P3A: Alternative protein-rich feedstuff and advanced amino acid nutrition

Sonia Liu, Ruth Zadoks, Peter Selle, Mehdi Toghyani, Shemil Macelline, Eunjoo Kim

Acknowledgement

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Overview:

Reduce our reliance on imported SBM

Ten feeding studies were budgeted.

Eight have been completed, one is ongoing, and another scheduled for early 2026.

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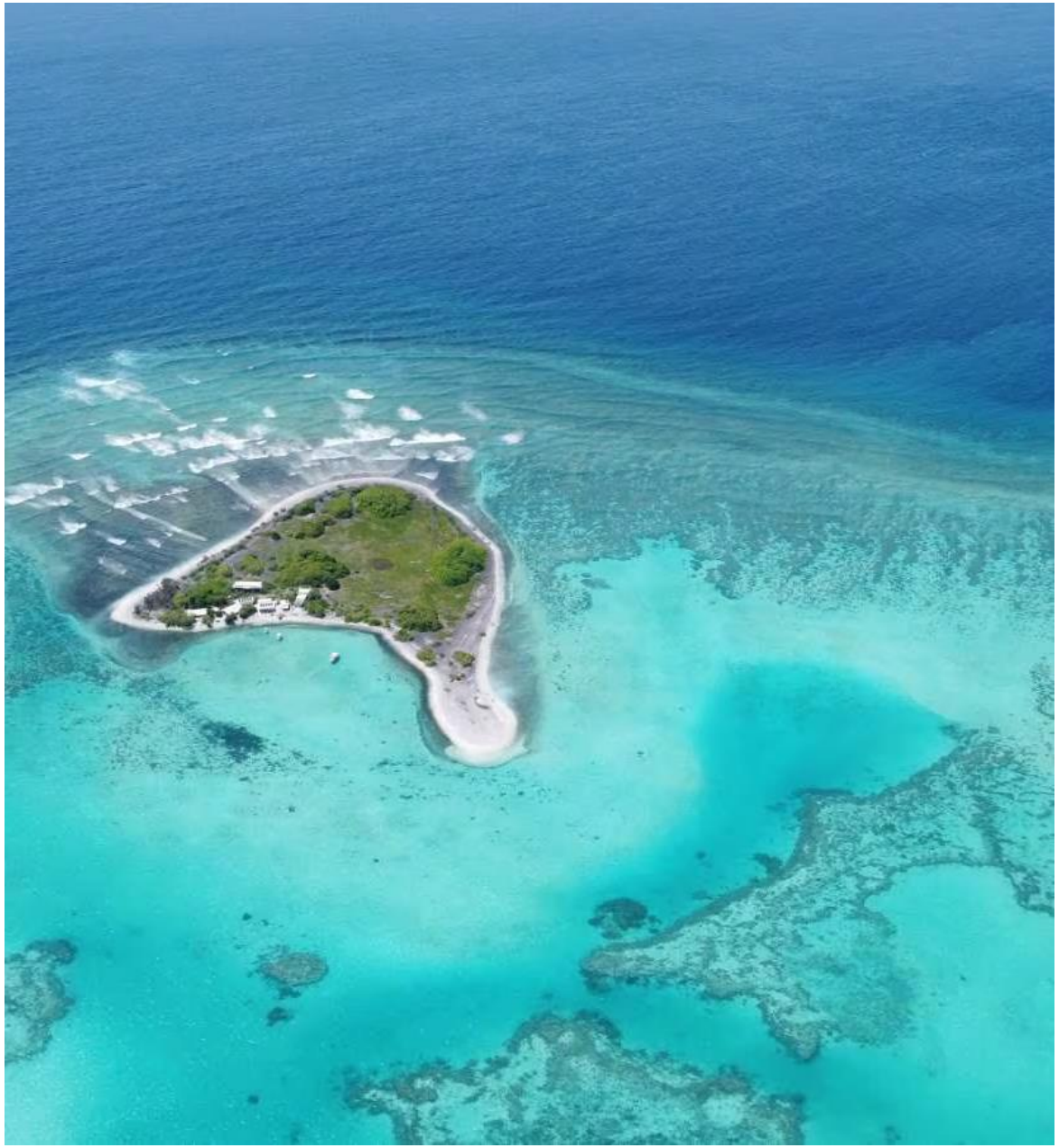

One Tree Island Research Station, The University of Syndey

The completed studies

Contents lists available at ScienceDirect

Animal Nutrition

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Review Article

The potential of canola to decrease soybean meal inclusions in diets for broiler chickens

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ABSTRACT

Feedstuffs derived from canola, predominantly canola meals plus whole, "full-fat" canola seed, and even canola protein isolates and/or concentrates, have the potential to decrease soybean meal inclusions in diets for broiler chickens. The protein content of soybean meal exceeds that of canola meal; however, canola meal contains more methionine and cysteine in absolute and relative terms. The purpose of this review is to explore this potential as Australian chicken-meat production is uniquely positioned to take advantage of this opportunity to the extent that it can be realised. Australia harvests ample quantities of canola, the bulk of which is exported as seed; alternatively, soybean production is very limited; therefore, large quantities of soybean meal are imported as the principal source of dietary protein for broiler chickens. This importation of soybean meal is not sustainable; however, canola meal inclusions in broiler diets do not usually exceed 100 g/kg. Regression equations derived from 15 recent studies indicate that dietary inclusions of 150 g/kg solvent-extracted canola meal would compromise weight gain by 4.04%

