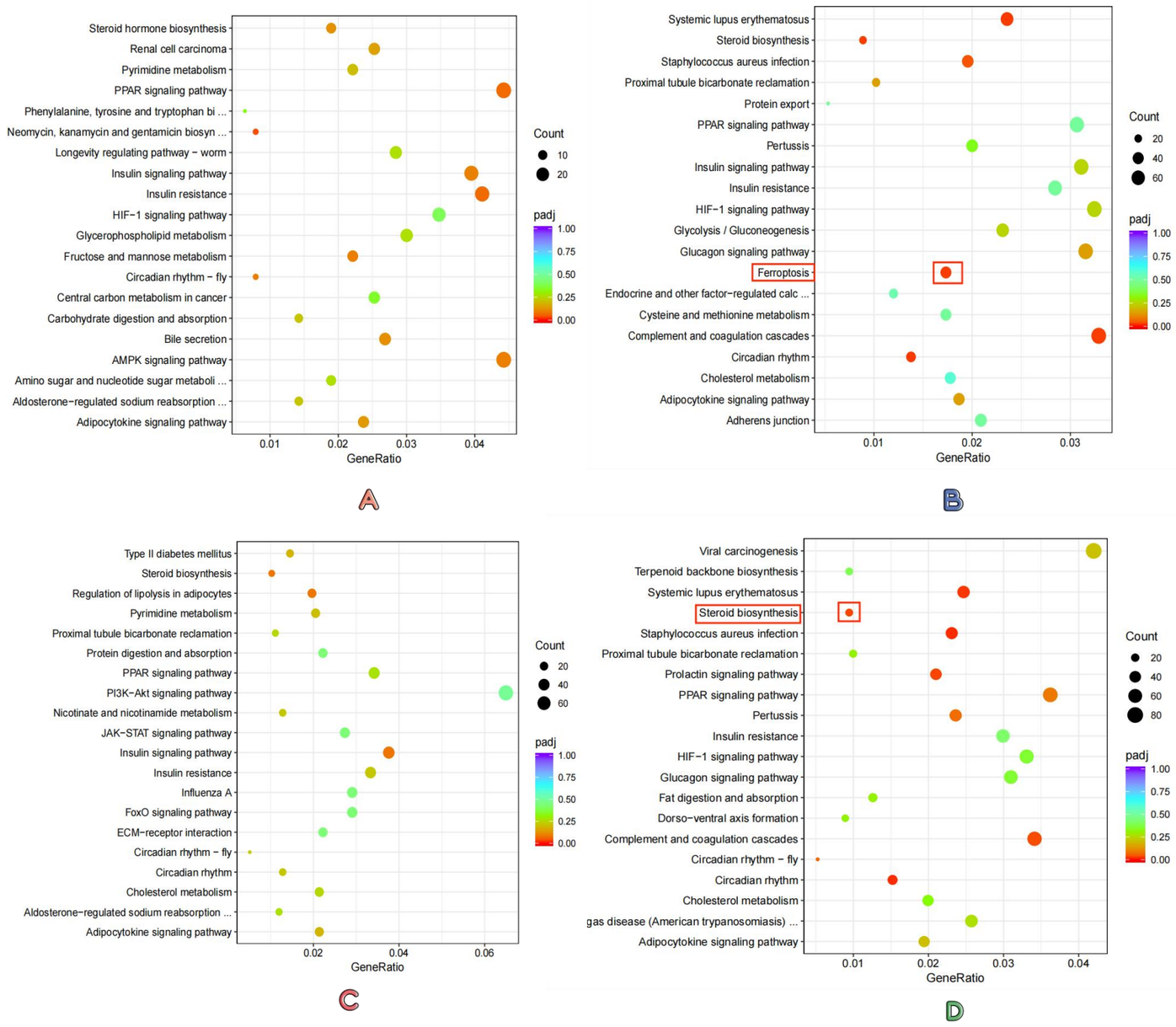


Fig.2 KEGG classification of putative functions of differential expressed genes

A. AS50 vs AS0C； B. AS0L96 vs AS0C； C. AS3L96 vs AS50； D. AS3L96 vs AS0L96