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High Efficiency Juncea Canola Meal, a potential high energy protein meal

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Introduction

The animal feed industry is facing serious problems from high prices of its main raw materials especially corn and soybean meal. High global demand particularly from China and competition from the biofuel industry has been driven up the price of grains, oilseeds and oils. Energy cost per Kcal has double or even triple from a few years back. The industry needs alternative feed ingredients that can partially replace corn and soybean meal. Previous trials have shown that with better processing, the AME and available/ digestible amino acids of soybean meal can be increased by about 10% (Creswell & Swick, 2008; Neoh, SB, 2008), and the value of this extra nutrient has been shown between USD43.6 to USD120.1/MT for soybean meal. There is a paper at this conference which argues there is still a need for high quality alternative protein meals with high energy.

Presently the most likely candidates to replace soybean meal are canola, sunflower and cottonseed meals as they are available in reasonable quantities and have protein levels comparable to soybean meal. Canola meal in particular has been reasonably successful in Australia and Canada for replacing soybean meal in poultry and pig diets. However canola meal has low AME of 2000 kcal/kg (NRC 1994) and its digestible amino acid about 10% lower than soybean meal. Newkirk (2002) has demonstrated that much of this lower availability of nutrients is due to processing, but the industry is unable so far to find a solution.

The key issue is whether the nutrient value of other alternative protein meals can be significantly increased by better processing techniques to a level comparable to soybean meal. Soon Soon Oilmills recently applied its high efficiency process to the processing of Juncea canola which is a dry land crop similar to canola, thus allowing it to be grown in low rainfall regions where canola will not thrive.

Juncea canola was developed as a drought and heat tolerant alternative oilseed to canola in Australia. Its oil and meal quality are similar to canola. The level and types of glucosinolates in the juncea canola meal meet the specification of canola meal with the total glusinolates less 30 umoles/g. (Primefact 786, 2009). Juncea canola oil is low in erucic acid (<2%) and moderate (57 - 63%) in Oleic acid (Australian Grain, 2009). The Juncea canola meal can therefore can be use to substitute canola meal in animal feedings.

Another challenge when replacing dehulled soybean meal with canola meal in broiler diets is that it is still commercially not practical to dehull canola, so the crude fiber / neutral detergent fiber (NDF) content of canola meal is more than double that of dehulled soybean meal and this will probably prevent a 100% replacement of soybean meal with canola meal in broiler diets. A previous study using canola meal at levels higher than 10% in broiler diet showed that growth rate decreased and feed intake conversion efficiency was poorer (Classen, 1992). However Prerez-Maldonado (2003) found that canola meal can be used up to 20% during starter phase and up to 30% during the finisher phase in broiler diets formulated on a digestible amino acid (DAA) basis. Another trial carried by Hameed et al, 2002, concluded that maximum weight and feed efficiency was found in quail rations containing 15% canola meal. All these evidences demonstrated that canola meal can be used as a protein supplement in broiler diet to partially replaced soybean meal.

For the purpose of this trial, the AME of High Efficiency Juncea Canola Meal (HE JCM) is assumed to be 2500kcal/kg compared with 2000 kcal/kg for normal canola meal and the digestible amino acids are increased by more than 5% over normal canola meal (Table 2). The nutrient matrix for the normal solvent extracted canola meal, expeller canola meal and HEJCM are listed in table 1. Subsequently the AME of the HE JCM was measured at BARC to be 2876kcal/kg (as fed basis) using broilers in metabolic cages.

Table 1: Nutrient Matrix of normal canola meal, expeller canola meal and High Efficiency Juncea Canola Meal

	*Normal Canola Meal	**Expeller canola meal	HE JCM
Crude Protein,%	37.5	36.3	35.0
ME Poultry, Kcal/kg	2000	2340	2500
Lysine,%	2.02	1.97	1.97
Methionine, %	0.72	0.70	0.7
M+C, %	1.60	1.56	1.56
Tryptophan, %	0.51	0.49	0.49
Threonine, %	1.56	1.50	1.5
Arginine, %	2.21	2.15	2.15
Isoleucine, %	1.43	1.39	1.39
Valine, %	1.86	1.79	1.79
Crude Fat, %	3.4	11.1	10
Crude Fibre, %	9.85	10.6	9
Digestible Lysine, %	1.515	1.54	1.606
Digestible Methionine, %	0.619	0.546	0.623
Digestible M+C, %	1.3	1.17	1.342
Digestible Tryptophan, %	0.362	0.382	0.418
Digestible Threonine, %	1.045	1.035	1.223
Digestible Arginine, %	1.068	1.849	1.874
Digestible Isoleucine, %	1.030	1.00	1.147
Digestible Valine, %	1.321	1.36	1.450

*Australian Canola Meal Guide
** Canola Council, Canola meal Feed Industry Guide, 4th Edition 2009

Table 2: Amino acid digestibility coefficients of US soybean meal, solvent extracted canola meal, expeller canola meal and HEJCM

