Increasing dietary inclusion of camelina meal for laying hens: Effects on performance and egg quality

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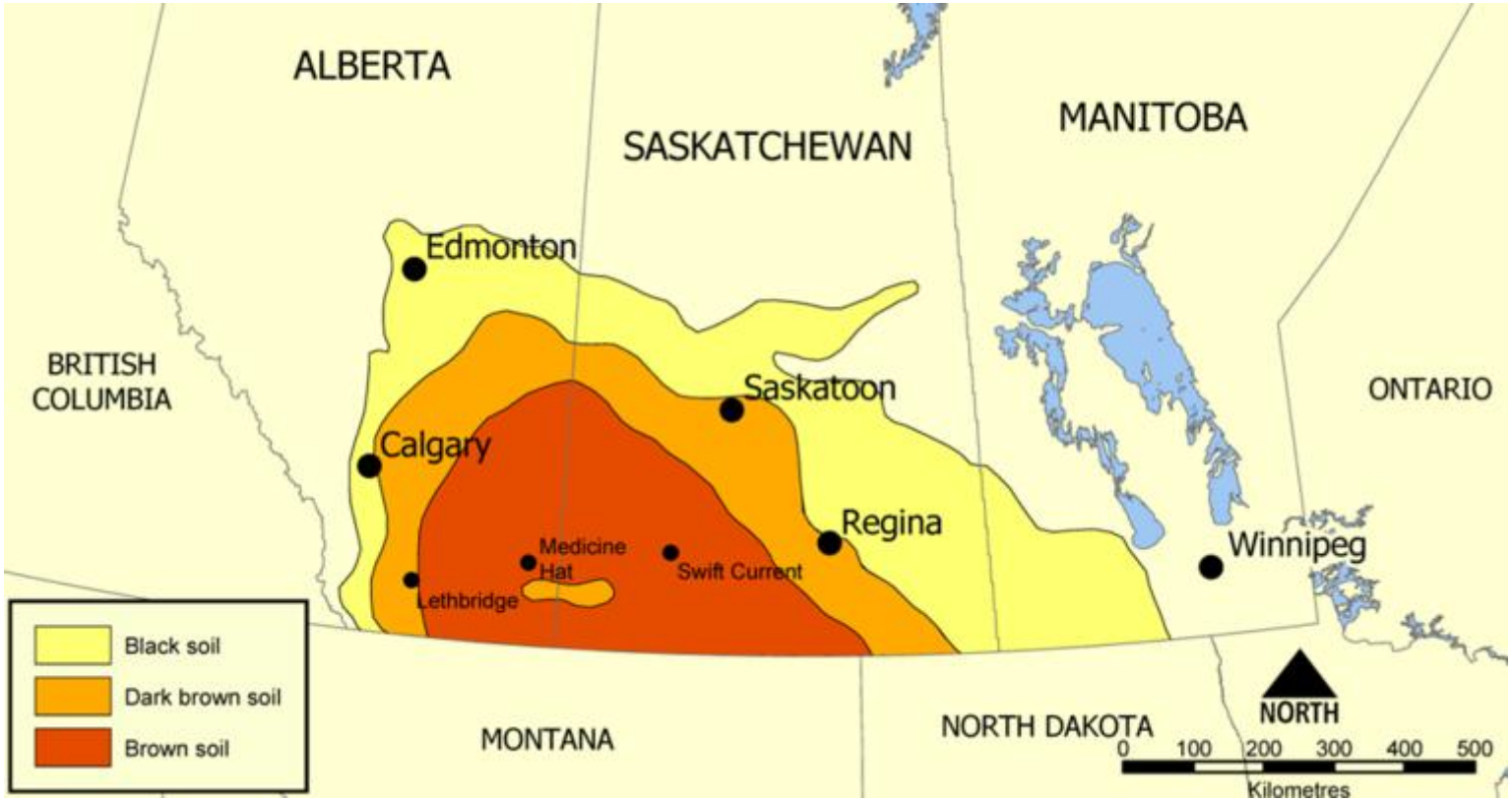
Background



Background

- Plenty of interest in camelina oil
  - Bio-SPK (jet fuel) for renewable aircraft fuel
  - ‘Boutique’ or ‘artisanal’ cooking oil

Background

- **The catch:** camelina meal not currently registered as feedstuff under Schedule IV of *Feeds Act*
  - Meal therefore has little commercial value to processors
- Expeller meal could be alternative to flax as source of n-3 to yield enriched animal products

Background

Table 1. Typical fatty acid content of camelina, canola, linseed, and sunflower oils.

Oil source	16:0[a]	18:0	18:1	18:2	18:3	20:0	20:1	22:1
	%							
Camelina	7.8	3.0	16.8	23.0	31.2	0	12.0	2.8
Canola	6.2	0	61.3	21.6	6.6	0	0	0
Linseed	5.3	3.1	16.2	14.7	59.6	0	0	0.9
Sunflower	6.0	4.0	16.5	72.4	0	0	0	0

Objectives

- To collect safety and efficacy data required to register expeller pressed meal for laying hens
- To study the effect of increasing dietary inclusion on performance and egg quality of layers fed diets containing up to 25% expelled camelina meal

Objectives (cont'd)

- Main questions we want to answer:
  - Can layers tolerate up to 25% inclusion of camelina meal without adversely affecting feed intake or bird health?
  - Are there any adverse impacts on performance or product quality not related to nutrient supply?
  - How accurate are our (i.e., MRFG) estimates of digestible nutrient content in camelina meal for poultry?

