Chapter 3
Feeding Applications of Corn Fermented Protein Co-Products in Poultry Diets

Introduction

The use of corn fermented protein (CFP) co-products in poultry diets is much less studied than applications in swine and aquaculture diets. However, the high metabolizable energy (ME) and digestible amino acid content of CFP co-products are best suited in broiler and turkey diets due to the need to provide high energy and nutrient dense diets to support rapid growth. The following sections summarize ME content and amino acid composition and digestibility of various sources of CFP and include a growth performance and environmental impact studies with broilers and turkeys using CFP. Unfortunately, no studies have been conducted to evaluate the use of CFP in layer diets.

Nutrient Profile of Corn Fermented Protein Co-Products for Poultry

Nutritional composition

The protein, lipid, fiber, and ash content of three different brands of CFP produced using three different technologies is shown in **Table 1**. Note that although these CFP co-products contain similar crude protein, the Lys:Crude protein ratio varies from 3.82 to 4.19, but is much greater than found in conventional DDGS sources. Furthermore, lipid, fiber, and ash content are highly variable among CFP sources. Like DDGS, the calcium content of CFP co-products is low, and the P content varies from 0.68 to 1.1%. These results indicate that due to the variable non-protein nutritional components of CFP, it is essential for end-users to know the specific source being used in poultry feed formulations for optimizing nutritional efficiency and poultry performance.

Table 1. Comparison of protein, lipid, fiber, and ash composition of corn fermented protein sources and technologies

Analyte	ANDVantage 50Y[1]	NexPro[2]
Dry matter, %	90.0	100.00
Crude protein, %	51.1	53.0
Lys:crude protein	3.82	4.19
Ether extract, %	9.6	5.1
Acid hydrolyzed ether extract, %	9.90	-
Crude fiber, %	8.5	-
Neutral detergent fiber, %	27.5	24.1
Acid detergent fiber, %	20.0	4.83
Soluble dietary fiber, %	2.8	-
Insoluble dietary fiber, %	29.2	-
Total dietary fiber, %	32.0	-
Ash, %	2.17	5.49
Ca, %	0.01	0.05
P, %	0.68	1.1

S, %	0.64	-
Mg, %	0.07	-
K, %	0.29	-
Na, %	0.04	0.05

[1]Data from product specifications (as-fed basis) provided with permission by The Andersons, Inc.
[2]Published data (dry matter basis) obtained from Correy et al. (2019).

Metabolizable energy

Fewer estimates for metabolizable energy (ME) content of CFP sources have been determined in poultry compared with swine, but all three of the primary CFP production technologies have been evaluated (**Table 2**). Nitrogen-corrected true ME (TME_n) values have been determined for ANDVantage 50Y and NexPro co-products, while nitrogen-corrected apparent ME (AME_n) content for ProCap Gold have been determined (3,546 kcal/kg; unpublished data from Dr. Bill Dozier, Auburn University provided with permission from Marquis Energy). As a result, it is difficult to compare the relative ME content between these three sources, but it is clear that they all contain about 130 to 150% of the ME concentrations in conventional DDGS sources which makes CFP an excellent ingredient in broiler and turkey diets.

Table 2. Comparison of gross energy (GE), metabolizable energy (ME), and ME:GE of corn fermented protein sources for poultry (dry matter basis)

Analyte	ANDVantage 50Y[1]	NexPro[2]
Dry matter, %	93.76	93.52
GE, kcal/kg	5,636	5,366
ME, kcal/kg	3,378	3,713
ME:GE	0.60	0.69

[1]TME_n = nitrogen-corrected true metabolizable energy; Unpublished data provided with permission from The Andersons, Inc.
[2]TME_n value (average of 6 samples); Unpublished data provided with permission from POET.

Digestible amino acids

A comparison of indispensable and dispensable amino acid content and digestibility of ANDVantage 50Y and NexPro is shown in **Table 3**. Amino acid concentration and digestibility varies by source, but in general, CFP is a highly digestible amino acid ingredient for use in poultry diets. However, it is essential for end-users to know the specific source being used in feed formulations for optimizing nutritional efficiency and poultry performance.

Table 3. Comparison of crude protein and amino acid content and ileal digestibility of corn fermented protein sources for poultry

Analyte[1]	ANDVantage 50Y[2]	NexPro[3]
Dry matter, %	90.0	93.0
Crude protein, %	51.1	50.2
Lys:Crude protein	3.82	4.19
Arg	2.62 (91)	2.37 (96)
His	1.81 (89)	1.46 (91)
Ile	2.16 (87)	2.22 (93)
Leu	6.53 (93)	6.65 (94)
Lys	1.95 (83)	2.11 (85)

Met	1.08 (91)	1.26 (94)
Phe	2.75 (90)	2.82 (95)
Thr	1.98 (85)	2.17 (87)
Trp	0.42 (89)	0.51 (89)
Val	2.58 (87)	2.95 (90)
Ala	3.82	3.51 (91)
Asp	3.49	3.62 (87)
Cys	1.12 (92)	0.90 (87)
Glu	8.87	7.61 (93)
Gly	1.96	2.00
Pro	4.17	3.46 (93)
Ser	2.39	2.25 (89)
Tyr	2.32	2.08 (87)

[1]Values in parentheses are ileal digestibility coefficients (%) for amino acids in each co-product sources for poultry.
[2]Unpublished digestibility coefficients of amino acid data were obtained with permission from The Andersons, Inc.
[3]Total amino acid concentrations (dry matter basis) and digestibility coefficients were obtained with permission from POET.

