

THE POTENTIAL OF WHITE LUPIN (*LUPINUS ALBUS*) INCLUSION IN DIETS FOR JUVENILE MIRROR CARP, *CYPRINUS CARPIO*

A.Y. Anwar¹, E. Sweetman^{*2} and S.J. Davies¹

¹ University of Plymouth, Plymouth, UK, ² Ecomarine Ltd, Brora, Sutherland, UK
ecomarine.ltd@gmail.com

Introduction

- Soybean meal is a key component in carp feeds but due to increased global demand with escalating prices alternate protein sources are being investigated.
- Lupins, a legume with high protein levels, has the potential to replace soya, however they have also been associated with anti-nutritional factors (ANF's) and non-starch polysaccharides which may reduce feed intake, growth, nutrient digestibility and utilization and disease resistance.
- The use of exogenous solid state fermentation dietary supplements has been shown to reduce the effects of ANF's and enhance dietary performance.

Objective

- To investigate the effect of replacing soya protein concentrate by white lupin seed meal with and without the addition of a solid state fermentation product in complete diets for juvenile mirror carp.

Materials and methods

- 300 juvenile mirror carp, *Cyprinus carpio*, (mean weight 15.35 ± 0.57g) were randomly distributed in 12 tanks freshwater recirculation tanks (duplicate tanks per treatment).
- Six isonitrogenous (38%) and isolipidic (8%) dietary treatments were prepared in which 0%, 12.5% and 25% of the soya protein concentrate (SPC) was substituted by white lupin seed meal (WL), with and without supplementation of 0.1% of the fermentation product Synergen™ (SYN) (Alltech Inc, USA).
- All diets were fed at a daily feeding rate of 3-4% of body weight in 3 rations per day for six days a week at a temperature of 25±0.2°C for 10 weeks.
- Initial body weight (IBW), final body weight (FBW), weight gain (WG), feed intake (FI), protein intake (PI), specific growth rate (SGR), feed conversion ratio (FCR), feed conversion efficiency (FCE), protein efficiency ratio (PER), lipid efficiency ratio (LER) apparent net protein utilization (ANPU) and energy retention (ER) were assessed.
- In addition carcass composition and gut morphology were investigated.

Results

- Data on the effects of each diet on the fish performance parameters are presented in table 1.

Table 1: Fish performance characteristics

Parameter	Diet					
	SPC	SPCSYN	WL12.5	WL12.5SYN	WL25	WL25SYN
IBW (g)	15.68±0.9	15.4±0.28	15.2±0.22	15.4±0.16	15.36±0.67	15.06±1.32
FBW (g)	43.92±1.76 ^a	53.84±1.2 ^b	44.2±1.32 ^a	62.24±0.7 ^c	42.12±1.6 ^a	52.36±2.04 ^b
WG (g)	28.24±1.12 ^a	38.44±1.0 ^b	29.0±1.48 ^a	46.84±0.6 ^c	26.76±1.1 ^a	37.3±1.1 ^b
WG (%)	180.1±0.28 ^a	248.6±6.6 ^b	190.9±16.6 ^a	303.5±2.1 ^c	174.15±2 ^a	248.13±11.4 ^b
SGR %day ⁻¹	1.47±0.0 ^a	1.79±0.02 ^b	1.52±0.06 ^a	2.00±0.0 ^c	1.43±0.01 ^a	1.75±0.06 ^b
FI (gfish ⁻¹)	60.71±3.76 ^{ab}	68.48±2.5 ^d	58.38±1.49 ^a	71.79±0.1 ^d	57.32±3.0 ^a	64.8±2.41 ^{bc}
PI (gfish ⁻¹)	24.29±1.5 ^a	29.62±1.0 ^c	24.36±0.62 ^a	30.26±0.0 ^c	23.88±1.2 ^a	26.97±1 ^b
FCR	2.14±0.0 ^d	1.77±0.0 ^b	2.01±0.06 ^c	1.53±0.02 ^a	2.14±0.01 ^d	1.73±0.0 ^b
FCE (%)	46.51±0.19 ^a	56.13±0.1 ^c	49.64±1.6 ^b	65.24±0.7 ^d	46.67±0.2 ^a	57.55±0.18 ^c
PER	1.15±0.0 ^a	1.29±0.0 ^b	1.18±0.03 ^a	1.52±0.04 ^d	1.11±0.0 ^a	1.37±0.0 ^c
ANPU (%)	17.86±0.12 ^{ab}	20.06±0.0 ^c	18.69±0.82 ^b	24.06±0.3 ^e	17.32±0.1 ^a	21.27±0.11 ^d
LER	6.19±0.04 ^a	7.67±0.02 ^c	6.72±0.31 ^b	8.57±0.14 ^d	6.28±0.04 ^a	7.45±0.03 ^c
ER (%)	2.48±0.01 ^{ab}	2.98±0.02 ^c	2.59±0.09 ^b	3.43±0.03 ^d	2.46±0.03 ^a	3.05±0.01 ^c
K-factor (%)	2.26±0.14	2.29±0.04	2.21±0.06	2.30±0.02	2.17±0.07	2.28±0.15
Survival (%)	100	100	100	100	100	100

Data are presented as mean ± S.D.

Data in the same row with different superscript are significantly different (P<0.05)

- The substitution of soya protein concentrate by white lupin seed meal resulted in no significant change in growth parameters and feed utilization.
- The addition of Synergen to the control diet (SPC) and the 12.5 and 25% WL diets resulted in highly significant increases in weight gain, more than 42.5% (WL25SYN) and up to 59.0% in the case of the WL12.5SYN.
- Further feed and protein intake was significantly improved (P<0.05) in the fish fed the 12.5% substituted SPC diet with Synergen (WL12.5SYN). The WL12.5SYN fed fish also exhibited significantly higher SGR, FCE and PER than the other dietary treatments.
- The FCR of the WL12.5SYN fed fish was significantly lower (P<0.05) than the other dietary treatments.
- The body composition of the mirror carp juveniles was not significantly affected by substituting SPC with WL.
- Histological analysis of the fish showed that gut morphological parameters were generally improved in all the diets containing Synergen suggesting an increased absorptive area in the mid and hind gut subsequently improving growth performance and feed utilization.

Conclusions

- Substitution of up to 25% of the soya protein concentrate by white lupin seed meal in diets for mirror carp did not have any significant negative effect on growth performance, feed utilization and carcass composition. The addition of the solid state fermentation product Synergen significantly improved growth and performance parameters, improved gut morphology and the utilization of nutrient in all dietary treatments.
- The WL12.5SYN fed fish had significantly improved growth performance and feed utilization when compared to all other dietary treatments.

Acknowledgements

This work was funded through a Technology Strategy Board project – LUKAA (Lupins in UK Agriculture and Aquaculture), sponsorship by the MHE KRG (Ministry of Higher Education and Scientific Research, Kurdistan Regional Government, Iraq) and with industrial support from Alltech, Alvan Blanch, Birchgrove Eggs, Ecomarine, Geminal Seeds, Kelvin Cave, NIAB, PGRO, Soya UK, Wynnstay Group PLC and in collaboration with the University of Aberystwyth (IBERS).