METHODS AND MATERIALS

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Methods and Materials

- EXP camelina meal (CAM) from Three Farmers/Canpressco (Midale, SK)
- Formulated iso-caloric, iso-nitrogenous diets containing 0, 5, 10, 15, 20, 25% of CAM
  - Digestible nutrient targets all in ratios to AME

Diet formulations

Ingredient	Expeller-pressed camelina meal inclusion, %					
	0%	5%	10%	15%	20%	25%
Corn grain	-	5.00	10.00	15.00	20.00	25.00
Wheat grain	-	0.84	1.68	2.52	3.36	4.20
Barley grain	58.64	51.37	44.11	36.84	29.58	22.31
Soybean meal	12.99	11.07	9.15	7.24	5.32	3.40
Wheat DDGS	10.00	8.87	7.74	6.61	5.48	4.35
Camelina meal	-	5.00	10.00	15.00	20.00	25.00
Canola oil	6.70	6.24	5.79	5.33	4.88	4.42
Salt	0.05	0.07	0.09	0.10	0.12	0.14
Sodium bicarbonate	0.37	0.36	0.35	0.35	0.34	0.33
Limestone (fine/coarse)	9.28	9.25	9.22	9.20	9.17	9.14
Dicalcium phosphate	0.49	0.47	0.45	0.43	0.41	0.39
Lysine HCl	0.15	0.15	0.16	0.16	0.17	0.17
D,L – Methionine	0.18	0.16	0.15	0.13	0.12	0.10
Threonine	0.10	0.08	0.06	0.04	0.02	-
Vitamin/mineral premix	1.00	1.00	1.00	1.00	1.00	1.00
Superzyme Plus	0.05	0.05	0.05	0.05	0.05	0.05

Target nutrient specs

		Expeller-pressed camelina meal inclusion, %					
Nutrient, %	**Target**	**0%**	**5%**	**10%**	**15%**	**20%**	**25%**
Crude fat	minimize	8.40	8.49	8.57	8.66	8.74	8.83
Crude protein	17.25	17.25	17.25	17.25	17.25	17.25	17.25
AME, Mcal/kg	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Digestible CP		14.93	14.69	14.46	14.22	13.98	13.75
Linoleic acid	1.90	2.14	2.20	2.25	2.31	2.36	2.42
Calcium	3.70	3.70	3.70	3.70	3.70	3.70	3.70
Available P	0.38	0.43	0.43	0.43	0.43	0.43	0.43
Sodium	0.17	0.17	0.17	0.17	0.17	0.17	0.17
AID Arginine	0.67	0.79	0.82	0.84	0.87	0.90	0.93
AID Isoleucine	0.52	0.65	0.63	0.61	0.59	0.57	0.55
AID Lysine	0.65	0.73	0.72	0.71	0.70	0.69	0.68
AID Methionine	0.32	0.40	0.39	0.38	0.37	0.36	0.35
AID Met + Cys	0.59	0.67	0.66	0.65	0.64	0.63	0.62
AID Threonine	0.46	0.53	0.52	0.51	0.50	0.50	0.49
AID Tryptophan	0.14	0.26	0.25	0.24	0.23	0.22	0.21
AID Valine	0.57	0.70	0.70	0.70	0.70	0.69	0.69

Methods and Materials (cont'd)

- Test system:
  - Nick Chick (n=144) and Brown Nick hens (n=144; H & N International)
  - Housed in conventional battery (668 cm^2/bird)

Methods and Materials (cont'd)

- Experimental design:
  - RCB design with 6 replicate cages (4 hens/cage) per treatment
  - Sampling unit
    - Bird (or parts thereof) = BW, Post-mortem, serology
    - Egg = egg quality measures, component wts, sensory evaluation
    - Composite egg/yolk sample = egg fatty acids, yolk TMA
    - Cage = ADFI, egg:feed

Methods and Materials (cont'd)

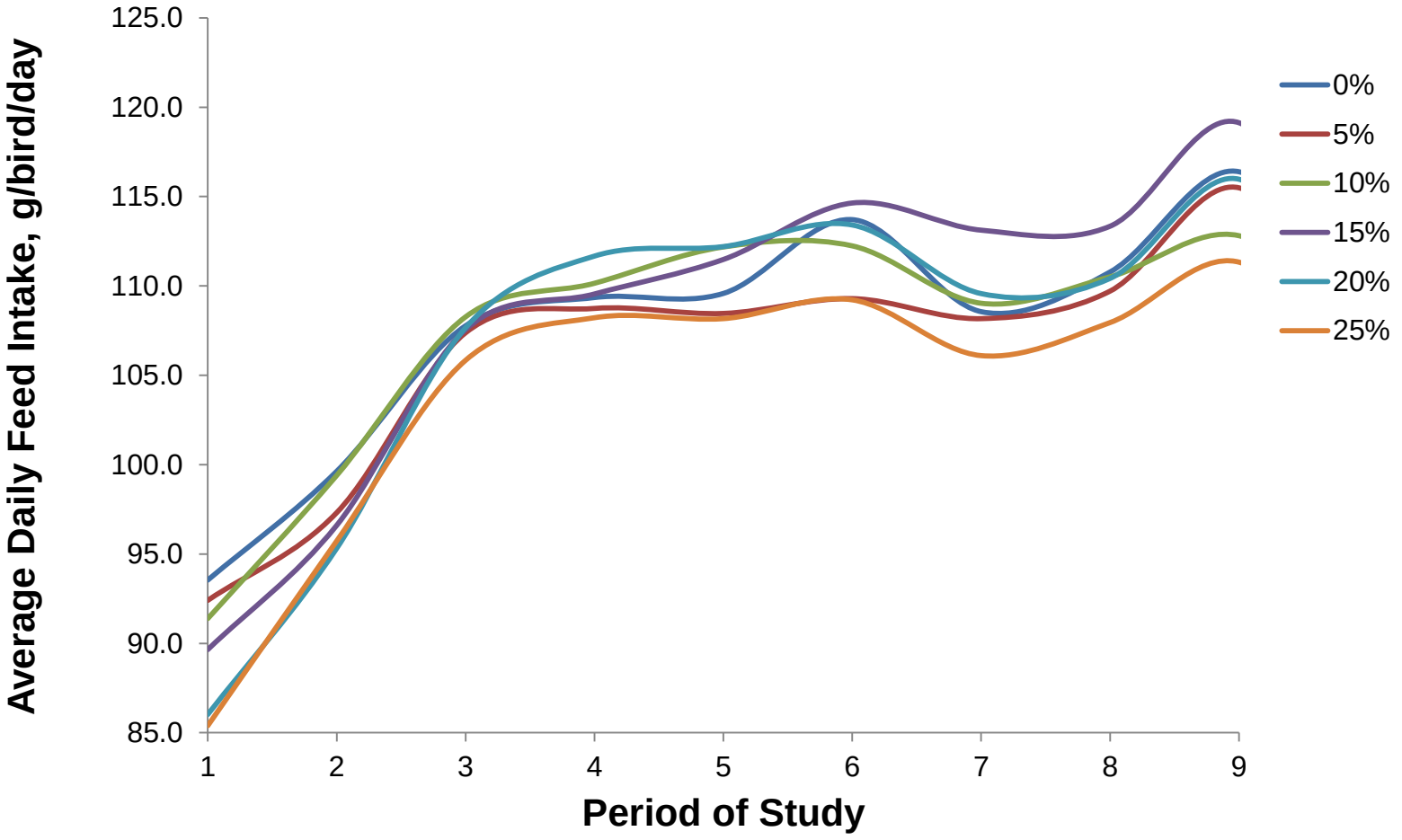
- Experiment lasted for 36-wk production cycle
- Measurements/calculations
  - Daily: Egg counts
  - Weekly: Egg wt, egg mass production
  - 4-wk intervals: ADFI, egg:feed, BW
  - Non-repeated: Fatty acids, egg components, egg quality, TMA, sensory evaluation