Digestible phosphorus

No studies have been conducted to determine the phosphorus digestibility or relative availability in CFP sources for poultry. Mutucumarana et al. (2014) reported that the use of non-phytate P to estimate digestible phosphorus concentration in feed ingredients is not accurate because the digestible P content often determined in feed ingredients is often greater than the non-phytate concentrations, which suggests that birds can utilize a portion of nonphytate P. However, it is reasonable to use estimates of P digestibility and availability for poultry obtained from studies evaluating DDGS sources. Mutucumarana et al. (2014) reported that the true digestible phosphorus content of corn DDGS was 0.59%, which represented about 73% of the total P. Wamsley et al. (2013) determined that the availability of phosphorus in the DDGS source they evaluated was between 66 to 68%, which is in agreement with the values reported by Martinez-Amezcua et al. (2006). Therefore, until studies are conducted to determine the phosphorus digestibility and availability in CFP for poultry are conducted, it is reasonable to assume that about 60% of the total phosphorus in CFP is available to birds. However, it is important to note that several ethanol plants add phytase during the fermentation process which further increases the conversion of indigestible phytate to digestible phosphate (Reis et al., 2018). Nutritionists should request information about whether or not phytase is being used during the production process for the source of corn co-products they are using because it affects phosphorus digestibility values.

Summary of Corn Fermented Protein Feeding Trials with Broilers

Burton et al. (2021) conducted a growth performance trial to evaluate the effects of replacing soybean meal with CFP (NexPro) for broilers. Male Ross broilers were obtained from a commercial hatchery on the day of hatch, weighed, assigned to floor pens (9 birds/pen), and fed diets containing 0, 5, or 10% CFP. Diets were fed using a 2-phase feeding program with starter

diets fed from day 0 to 21, and grower diets fed from days 21 to 42. Dietary inclusion rate of CFP had no effect on final body weight and weight gain, but birds fed the 10% CFP diets had greater feed intake and poorer feed conversion compared with birds fed the control diet without CFP (**Table 4**). Nitrogen retention was similar for broilers fed the 10% CFP diets compared to those fed the control diet and was improved by feeding the 5% CFP diets (**Table 4**). Presumably, this improvement in dietary nitrogen utilization was a result of adding crystalline lysine, methionine, arginine, threonine, and valine to correct amino acid imbalances resulting from partially replacing soybean meal with CFP in these diets.

Table 4. Effects of feeding increasing dietary levels of corn fermented protein (NexPro) to broilers on growth performance, nitrogen retention, and carcass component yield during a 42-day feeding period (adapted from Burton et al., 2021)

	Dietary Corn Fermented Protein Inclusion Rate, %		
Measure	**0%**	**5%**	**10%**
Initial body weight, g	45	45	44
Final body weight, g	3,360	3,439	3,339
Weight gain, g	3,315	3,394	3,295
Feed intake, g/bird	4,878[b]	5,042[ab]	5,151[a]
Feed conversion ratio[2]	1.47[a]	1.49[a]	1.57[b]
Nitrogen retention, %	29.4[b]	30.4[a]	28.7[b]
Carcass breast, thigh, drum yield, kg	1.41	1.49	1.45

[a,b] Means without common superscripts within rows are different ($P < 0.05$).

Summary of Corn Fermented Protein Feeding Trials with Turkeys

Similar to the broiler study, Burton et al. (2021) conducted a growth performance trial to evaluate the effects of replacing soybean meal with CFP (NexPro) in turkey diets. Male BUT6 turkey poults were obtained from a commercial hatchery on the day of hatch, weighed, assigned to floor pens (5 birds/pen), and fed diets containing 0, 4, or 8% CFP. Diets were fed using a 2-phase feeding program with starter diets fed from day 0 to 21, and grower diets fed from days 21 to 42. Dietary inclusion rate of CFP had no effect on final body weight, weight gain, feed intake, and feed conversion compared with birds fed the control diet without CFP (**Table 5**). Nitrogen retention was greater for turkeys fed the 8% CFP diets compared to those fed the control diet (**Table 5**). Presumably, this improvement in dietary nitrogen utilization was a result of adding crystalline lysine, methionine, and threonine to correct amino acid imbalances resulting from partially replacing soybean meal with CFP in these diets.

Table 5. Effects of feeding increasing dietary levels of corn fermented protein (NexPro) to turkey poults on growth performance during a 42-day feeding period (adapted from Burton et al., 2021)

	Dietary Corn Fermented Protein Inclusion Rate, %		
Measure	**0%**	**4%**	**8%**
Initial body weight, g	66	66	66
Final body weight, g	2,328	2,423	2,518

Weight gain, g	2,262	2,357	2,452
Feed intake, g/bird	3,741	3,850	3,743
Feed conversion ratio[2]	1.66	1.64	1.61
Nitrogen retention, %	18.3[b]	21.0[ab]	21.8[a]

[a,b] Means without common superscripts within rows are different (P < 0.05).

Conclusions

The limited data available on the feeding value and growth performance responses of feeding corn fermented protein (CFP) co-products to broilers and turkeys indicate that CFP is a higher energy and more digestible amino acid ingredient compared with conventional DDGS sources and appears to support acceptable growth performance and nitrogen retention at inclusion rates up to 10% in broiler diets and 8% in turkey diets.

References

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