	[1]US SBM	[2]Solvent Ext Canola Meal	[2] Expeller canola meal	HE JCM
Lysine	0.85	0.75	0.78	0.815
Methionine	0.9	0.86	0.78	0.89
M+C	0.88	0.81	0.75	0.86
Tryptophan	0.887	0.71	0.78	0.854
Threonine	0.85	0.67	0.69	0.815
Arginine	0.853	0.76	0.86	0.872
Isoleucine	0.82	0.72	0.72	0.825
Valine	0.81	0.71	0.76	0.810

1 David Creswell, Asian Poultry Magazine August 2007
2 Australian Canola Meal Guide
3 Canola Council, Canola meal Feed Industry Guide, 4th Edition 2009

Our present study seeks to establish the optimal level of HEJCM that can be used in broiler diets. Broiler diets with, 0%, 5%, 10% and 15% inclusion of HE JCM were prepared for the starter (0-16days) and grower (17 - 34 days) phases.

Materials and methods

This trial was conducted at Bangkok Animal Research Center (BARC) from January 27th to March 2nd, 2011. A total of 240 day old Arbor Acres Plus broiler chicks were used in this trial. The chicks were assigned to 4 treatments and each treatment with 6 replicates. The chicks were allocated equally over 24 pens and each pen contained 10 chicks. Chicks were raised on the solid concrete floor pens using rice hull as bedding material. Each pen measure 1m x 1m and equipped with a self feeder and two nipple water drinkers.

Four treatment diets with 0, 5%, 10% and 15% inclusion rate of HE JCM were offered to the birds. Diet formulations were showed in table 3 and 4. Starter diets were offered to th6 birds from 0 to 16 days of age and grower diets were offered from 17 to 34 days of age. The diets were offered in crumble form from 0 to 14 days and were then changed to pellet form from day 15 until the end of trial. The diets and water were provided *ad libitum* throughout the 34 days trial period.

Body weight of the birds was determined at 0, 16 and 34 days of age. Total feed consumption was measured at 16 and 34 days of age. Fecal moisture of broiler was scored at day 35. Mortality and culled rates were recorded daily.

Table 3: Starter diet formulation and calculated nutrient content (0- 16 days of age)

Feed ingredients	Diet			
Level of HE JCM, %	0	5	10	15
Corn	60.360	58.180	56.010	53.810
SS dehulled SBM	35.090	31.960	28.820	25.690
HE JCM	0.000	5.000	10.000	15.000
Palm oil	0.520	0.950	1.380	1.800
Limestone	1.240	1.210	1.190	1.170
MDCP 21	1.400	1.350	1.300	1.250
Salt	0.360	0.360	0.360	0.360
Sodium bicarbonate	0.200	0.190	0.180	0.170
Lysine HCL	0.160	0.170	0.180	0.200
DL Methionine	0.250	0.230	0.200	0.180
L Threonine	0.070	0.060	0.050	0.050

Choline chloride 60	0.100	0.090	0.080	0.070
Vitamins/ mineral	0.200	0.200	0.200	0.200
Cygro (coccidiostat)	0.050	0.050	0.050	0.050
Total, %	100.00	100.00	100.00	100.00
Calculated Nutrient				
ME, Kcal/kg	2950	2950	2950	2950
Protein, % (actual)	(21.3)	(21.5)	(21.6)	(21.8)
Digest. Lysine, %	1.2	1.2	1.2	1.2
Digest. Methionine, %	0.5471	0.5331	0.5191	0.5051
Digest. M+C, %	0.84	0.84	0.84	0.84
Digest. Tryptophan, %	0.2483	0.2485	0.2486	0.2487
Digest. Threonine, %	0.744	0.744	0.744	0.744
Digest. Arginine, %	1.3707	1.3521	1.3335	1.3149
Digest. Isoleucine, %	0.8375	0.8271	0.8167	0.8063
Digest. Valine, %	0.924	0.924	0.924	0.924
Calcium, %	0.84	0.84	0.84	0.84
Avail. P, %	0.42	0.42	0.42	0.42
Sodium, %	0.22	0.22	0.22	0.22
Choline, ppm	1850	1850	1850	1850

Table 4: Grower diet formulation and nutrient content (17- 34 days of age)

Feed ingredients	Diet			
Level of HEJCM, %	0	5	10	15
Corn	64.190	62.050	59.910	57.670
SS dehulled SBM	29.520	26.380	23.240	20.190
HE JCM	0.000	5.000	10.000	15.000
Palm oil	2.840	3.230	3.620	4.020
Limestone	1.070	1.050	1.030	1.010
MDCP 21	1.170	1.120	1.060	1.010
Salt	0.260	0.250	0.240	0.230
Sodium bicarbonate	0.200	0.200	0.200	0.200
Lysine HCL	0.150	0.160	0.180	0.190
DL Methionine	0.230	0.210	0.190	0.160
L Threonine	0.080	0.070	0.070	0.060
Choline chloride 60	0.040	0.030	0.020	0.010
Vitamins/ mineral	0.200	0.200	0.200	0.200
Cygro (coccidiostat)	0.053	0.053	0.053	0.053