Methods and Materials (cont'd)

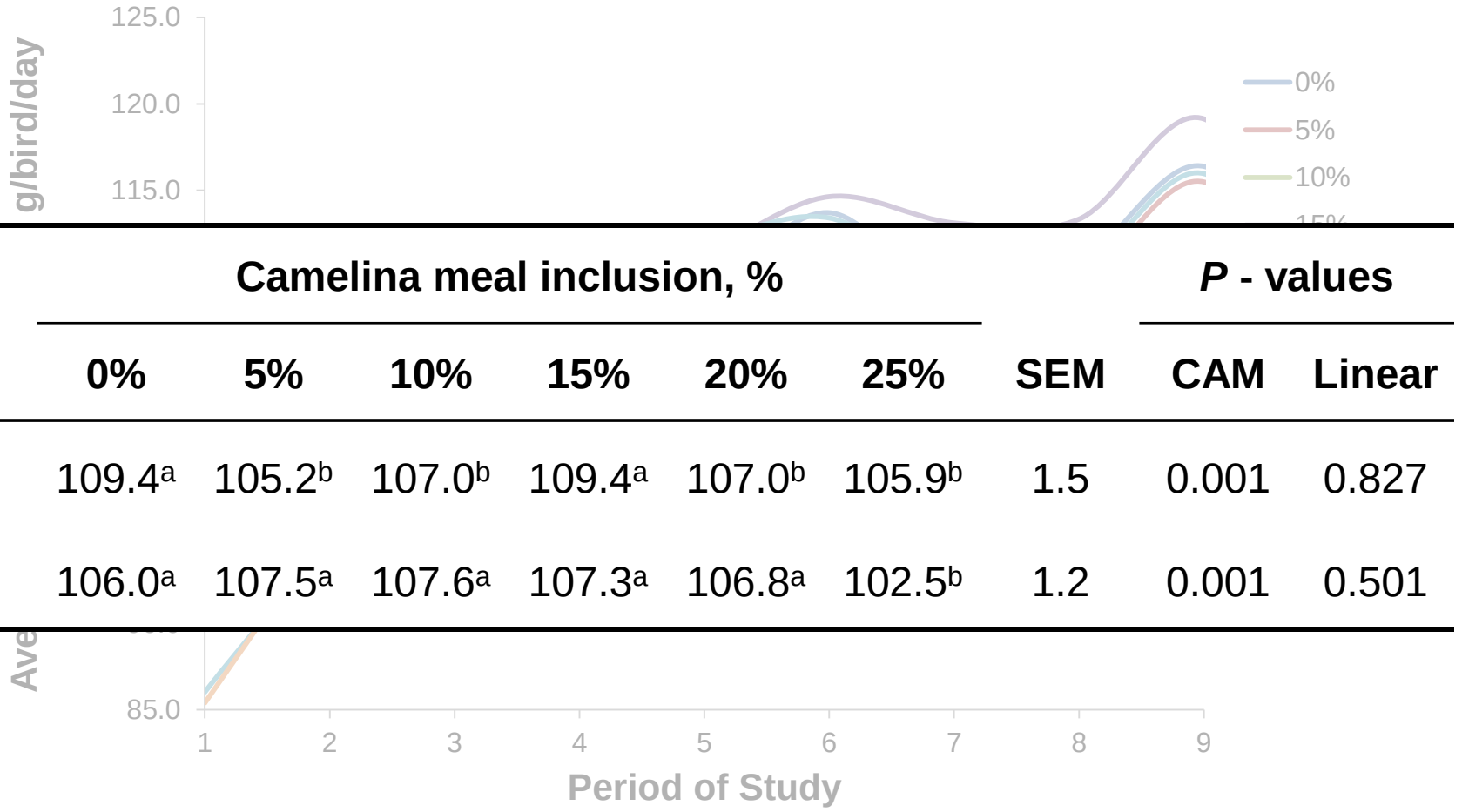
- Statistical analysis (PROC MIXED)
  - **Fixed effects**: CAM inclusion (0, 5, 10, 15, 20, 25%), bird strain (white, brown), 2-way interaction
  - **Random effects**: block, egg
  - **Repeated term** (where used): week/period
  - Linear and quadratic contrasts (CAM inclusion)