Kandel, M., Macelline, S. P., Toghyani, M., Chrystal, P. V., Choct, M., Cowieson, A. J., Liu, S. Y., and Selle, P. H. 2025. The potential of canola to decrease soybean meal inclusions in diets for broiler chickens. Anim. Nutr. 20:**342-354.**

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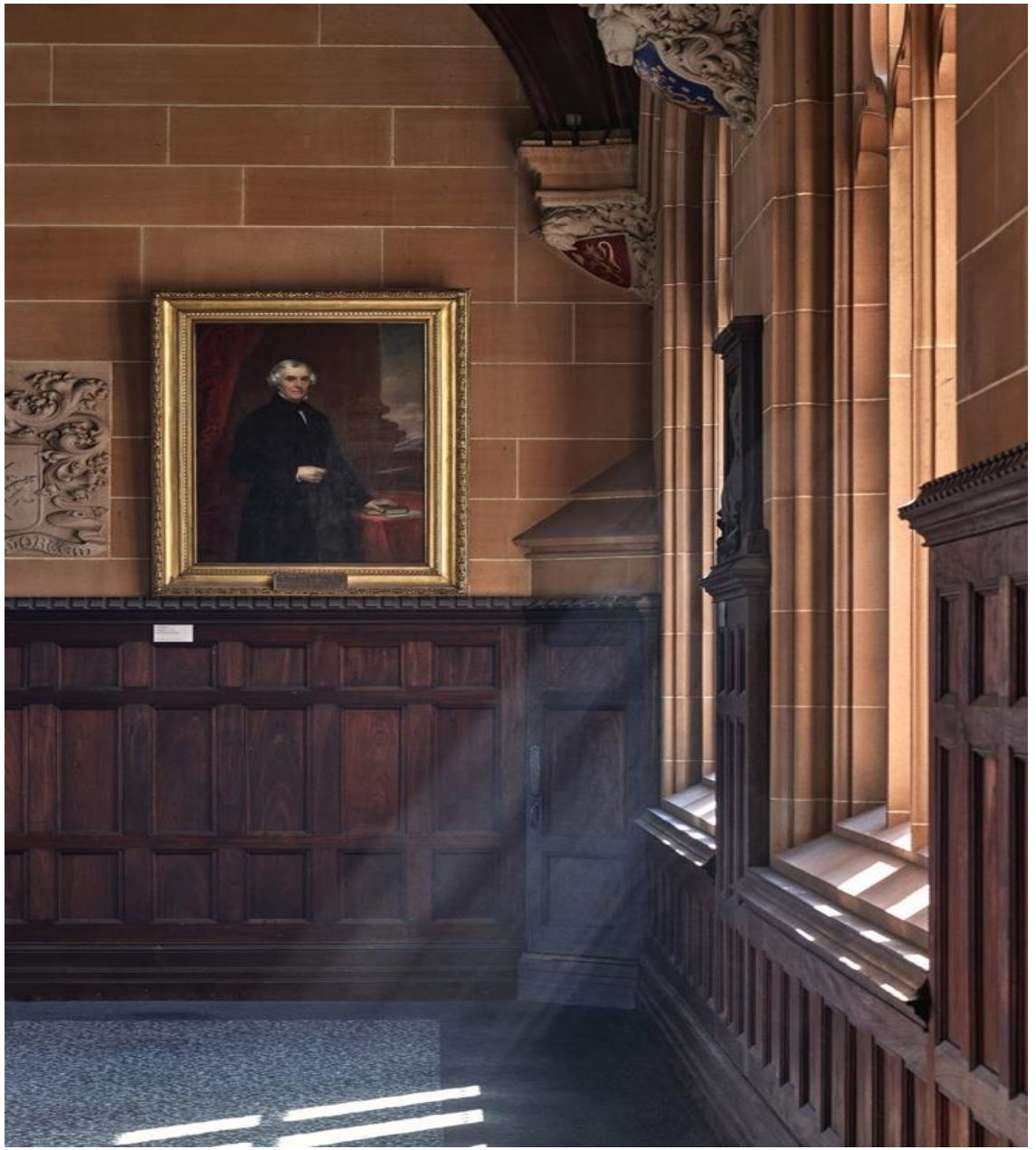

AC1 study – the maximal canola inclusion

Mr Milan Kandel

Contents lists available at ScienceDirect

Poultry Science

journal homepage: www.elsevier.com/locate/psj

The impact of canola meal and canola seed inclusions in broiler diets

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ARTICLE INFO

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Digestibility
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ABSTRACT

