Cargill corn protein concentrate trials

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ABSTRACT

A digestibility trial was conducted to evaluate the apparent digestibility coefficients (ADCs) of protein, fat, dry matter, and amino acids in rainbow trout fed diets containing three variants of corn protein concentrate (CPC): Empyreal 75, Balance, and LP. Diets were formulated using a 70:30 blend of a fishmeal-free reference diet and test ingredients, extruded under controlled thermal conditions, and fed to trout in a replicated tank system. Fecal samples were collected via manual stripping and analyzed using yttrium oxide as an inert marker. Results indicated high protein digestibility across all CPC variants, with Balance exhibiting the highest ADC for protein (83.0%) and lysine (90.1%). Empyreal 75 showed strong overall amino acid digestibility (83.8%), outperforming fishmeal in most categories. These findings support the nutritional efficacy of CPCs, particularly Balance and Empyreal 75, as viable protein sources in aquafeeds for rainbow trout.

DIGESTIBILITY OF EMPYREAL 75 VARIANTS

The apparent digestibility of nutrients, energy, and amino acid availability was determined for three variants of corn protein concentrate in compounded, extruded diets. The methodologies employed were standard procedures that are well established in the investigators' laboratories (e.g., Gaylord et al. 2004; Li et al. 2004). The methods of Cho et al. (1982) and Bureau et al. (1999) were used to estimate apparent digestibility coefficients (ADCs). Yttrium oxide will serve as the inert marker. A complete reference diet meeting or exceeding all known nutritional requirements was blended with the test ingredients in a 70:30 ratio (dry-weight basis) to form test diets (Table 1). The reference diet was fishmeal-free in order to reduce endogenous phosphorus levels and improve sensitivity of detection for test ingredients' phosphorus availability. This diet has been used successfully in several digestibility and growth trials with rainbow trout (Barrows et al., 2008; Gaylord et al., 2009; Barrows et al., 2009). Apparent digestibility coefficients of each nutrient in the test diet and ingredients were calculated according to the following equations (Kleiber 1961; Forster 1999):

$$ADCN_{diet} = 100 - 100 \left\{ \frac{\%\ Yt\ in\ diet}{\%\ Yt\ in\ feces} \times \frac{\%\ nutrient\ in\ feces}{\%\ nutrient\ in\ diet} \right\}$$

$$ADCN_{ingredient} = \{(a+b)\ ADCN_t - (a)\ ADCN_r\}\ b^{-1}$$

where,

$ADCN_{ingredient}$ = apparent digestibility coefficient of the nutrient in the test ingredient

$ADCN_t$ = apparent digestibility coefficient of the nutrient in the test diets

$ADCN_r$ = apparent digestibility coefficient of the nutrient in the reference diet

a = (1-p) x nutrient content of the reference diet

b = p x nutrient content of the test ingredient

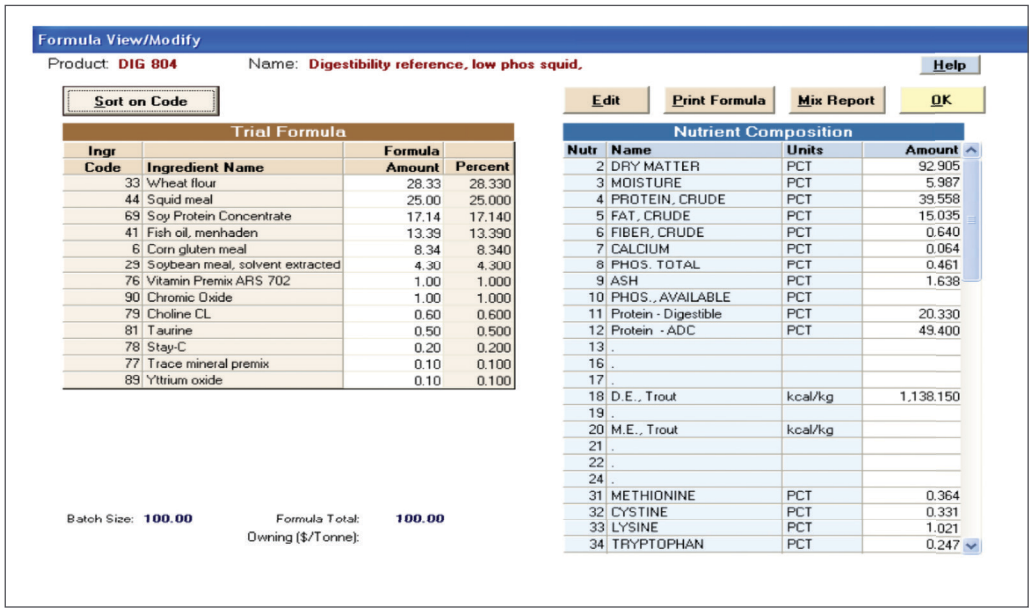
p = proportion of test ingredient in the test diet

All diets were manufactured by cooking extrusion (DNDL-44, Buhler AG, Uzwil, Switzerland) with an 18-s exposure to an average of 127°C in the sixth extruder barrel section. Pellets of 4-mm size were produced, then dried in a pulse-bed drier (Buhler AG, Uzwil, Switzerland) for 25 minutes at 102°C with a 10-minute cooling period. Final moisture level was less than 10%.