RESULTS AND DISCUSSION

Average Daily Feed Intake

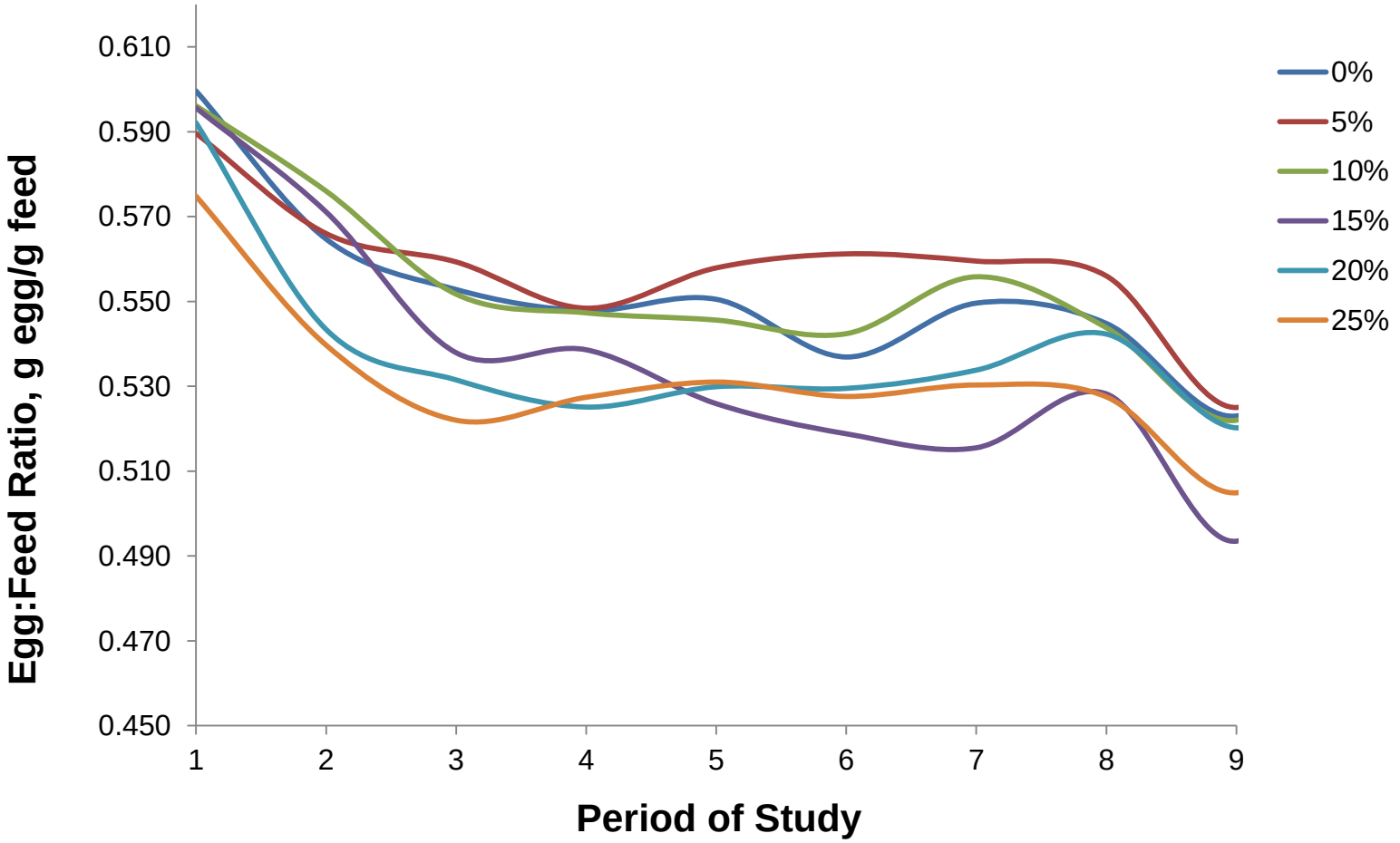


Average Daily Feed Intake

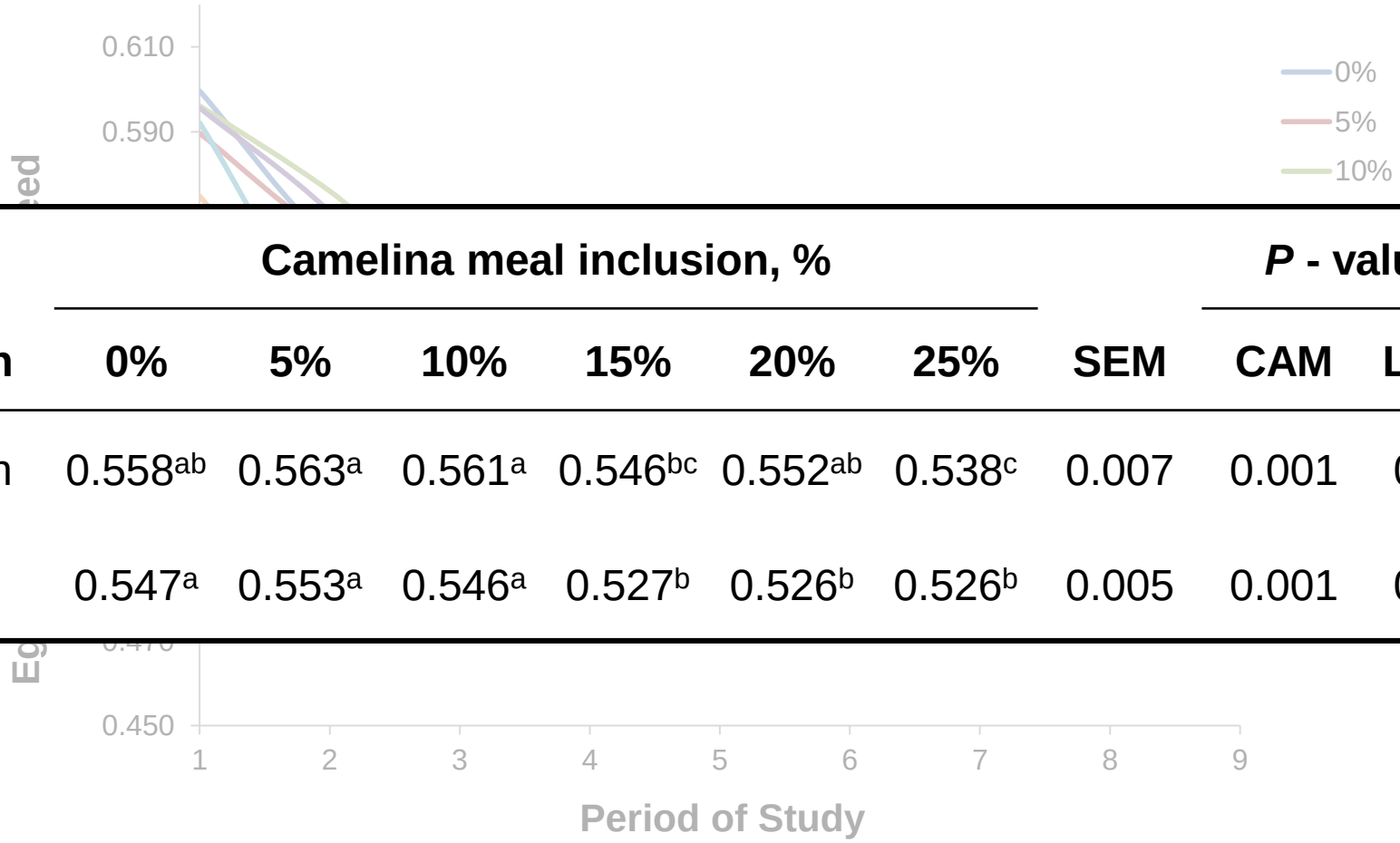


	Camelina meal inclusion, %							*P* - values	
Strain	**0%**	**5%**	**10%**	**15%**	**20%**	**25%**	**SEM**	**CAM**	**Linear**
Brown	109.4[a]	105.2[b]	107.0[b]	109.4[a]	107.0[b]	105.9[b]	1.5	0.001	0.827
White	106.0[a]	107.5[a]	107.6[a]	107.3[a]	106.8[a]	102.5[b]	1.2	0.001	0.501