A total of 450 day-old straight-run Ross 308 broiler chickens were offered nine dietary regimes where canola products primarily replaced soybean meal at varying levels in iso-energetic diets with balanced amino acid profiles. Each of the nine dietary treatments was offered to ten replicate cages, with five birds per cage from 1 to 42 days post-hatch. During the starter period (1-10 d), there was no significant dietary impact on feed intake and feed conversion ratio (FCR) ($P > 0.05$) and transition of canola product inclusion from 0 to 50 g/kg did not influence weight gain but transition from 50 to 100 g/kg depressed weight gain by 2.17 % (317 versus 323 g/kg, $P = 0.049$). From 1-24, 1-35 and 1-42 days post-hatch, canola products inclusions depressed feed intake and weight gain ($P > 0.05$) compared to canola products-free diet. Dietary treatments did not influence FCR for 1-42 days post-hatch. Based on pair-wise comparisons diets containing the highest canola product inclusions (Treatment 9) reduced feed intake by 6.90 % (5673 vs. 5281 g/bird, $P = 0.011$) and body weight gain (BWG) by 7.11 % (3727 vs. 3462 g/bird, $P = 0.004$) compared to canola product-free diet. Negative correlations between feed intake and pellet durability index (PDI) were detected in the finisher ($r = -0.887$, $P = 0.001$) and withdrawal phases ($r = -0.869$, $P = 0.002$). Dietary treatments did not influence carcass traits ($P > 0.05$). Apparent metabolizable energy (AME), nitrogen retention, and AME_n were not affected by dietary treatments. However, diets with canola products exhibited a lower AME:GE ratio compared to canola-free diets ($P = 0.045$). There were no significant differences in apparent starch and protein digestibility coefficients in the distal jejunum and distal ileum ($P > 0.05$). In conclusion, since there were no significant changes in FCR and nutrient digestibility coefficients with the inclusion of canola products, it is fair to argue that depression of growth performance in broiler chicken offered diets containing high inclusion rates of canola products is likely due to a reduction in feed intake.

Trts	Starter	Grower	Finisher	Withdrawal	BWG/bird (g)	FI/bird (g)	FCR (g/g)	BWc FCR (g/g)
1	0%	0%	0%	0%	3727^{c}	5673^{c}	1.523	1.539
2	5%	12%	16%	22%	3598^{b}	5442^{b}	1.514	1.555
3	5%	12%	20%	26%	3510^{ab}	5308^{ab}	1.513	1.573
4	5%	16%	20%	30%	3513^{ab}	5279^{ab}	1.503	1.562
5	5%	12%	24%	30%	3456^{a}	5287^{ab}	1.530	1.601
6	5%	16%	24%	30%	3478^{a}	5230^{a}	1.506	1.572
7	10%	16%	20%	30%	3471^{a}	5271^{ab}	1.519	1.586
8	10%	16%	24%	30%	3462^{a}	5247^{ab}	1.517	1.586
9	10%	20%	24%	30%	3462^{a}	5281^{ab}	1.527	1.596
P-value					<0.001	<0.001	0.966	0.479

Feed Conversion Ratio-NS

~ 7% DROP IN BWG 250 g/bird

~ 7% DROP IN FI 400 g/bird

In conclusion, since there were no significant changes in FCR and nutrient digestibility coefficients with the inclusion of canola products, it is fair to argue that depression of growth performance in broiler chicken offered diets containing high inclusion rates of canola products is likely due to a reduction in feed intake.

NUTRITION GUT HEALTH ENVIRONMENT

AC2 - Impacts of Dietary Nutrient Density on Canola-based Broiler Diets

Mr Milan Kandel

Treatments	Characterization of diets
T1	Positive Control diet SBM + Canola seed at 4, 5, 6 and 7% in starter, grower, finisher and withdrawal diets, respectively
T2	High CM/CS diets at 15, 20, 25, 30% in starter, grower finisher and withdrawal diets, respectively
T3	T2 with 1.5, 2.0, 2.5 and 3.0% higher nutrient density, in starter, grower finisher and withdrawal diets, respectively (AA and ME)
T4	T2 with 3.0, 4.0, 5.0 and 6.0% higher nutrient density, in starter, grower finisher and withdrawal diets, respectively (AA and ME)

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Research Report

Increased dietary nutrient density did not restore growth performance in broiler chickens offered diets with high canola inclusion

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Energy
Growth
Feed cost

SUMMARY

Feed intake reduction is one of the key challenges in diets formulated with higher inclusions of canola products for broiler chickens. Increasing dietary nutrient densities was proposed to compensate for nutrient losses caused by decreased feed intake. Hence, this study investigated whether increasing amino acid and energy density in diets with higher inclusions of canola products restores growth performance in straight-run Ross 308 broiler chickens. The study included four dietary treatments: a typical wheat-soybean meal-based control diet (T1), a diet with high inclusions of canola products at 15, 20, 25, 30 % in starter, grower finisher and withdrawal diets, respectively (T2), and two diets (T3 and T4) with higher nutrient densities compared to T2. In T3 and T4, nutrient densities were progressively increased across phases, with T3 increasing by 1.5 % to 3.0 % and T4 increasing by 3.0 % to 6.0 %. Body weight gain ($P < 0.001$), feed intake ($P < 0.001$), FCR ($P = 0.003$), and body

Kandel, M., Macelline, S. P., Melwani, R. R., Toghyani, M., Zadoks, R. N., Selle, P. H., and Liu, S. Y. 2025. J. Appl. Poult. Res. 34**:100566.**