Total, %	100.0	100.0	100.0	100.0
Calculated Nutrient				
ME, Kcal/ kg	3100	3100	3100	3100
Protein, % (Actual)	(19.0)	(19.1)	(19.3)	(19.5)
Digest. Lysine, %	1.05	1.05	1.05	1.05
Digest. Methionine, %	0.503	0.489	0.475	0.4606
Digest. MC, %	0.767	0.767	0.767	0.767
Digest. Tryptophan, %	0.2147	0.2148	0.217	0.2155
Digest. Threonine, %	0.672	0.672	0.672	0.672
Digest. Arginine, %	1.1949	1.1763	1.1576	1.1417
Digest. Isoleucine, %	0.7338	0.7233	0.7129	0.704
Digest. Valine, %	0.819	0.819	0.819	0.819
Calcium,%	0.72	0.72	0.72	0.72
Avail. P, %	0.36	0.36	0.36	0.36
Sodium, %	0.18	0.18	0.18	0.18
Choline, ppm	1450	1450	1450	1450

Results & Discussion

Table 5. Performance of HE JCM in broiler[1] at starter phase (0-16 days of age).

Juncea Canola meal %	Initial Wt, (g)	Final Wt, (g)	Gain, (g)	Feed, (g)	FCR[2]	Livability, (%)
0	43	684	641	789[ab]	1.249	98.3
5	43	696	653	804[a]	1.232	100.0
10	43	693	650	795[a]	1.224	100.0
15	43	675	632	771[b]	1.220	100.0
P value		0.1339	0.1301	0.0262	0.4142	0.4199
Pooled SEM		6.343	6.334	6.871	0.013	0.833
CV%		2.26	2.41	2.13	2.53	2.05

[a,b] Means within column with no common superscript differ significantly (P<0.05).
[1] Male broilers (Arbor Acres Plus).
[2] Feed conversion ratio uncorrected for mortality and culls.

Performance of HE JCM during the starter phase is shown in the table 5. There were no effects of feeding up to 15% meal on weight gains or on FCR.

There were some effects of HE JCM on feed intake, with 15% inclusion rate resulting in lower (P<0.05) feed intake when compared with diets using 5% and 10% inclusion rates. This is similar with Montazer-Sadegh *et al.* (2008) who found addition 8, 12 and 16% of rapeseed meal to the diet during the 7- 21 days period led to decreased feed intake.

Table 6. Overall performance of Soon Soon high efficiency Juncea canola meal in broiler[1] feeding (0-34 days of age).

Juncea Canola meal %	Initial Wt, (g)	Final Wt, (g)	Gain, (g)	Feed, (g)	FCR[2]	Livability, (%)	Faecal score
0	43	2385	2343	3632[b]	1.578	96.67	2.33
5	43	2398	2355	3715[ab]	1.578	100	2.00
10	43	2409	2366	3745[a]	1.599	98.33	2.33
15	43	2396	2353	3661[ab]	1.578	98.33	2.33
P value		0.8150	0.8202	0.0478	0.8796	0.5289	0.4962
Pooled SEM		17.423	17.398	27.909	0.022	1.552	0.183
CV%		1.78	1.81	1.85	3.37	3.87	19.88

[a,b,c] Means within column with no common superscript differ significantly ($P<0.05$).
[1] Male broilers (Arbor Acres Plus).
[2] Feed conversion ratio uncorrected for mortality and culls.
Fecal score 1 = hard, 2 = soft, 3 = watery.

The overall performance of broilers fed with diets containing HE JCM inclusion are shown in table 6. There were no differences in body weight gain or FCR among the diets with different inclusion rates of HE JCM.

At day 34, the broilers fed the diet with 10% HE JCM had the highest feed intake (3745g) which was higher ($P<0.05$) than those fed 0% HE JCM. However there was no significant differences in feed intake among the treatments with 5, 10 and 15% HE JCM inclusion. Other studies has shown that no reduction in feed intake was observed when canola meal was used up to 15% (Rojas *et al*., 1985 & Leeson *et al*., 1987).

The broilers of all treatments had similar fecal score. This indicates that the mortality and health of the broilers were not affected when HE JCM is used up to 15% in broiler diets.

Conclusions

This trial has clearly demonstrated that HE Juncea canola meal can be used in broiler diets up to at least 15% without adversely affecting the growth performance.

It is interesting to note that despite using a higher AME of 2500kcal for the HE JCM and digestible amino acid levels being set at more than 5% higher than canola meal, the HE JCM performed as well or better than diets using only soybean meal. This suggest that the AME and digestible amino acids of HE JCM may be even higher than the levels used in this trial. This is supported by the fact that the actual AME (as fed) of the HE JCM was measured at 2876kcal/kg at BARC using broilers in metabolic cages.

Such a canola meal will be potentially useful for inclusion in Asian broiler diets, providing support for soybean meal.

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