Egg-to-Feed

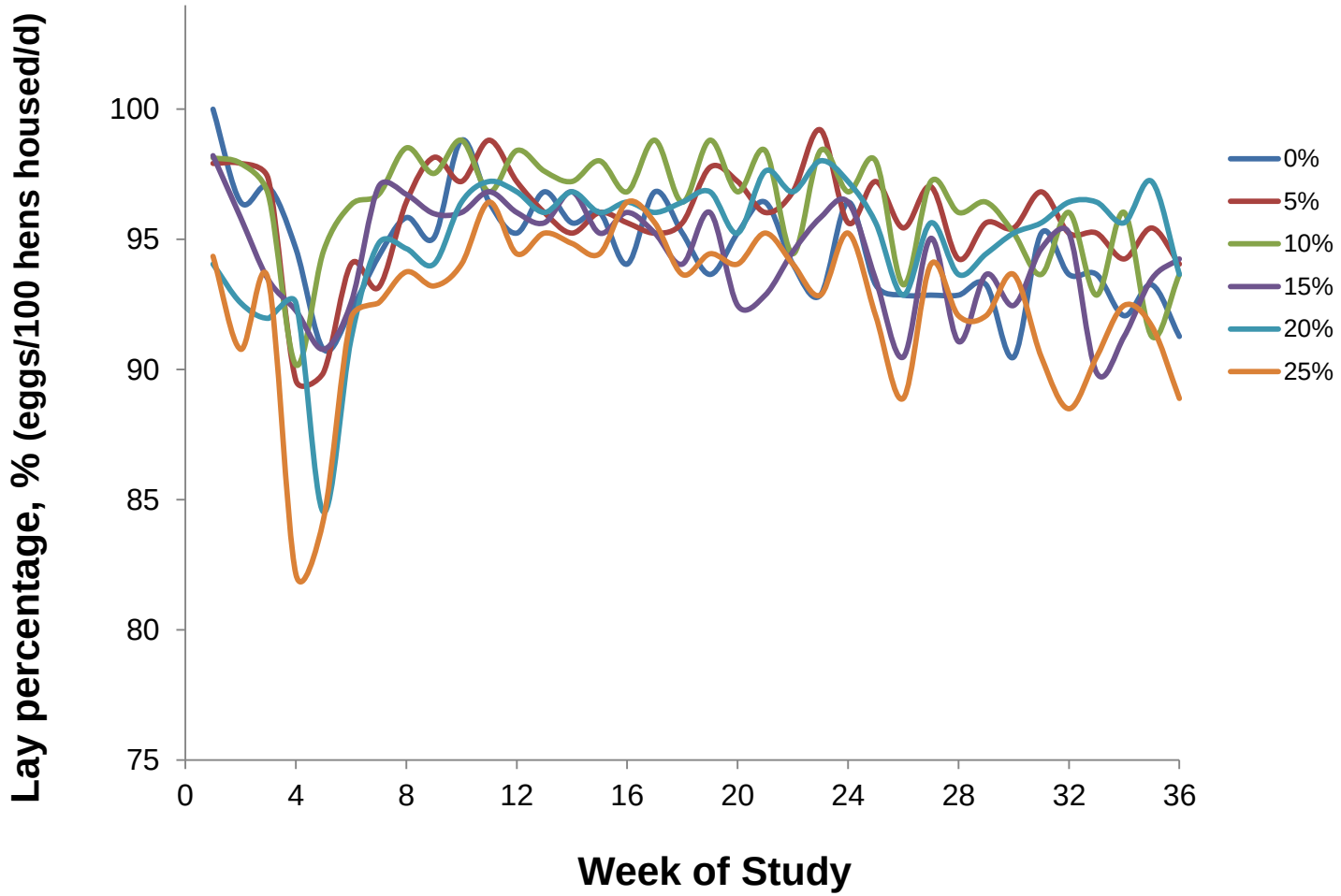


Egg-to-Feed

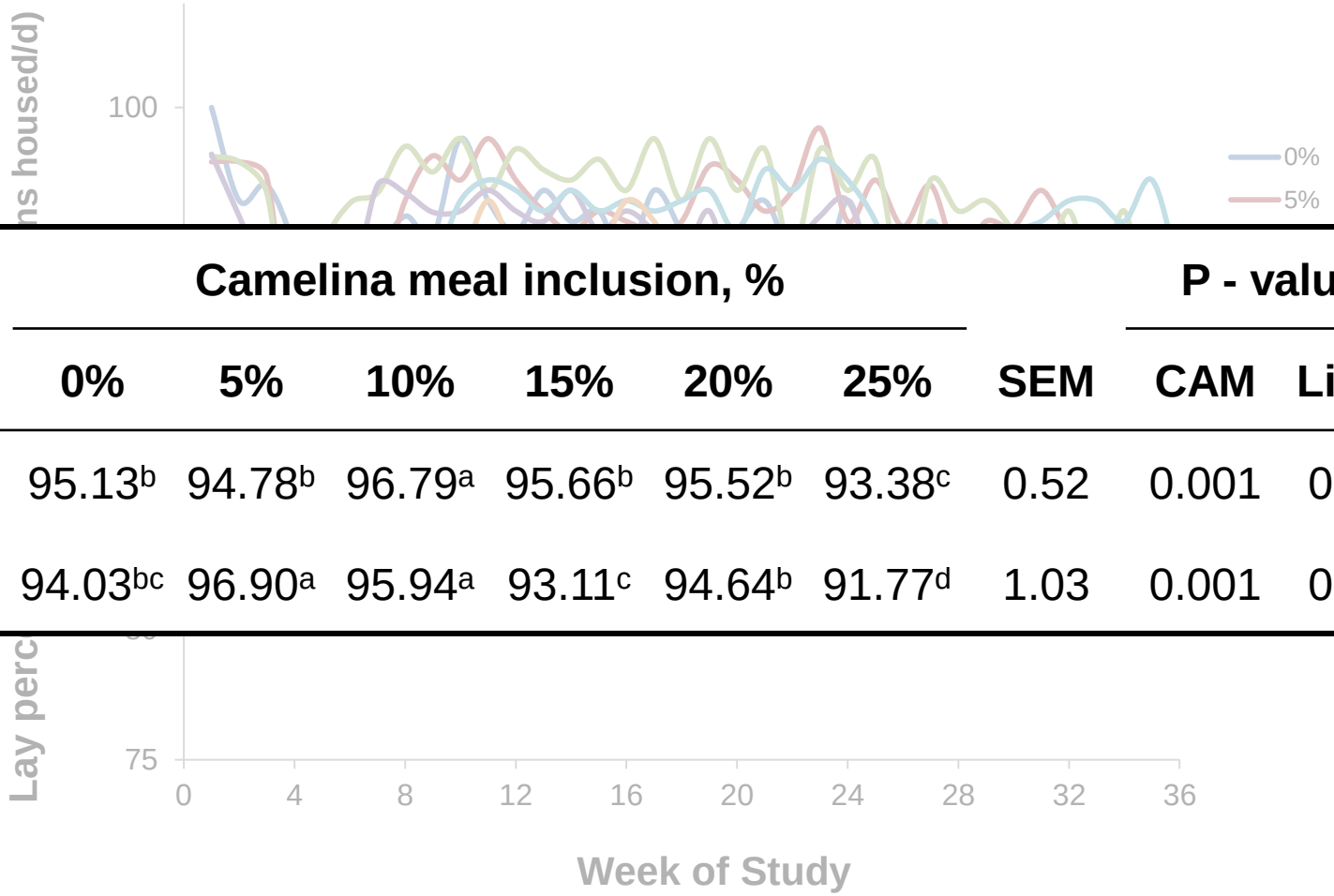


	Camelina meal inclusion, %							*P* - values	
Strain	**0%**	**5%**	**10%**	**15%**	**20%**	**25%**	**SEM**	**CAM**	**Linear**
Brown	0.558^{ab}	0.563^{a}	0.561^{a}	0.546^{bc}	0.552^{ab}	0.538^{c}	0.007	0.001	0.040
White	0.547^{a}	0.553^{a}	0.546^{a}	0.527^{b}	0.526^{b}	0.526^{b}	0.005	0.001	0.001