NUTRITION GUT HEALTH ENVIRONMENT

AC5- dietary strategies to improve feed take in broiler chickens offered diets containing high levels of canola products

Mr Milan Kandel

Treatments	Feed additive /nutrient strategy
PC	Control (wheat-SBM, 6% CS in GRW and 7% CS in FIN)
NC1	Medium inclusions of CM at 8% and 9% in grower and finisher phases
NC2	High inclusions of CM at 9% and 18% in grower and finisher phases
NC1 + VP	VP multi-carbohydrase
NC2 + PB	Pellet binder (inclusion: 1 g/kg)
NC2 + Glu	Glutamate (10 g/kg)
NC2 + I	Iodine (15 mg/kg)
NC2 + SB	**Sodium metabisulphite (2.50 g/kg)**
NC2 + Met	NC2 diet formulated with 10% higher digestible methionine
NC2 + FB	**NC2 diet formulated with faba beans**

Treatments	FCR D9-35(g/g)
PC	1.433^{d}
NC1	1.412^{cd}
NC2	1.393^{bc}
NC1 + VP	1.378^{abc}
NC2 + PB	1.400^{bcd}
NC2 + Glu	1.392^{bc}
NC2 + I	1.375^{abc}
NC2 + SB	1.372^{ab}
NC2 + Met	1.380^{abc}
NC2 + FB	1.353^{a}
SEM	0.008
P -value	<0.001

NUTRITION GUT HEALTH ENVIRONMENT

Mr Milan Kandel

Study 1 (AC10) – Cage study, Using field peas, canola product and moderate levels of non-bound amino acids to replace SBM

Treatments	SBM inclusions	Pea inclusions	Dietary CP
Diet 1A	Conventional	-	CP
Diet 2B	Medium	-	CP – 1%
Diet 3C	Low/Nil	-	CP – 2%
Diet 4D	Conventional	+	CP
Diet 5E	Medium	+	CP – 1%
Diet 6F	Low/Nil	+	CP – 2%

Diets	Starter				Grower				Finisher				Withdrawal			
	SBM	Pea	Wheat	NBAA	SBM	Pea	Wheat	NBAA	SBM	Pea	Wheat	NBAA	SBM	Pea	Wheat	NBAA
1	230	-	621	15.9	170	-	653	13.7	140	-	707	13.2	100	-	708	15.3
2	180	-	680	27.4	120	-	719	25.1	70	-	759	25.5	50	-	781	27.9
3	130	-	720	39.5	70	-	760	37.1	-	-	796	38.6	-	-	816	34.2
4	230	50	583	14.9	170	80	591	12.1	140	100	630	11.2	100	120	603	12.1
5	180	50	646	26.2	120	80	658	23.0	70	100	686	22.9	50	120	590	25.2
6	130	50	660	33.7	70	80	706	35.2	-	100	726	36.3	-	120	709	32.2

Kandel, M., Toghyani, M., Macelline, S. P., Selle, P. H., Zadoks, R. N., and Liu, S. Y. 2025. The impact of soybean meal and field peas inclusion on growth performance, carcass traits and nutrient digestibilities in broiler chickens offered wheat-based diets. Anim. Nutr.:**10.1016/j.aninu.2025.1003.1011.**

In conclusion, replacing SBM with 5-12% field peas and NBAAs in wheat-based broiler diets to achieve a 20 g/kg dietary CP reduction did not compromise growth performance in broiler chickens.

NUTRITION & GUT HEALTH ENVIRONMENT

AC7- Impact of wheat particle size in reduced soybean meal diets (canola, peas, meat meal and NBAAs) on broiler growth performance (WW: whole wheat)

Diets	Characterization of diets
T1	Standard SBM- Wheat diet (3.2mm GRW, 3.2mm FIN diets)
T2	Standard SBM- Wheat diet (3.2mm GRW, 6mm FIN diets)
T3	Standard SBM- Wheat diet (6mm GRW, 6mm FIN diets)
T4	Standard SBM- Wheat diet (7.5% WW in GRW, 15% WW in FIN diet)
T5	Low/nil SBM- Wheat diet(3.2mm GRW, 3.2mm FIN diets)
T6	Low/nil SBM- Wheat diet (3.2mm GRW, 6mm FIN diets)
T7	Low/nil SBM- Wheat diet (6mm GRW, 6mm FIN diets)
T8	Low/nil SBM- Wheat diet (7.5% WW in GRW, 15% WW in FIN diet)

Mr Milan Kandel

- Regardless of particle size, low SBM diets had worse performance (2434 versus 2354 g/kg in BWG, 1.486 versus 1.531 in FCR) from 0-35 days post-hatch.

- There is a trend that whole wheat inclusion reduced FI in std-SBM diets (3680 versus 3573 g/kg) but increased FI in low-SBM diets (3513 versus 3666 g/kg, P = 0.064)

NUTRITION GUT HEALTH ENVIRONMENT

Legumes!