Rainbow trout were fed the experimental diets at the USDA/ARS Laboratory in Bozeman, Montana. Ten fish weighing approximately 700-g each were stocked into each of 21 500-L tanks. Water temperature was maintained at 15°C and lighting maintained on a 14:10 h diurnal cycle. Each diet was fed to three different tanks of fish and each diet was randomly assigned to a tank of fish and fed to apparent satiation by hand. Fecal samples were collected by manual stripping, 16-18 h post-feeding for trout. Manual stripping of all fish in each tank was accomplished by netting and anesthetizing the fish, followed by gently drying and then applying pressure to the lower abdominal region to express fecal matter into a plastic weighing pan. Care was taken to exclude urinary excretions from the collection. Fecal samples for a given tank were freeze-dried and stored at -20°C until chemical analyses were performed.

RESULTS

Table 2 shows the ADCs for protein fat dry matter and amino acids for the three variants of corn protein concentrate. ADCs for protein were high for all three variants, but the ADC protein for Balance was higher (83.0%) than for LP (78.0%) and Empyreal 75 (80.2%). This is also reflected in the amino acid ADCs, particularly lysine. The ADC for lysine for Balance was 90.1% and for Empyreal 75 and LP, 64.5% and 64.7%, respectively.



Formula View/Modify

Product: DIG 804 Name: Digestibility reference, low phos squid,

Help | Sort on Code | Edit | Print Formula | Mix Report | OK

Trial Formula

Ingr Code	Ingredient Name	Formula Amount	Percent
33	Wheat flour	28.33	28.330
44	Squid meal	25.00	25.000
69	Soy Protein Concentrate	17.14	17.140
41	Fish oil, menhaden	13.39	13.390
6	Corn gluten meal	8.34	8.340
29	Soybean meal, solvent extracted	4.30	4.300
76	Vitamin Premix ARS 702	1.00	1.000
90	Chromic Oxide	1.00	1.000
79	Choline CL	0.60	0.600
81	Taurine	0.50	0.500
78	Stay-C	0.20	0.200
77	Trace mineral premix	0.10	0.100
89	Yttrium oxide	0.10	0.100

Batch Size: 100.00 Formula Total: 100.00

Owning ($/Tonne):

Nutrient Composition

Nutr	Name	Units	Amount
2	DRY MATTER	PCT	92.905
3	MOISTURE	PCT	5.987
4	PROTEIN, CRUDE	PCT	39.558
5	FAT, CRUDE	PCT	15.035
6	FIBER, CRUDE	PCT	0.640
7	CALCIUM	PCT	0.064
8	PHOS. TOTAL	PCT	0.461
9	ASH	PCT	1.638
10	PHOS., AVAILABLE	PCT	
11	Protein - Digestible	PCT	20.330
12	Protein - ADC	PCT	49.400
13	.		
16	.		
17	.		
18	D.E., Trout	kcal/kg	1,138.150
19	.		
20	M.E., Trout	kcal/kg	
21	.		
22	.		
24	.		
31	METHIONINE	PCT	0.364
32	CYSTINE	PCT	0.331
33	LYSINE	PCT	1.021
34	TRYPTOPHAN	PCT	0.247

Table 1. Composition of Reference Diet for Digestibility Study.

	DM	Fat	Protein	Sum AA	Ala	Arg	Asp	Glu	Gly	His	Ile	Leu	Lys	Met	Phe	Pro	Ser	Thr	Tyr	Val
Fishmeal	54.3	94.9	64.9	69.6	75.0	78.8	50.4	68.5	69.5	68.2	72.4	73.3	66.1	71.4	73.2	71.7	68.8	68.8	73.8	72.5
Empyreal 75	67.0	76.9	80.2	83.8	85.8	87.5	75.1	84.5	71.5	80.3	81.6	86.3	64.5	84.9	86.2	83.4	85.1	78.2	88.4	85.9
Balance	78.4	85.2	83.0	85.9	88.2	89.3	76.9	87.1	77.3	82.9	85.6	88.6	90.1	87.4	88.8	86.9	69.8	82.9	90.4	83.9
LP	71.9	67.8	78.0	79.9	82.8	83.4	70.1	81.6	68.1	75.5	77.1	83.2	64.7	78.1	82.9	78.6	80.9	73.1	85.3	77.0

Table 2. Apparent Digestibility Coefficients for protein, fat, and amino acids for fishmeal and corn protein concentrates.

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