Lay percentage

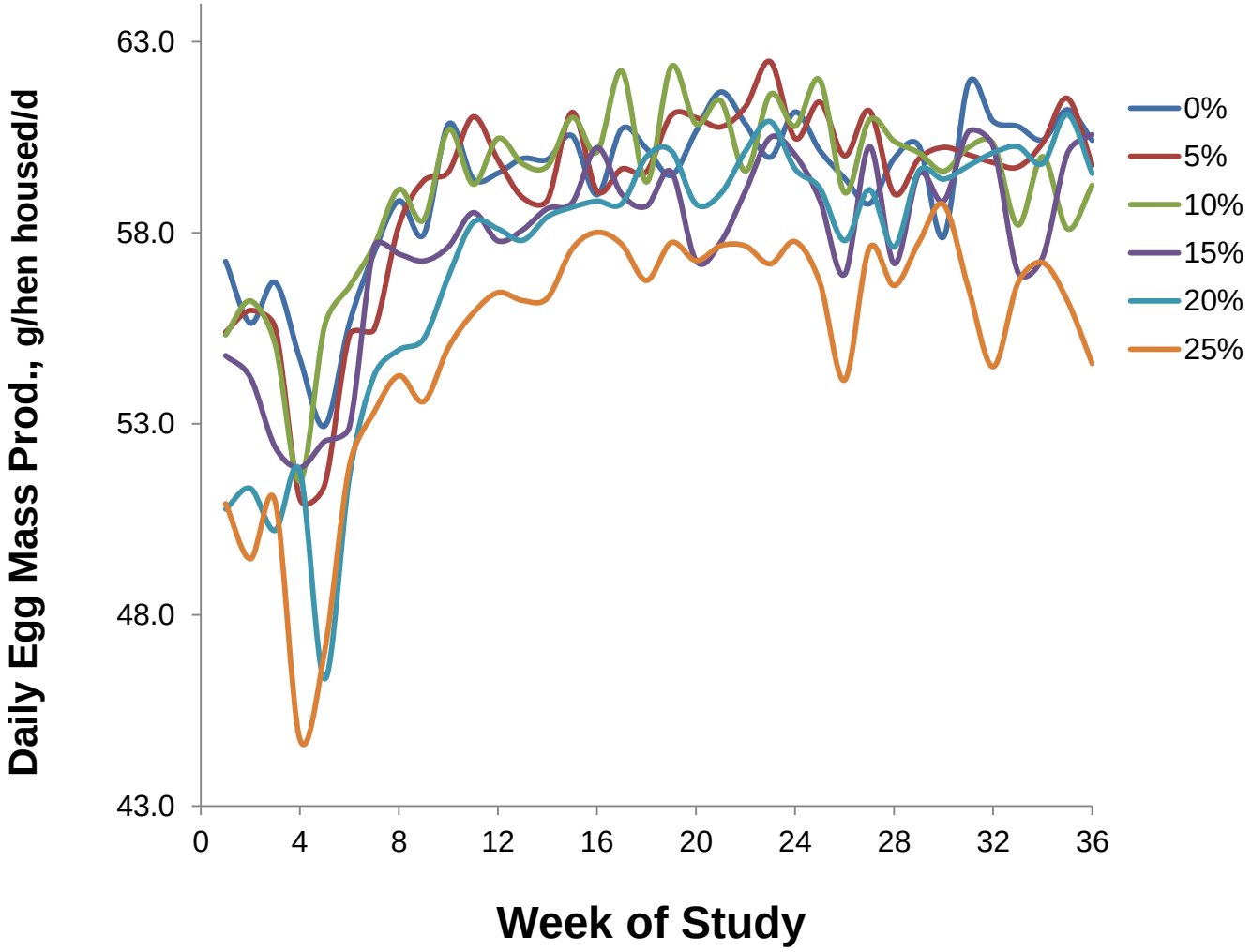


Lay percentage

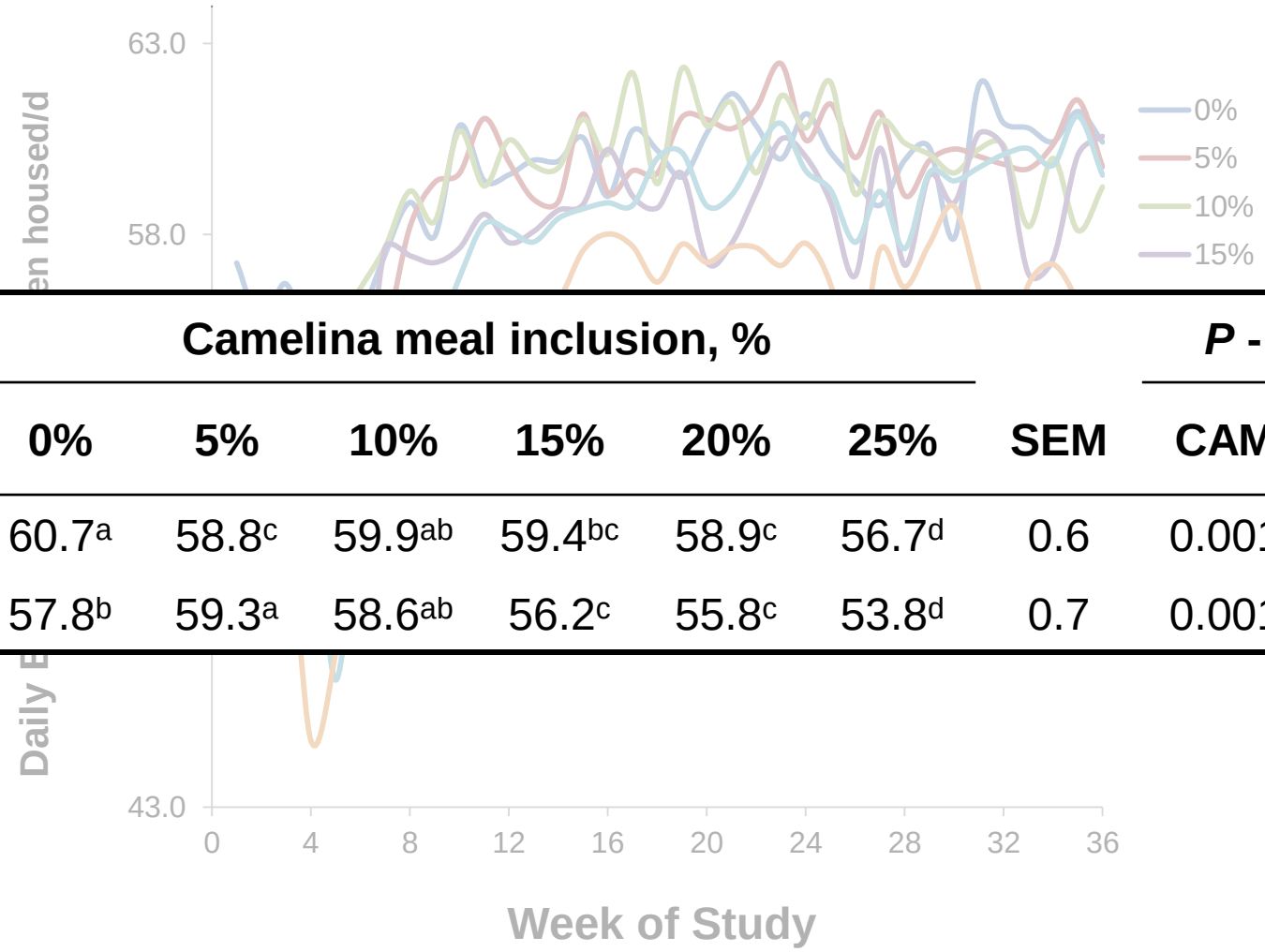


	Camelina meal inclusion, %							P - values	
Strain	**0%**	**5%**	**10%**	**15%**	**20%**	**25%**	**SEM**	**CAM**	**Linear**
Brown	95.13^{b}	94.78^{b}	96.79^{a}	95.66^{b}	95.52^{b}	93.38^{c}	0.52	0.001	0.194
White	94.03^{bc}	96.90^{a}	95.94^{a}	93.11^{c}	94.64^{b}	91.77^{d}	1.03	0.001	0.061