Photo by Jose Quinteros

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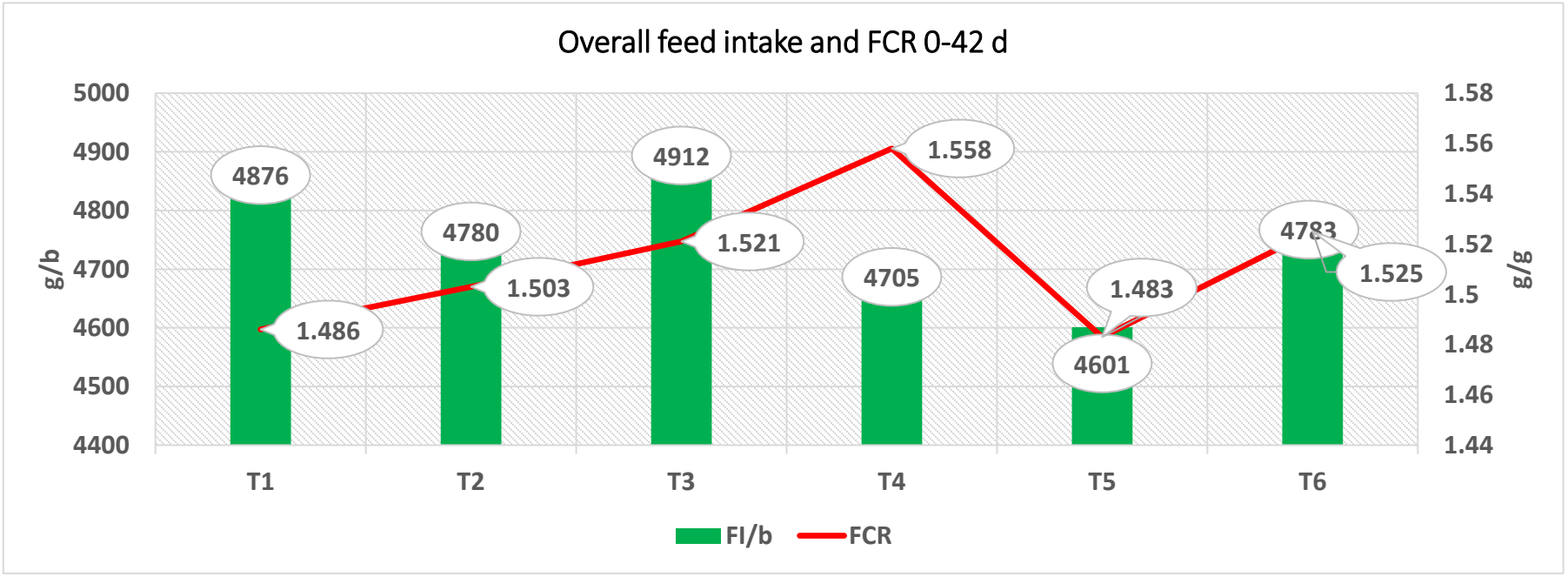
AC3 - Field peas and faba beans as alternatives to soybean meal

✓ **360 day-old straight-run Ross 308 broiler chicks allocated to 6 treatments – 10 reps of 6 birds**

TRT	Reductions of soybean meal inclusions (%)				legume
	STR (0-10 d)	GRW (10-25 d)	FIN (25-35 d)	WDRL (35-42 d)	
1	-	-	-	-	-
2	40 (12%)	66 (17%)	100 (25%)	100 (25%)	Peas
3	40 (12%)	66 (17%)	100 (25%)	100 (25%)	Faba beans
4	55 (17%)	100 (25%)	100 (25%)	100 (25%)	Peas
5	55 (17%)	100 (25%)	100 (25%)	100 (25%)	Faba beans
6	70 (12+12%)	100 (12.5+12.5%)	100 (12.5+12.5 %)	100 (12.5+12.5 %)	Peas + Faba

Ms Shay Sadr



- **T2 and 3 worked**
- **STR and GRW?**
- **T6? Why good**

NUTRITION GUT HEALTH ENVIRONMENT

AC4 – Optimize diets using faba beans to replace SBM

Ms Shay Sadr

Treatment	% of Faba bean inclusion STR, GRW, FIN	% of SBM reduction STR, GRW, FIN	Balancing Trp	Balancing for Gly equiv
1	15, 18 and 21%	50, 65 and 80%	Nil	Nil
2	15, 18 and 21%	50, 65 and 80%	Nil	Yes
3	15, 18 and 21%	50, 65 and 80%	Yes	Nil
4	15, 18 and 21%	50, 65 and 80%	Yes	Yes
5	18, 21 and 24%	70, 85 and 100%	Nil	Nil
6	18, 21 and 24%	70, 85 and 100%	Nil	Yes
7	18, 21 and 24%	70, 85 and 100%	Yes	Nil
8	18, 21 and 24%	70, 85 and 100%	Yes	Yes
Control	Formulate based on soybean meal diet			