Daily egg mass production

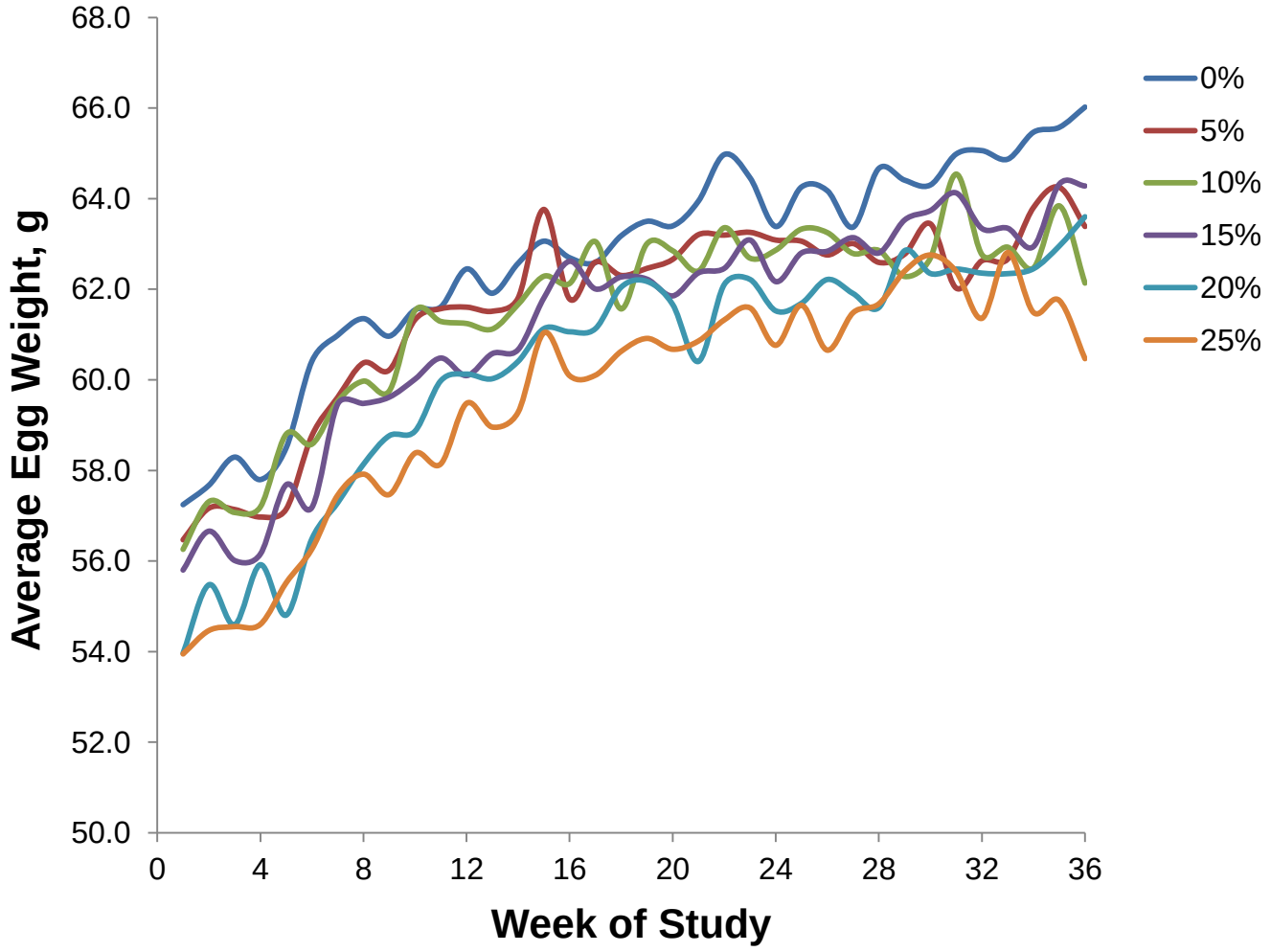


Daily egg mass production



	Camelina meal inclusion, %							*P* - values	
Strain	**0%**	**5%**	**10%**	**15%**	**20%**	**25%**	**SEM**	**CAM**	**linear**
Brown	60.7^{a}	58.8^{c}	59.9^{ab}	59.4^{bc}	58.9^{c}	56.7^{d}	0.6	0.001	0.001
White	57.8^{b}	59.3^{a}	58.6^{ab}	56.2^{c}	55.8^{c}	53.8^{d}	0.7	0.001	0.001

Average Egg Weight



Egg component weights

	Expeller-pressed camelina meal inclusion, %							*P* - values	
	0%	5%	10%	15%	20%	25%	SEM	CAM	Linear
Weight, g									
Intact egg	64.8^{a}	63.0^{ab}	63.1^{ab}	62.0^{bc}	62.0^{bc}	61.0^{c}	0.8	0.012	0.005
Albumen	38.4	37.5	37.5	36.9	36.9	36.7	0.7	0.378	0.059
Shell	8.8	8.6	8.8	8.7	8.5	8.4	0.1	0.058	0.136
Yolk	17.5^{a}	17.0^{ab}	16.8^{b}	16.4^{bc}	16.6^{bc}	15.9^{c}	0.3	0.001	0.003
Weight, %									
Shell	13.66	13.65	13.99	14.01	13.80	13.84	0.20	0.476	0.213
Albumen	59.28	59.37	59.32	59.48	60.03	60.04	0.44	0.410	0.156
Yolk	26.98	26.99	26.63	26.47	26.18	26.17	0.33	0.219	0.031

Whole Egg FA profiles

	Expeller-pressed camelina meal inclusion, %							*P* - values	
	0%	5%	10%	15%	20%	25%	SEM	CAM	Linear
SFA	25.72^{a}	25.49^{a}	25.00^{ab}	23.99^{c}	24.11^{bc}	24.55^{bc}	0.33	0.001	0.001
MUFA	44.75^{a}	43.47^{ab}	42.93^{bc}	41.66^{c}	41.66^{c}	42.13^{bc}	0.54	0.001	0.001
PUFA	15.33^{c}	15.47^{c}	15.75^{c}	15.70^{c}	16.54^{b}	17.47^{a}	0.22	0.001	0.001
C18:3 (n-3)	1.17^{f}	1.40^{e}	1.60^{d}	1.75^{c}	2.10^{b}	2.43^{a}	0.04	0.001	0.001
C20:5 (n-3)	0.01^{c}	0.03^{bc}	0.03^{ab}	0.03^{ab}	0.04^{a}	0.04^{a}	0.01	0.001	0.001
C22:5 (n-3)	0.14^{c}	0.16^{bc}	0.18^{a}	0.18^{a}	0.17^{ab}	0.18^{a}	0.01	0.000	0.001
C22:6 (n-3)	1.44	1.45	1.50	1.50	1.51	1.53	0.03	0.086	0.021
Total n-3	2.82^{e}	3.10^{d}	3.38^{c}	3.54^{c}	3.93^{b}	4.33^{a}	0.06	0.001	0.001
Total LC n-3	1.65^{c}	1.70^{bc}	1.78^{ab}	1.79^{ab}	1.80^{ab}	1.84^{a}	0.04	0.009	0.002
n-6:n-3	3.91^{a}	3.45^{b}	3.12^{c}	2.86^{d}	2.70^{e}	2.61^{e}	0.04	0.001	0.001

Take-home messages

- Birds tolerated high dietary inclusions of CAM quite well
  - Except for egg wt, birds met or exceeded production manual targets
- More refinement of dig nutrient content in CAM warranted (esp. AME)
  - Was camelina really to blame for reduced performance (e.g., egg mass)???

Take-home messages

- Impressive shift in egg FA profiles
  - N-3 enrichment exceeded Health Canada threshold for label claim (100 g basis)
  - Canola oil vs. tallow as supplemental fat source???

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  - Colleen Christensen
  - Canpressco