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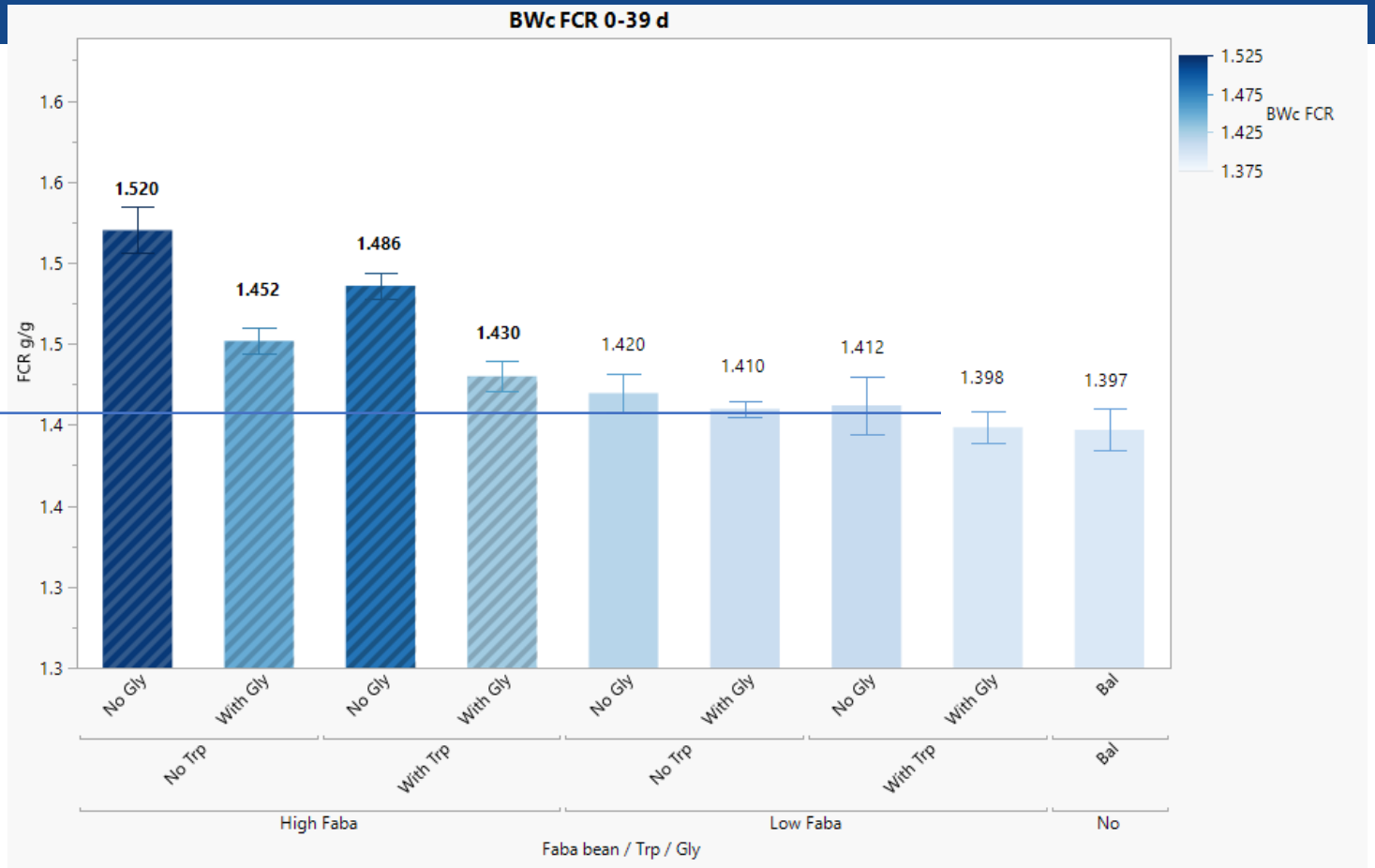


P-value		
Faba Beans		<.001
Tryptophan		0.008
Glycine		<.001
Faba × Trp		0.068
Faba × Gly		0.003
Trp × Gly		0.433
Faba × Trp × Gly		0.570

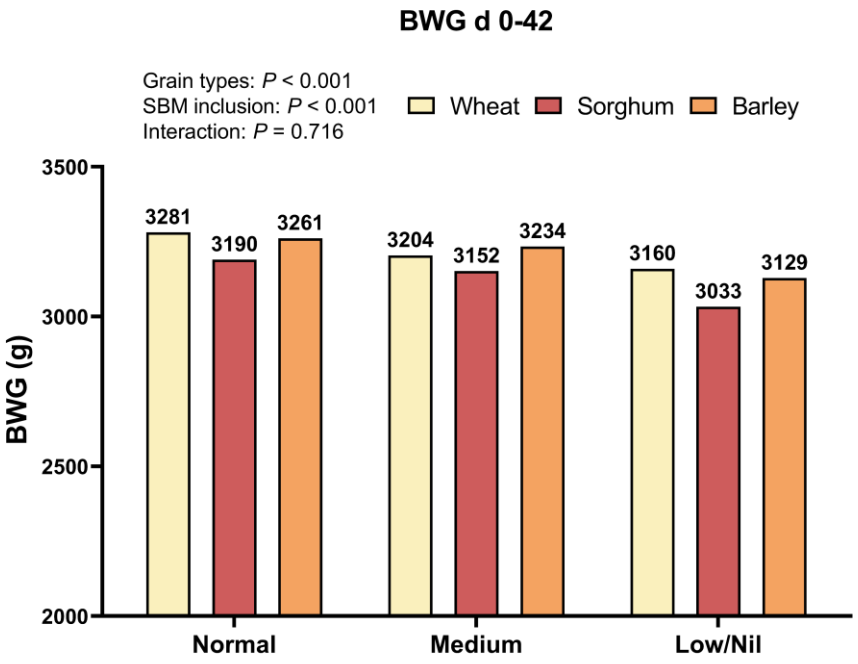
Diet Performance Summary:

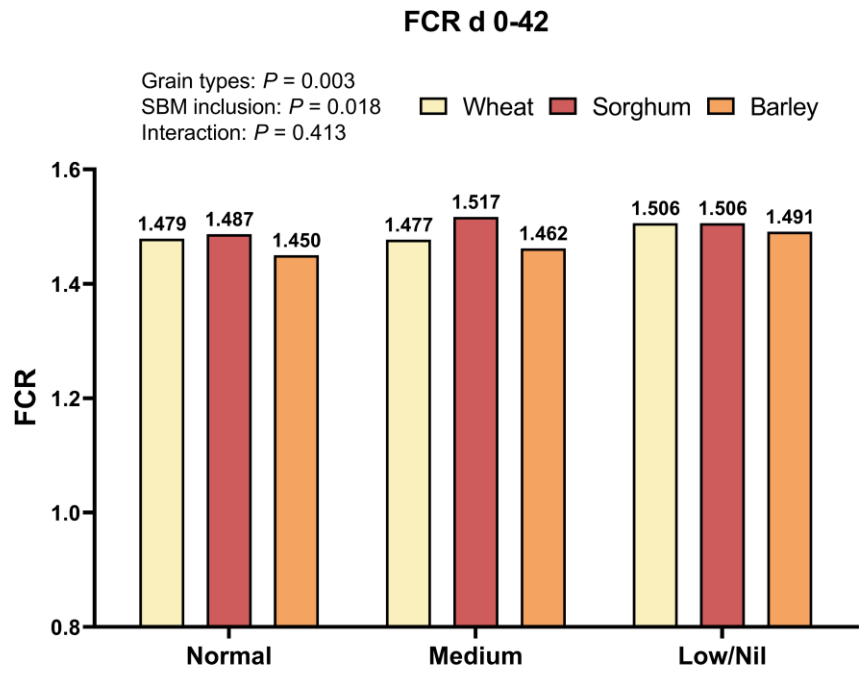
- Diets with low faba bean + Trp + Gly performed similarly to the industry control.
- Removing either Trp or Gly from low faba bean diets results in a 1-point increase in FCR (non-significant).
- Removing both Trp and Gly from low faba bean diets leads to a 2-point increase in FCR (non-significant).
- High faba bean diets show a 7.5-point increase in FCR compared to the industry control ($P < 0.05$).
- Supplementing both Trp and Gly improves FCR, but Gly is more critical for performance ($P < 0.05$).

NUTRITION GUT HEALTH ENVIRONMENT

AC6 - The impact of base grain and SBM inclusions on growth performance

Ms Yutong Fu





Grain types		SBM inclusion	
Wheat	3215[a]	Normal	3244[a]
Sorghum	3125[b]	Medium	3196[a]
Barley	3208[a]	Low/nil	3107[b]

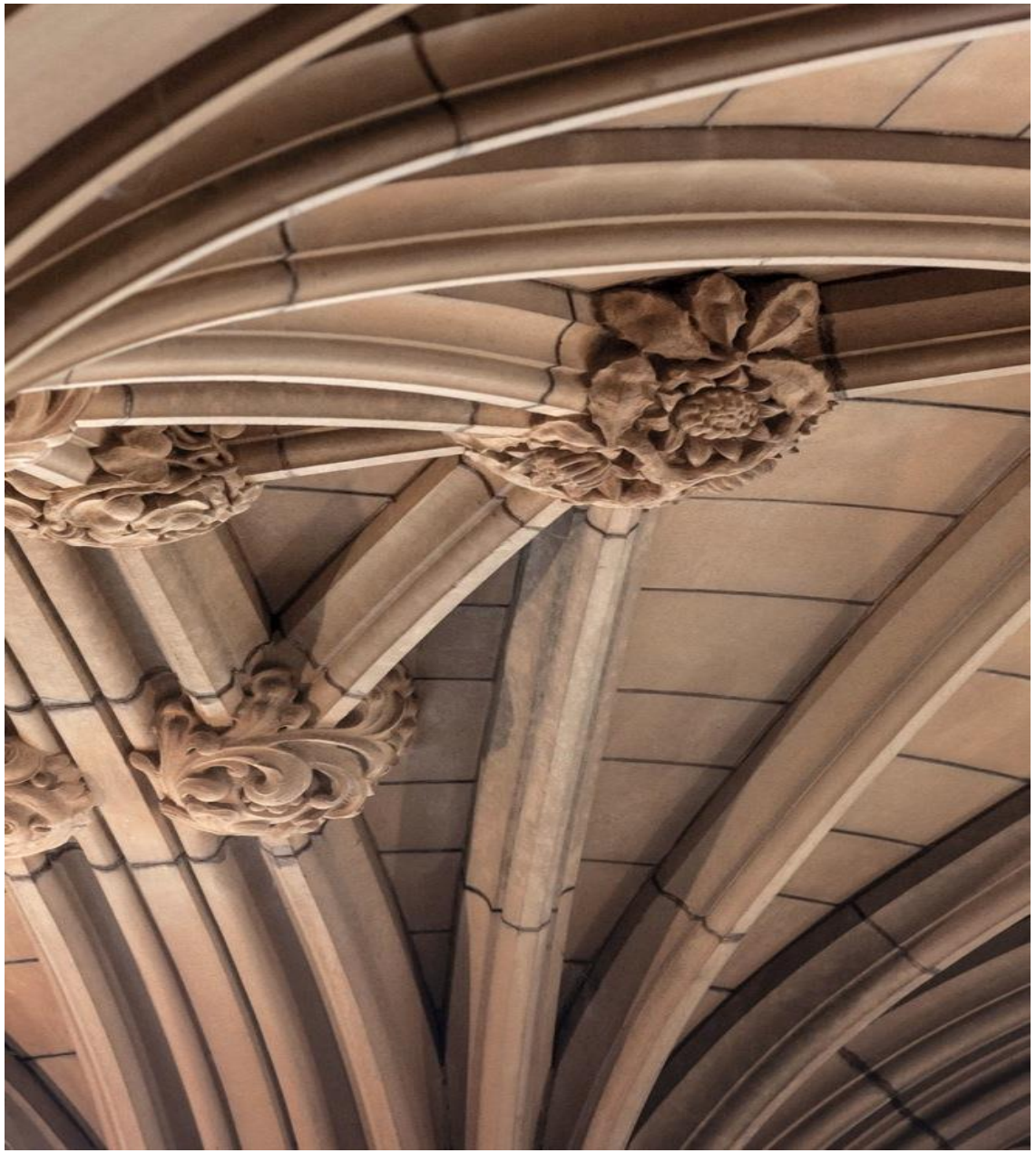
Grain types		SBM inclusion	
Wheat	1.487[ab]	Normal	1.472[b]
Sorghum	1.503[a]	Medium	1.485[ab]
Barley	1.467[b]	Low/nil	1.501[a]

Soybean meal inclusion can be reduced by 25%, 50%, and 75% in starter, grower, and finisher diets, respectively, without compromising growth performance. However, further reductions of 50%, 75%, and 100% led to a decrease in weight gain by 113 g per bird, an increase of FCR by 2 points

Final steps

Young birds?

Performance benefit of low protein diets?



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AC8 – optimizing starter nutrition to compensate performance loss

Dr Shemil Macelline

Ms Yutong Fu

Diet	Starter (0-14 days)	Grower (15-24 days)	Finisher (25 to 35 days)
1	Industry control	Industry control	Industry control
2	Industry control, High Lys, Met, Thr (10% increase)	Industry control	Industry control
3	Industry control	Low-SBM diet (60% reduction)	Nil-SBM diet
4	Industry control, High Lys, Met, Thr **(10% increase)**	Industry control	Nil-SBM diet
5	Industry control, High Lys, Met, Thr **(10% increase)**	Low-SBM diet	Nil-SBM diet
6	Industry control, High AA density **(10% increase)**	Industry control	Nil-SBM diet
7	Industry control, **High AA density (10% increase)**	Low-SBM diet	Nil-SBM diet

NUTRITION GUT HEALTH ENVIRONMENT

AC9 (2026) Treatment arrangement

Dr Mehdi Toghyani

Balanced for:
Lys, M+C, Thr, Trp, Ile, Val and Arg

- Each treatment replicated 8 times with 25 birds per rep
- Collet faeces at the end of each phase to analyse for N
- Litter quality measurement at the end of each phase – selected TRT
- Foot pad and hock scoring on day 48
- Carcass parameters (3 birds/rep) on day 49

	% of dietary crude protein levels								
Phase	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
Starter 1 - 10 d	**23**	**22**	**21**	**23**	**23**	**23**	**23**	**23**	**23**
Grower 11 - 24 d	**21.5**	**20.5**	**19.5**	**20.5**	**19.5**	**21.5**	**21.5**	**21.5**	**21.5**
Finisher 25 - 35 d	19.5	**18.5**	**17.5**	**18.5**	**17.5**	**18.5**	**17.5**	**19.5**	**19.5**
Withdrawal 36 – 49 d	**18.5**	**17.5**	**16.5**	**17.5**	**16.5**	**17.5**	**16.5**	**17.5**	**16.5**

NUTRITION GUT HEALTH ENVIRONMENT

What else?

- Feed intake regulation in broiler chickens offered canola diets (transcriptomic analysis, APSS2026, Ms Shay Sadr)
- Gut health and NSP fermentation in diets containing NBAA and alternative feed ingredients (AC6 study, Ms Yutong Fu and Dr Eunjoo Kim)

Data pending:

- Shift in host–diet–microbial interactions (Dr Irene Li, AC2, AC3, AC4, and AC6)
- Host gene expression to understand nutrient utilisation and absorption, gut integrity (A/Prof Reza Barekatain AC3, AC4 and AC6)

NUTRITION
GUT HEALTH
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2026 Graduates

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NUTRITION GUT HEALTH ENVIRONMENT

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