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Appendix A-1. *Hen performance details in Experimental 1 (BD = basal diet, RM = rapeseed meal, SM = soybean meal, BW = body weight, FI = feed intake, EP = egg production, EW = egg weight, IL = ileum length)*

Diet	Replication	BW (g)	FI (g/d)	EP (%)	EW (g)	IL (cm)
BD	1	1654	30.0	59.5	58.3	52.7
BD	2	1837	83.9	76.2	53.8	67.5
BD	3	2000	84.8	76.2	56.1	59.5
BD	4	1972	75.0	71.4	59.9	63.2
BD	5	1643	18.3	42.9	57.1	46.2
BD	6	1906	81.9	61.9	53.7	63.8
BD	7	1810	64.2	64.3	60.7	61.0
RM 14 %	1	1705	67.4	47.6	62.2	54.2
RM 14 %	2	1679	8.1	45.2	55.7	52.8
RM 14 %	3	1945	73.3	69.0	64.4	56.3
RM 14 %	4	2054	111.0	83.3	57.9	69.8
RM 14 %	5	1988	69.5	71.4	59.9	63.8
RM 14 %	6	1826	47.4	57.1	57.2	61.0
RM 14 %	7	1844	60.9	73.8	55.5	54.7
RM 28 %	1	1805	74.4	66.7	62.6	64.2
RM 28 %	2	2002	100.0	73.8	57.5	69.7
RM 28 %	3	1804	66.9	66.7	50.5	57.7
RM 28 %	4	2079	84.6	69.0	64.4	62.7
RM 28 %	5	2071	121.1	90.5	62.1	67.0
RM 28 %	6	1711	23.5	45.2	54.1	51.7
RM 28 %	7	2144	130.0	92.9	68.2	66.3
SM 14 %	1	1958	79.0	78.6	60.7	63.3
SM 14 %	2	1971	69.0	69.0	62.7	56.7
SM 14 %	3	1778	66.3	76.2	60.4	55.2
SM 14 %	4	2218	117.5	73.8	58.7	68.8
SM 14 %	5	2143	127.0	92.9	65.8	66.3
SM 14 %	6	1897	89.1	64.3	61.1	72.3
SM 14 %	7	1836	84.4	81.0	51.7	63.5
SM 28 %	1	1994	70.0	69.0	58.3	66.3
SM 28 %	2	2063	111.4	83.3	66.4	61.5
SM 28 %	3	1797	67.9	66.7	62.3	60.7
SM 28 %	4	1928	85.1	71.4	67.0	66.0
SM 28 %	5	2040	108.7	90.5	62.6	64.2
SM 28 %	6	1901	88.8	88.1	59.9	63.8
SM 28 %	7	1970	69.6	71.4	60.4	63.5

Appendix A-2. *Net disappearance of crude protein and amino acids (mean of central and proximal sub-sections) for the basal diet (BD) and the other diets with different inclusion rates of soybean meal (SM) and rapeseed meal (RM) used in Experiment 1*

Diet	Rep.	CYS	ASP	MET	THR	SER	GLU	PRO	GLY	ALA	VAL	ILE	LEU	TRY	PHE	LYS	ARG	CP
BD	1	0.76	0.54	0.90	0.63	0.73	0.90	0.88	0.68	0.69	0.75	0.66	0.81	0.63	0.80	0.80	0.77	0.71
BD	2	0.76	0.51	0.88	0.57	0.71	0.89	0.84	0.66	0.63	0.69	0.73	0.77	0.65	0.80	0.79	0.79	0.76
BD	3	0.84	0.70	0.92	0.75	0.82	0.93	0.92	0.78	0.77	0.82	0.84	0.86	0.79	0.89	0.86	0.85	0.85
BD	4	0.71	0.49	0.87	0.60	0.69	0.88	0.87	0.64	0.62	0.67	0.69	0.74	0.55	0.78	0.76	0.64	0.72
BD	5	0.65	0.44	0.85	0.47	0.63	0.88	0.88	0.60	0.67	0.69	0.66	0.77	0.55	0.78	0.71	0.63	0.71
BD	6	0.87	0.76	0.94	0.79	0.85	0.95	0.92	0.81	0.84	0.86	0.85	0.89	0.81	0.90	0.89	0.87	0.87
BD	7	0.73	0.50	0.87	0.57	0.68	0.88	0.86	0.63	0.67	0.70	0.70	0.78	0.71	0.79	0.72	0.62	0.73
RM 14 %	1	0.71	0.52	0.82	0.59	0.70	0.86	0.86	0.66	0.62	0.68	0.62	0.73	0.54	0.76	0.72	0.71	0.68
RM 14 %	2	0.62	0.43	0.77	0.49	0.60	0.81	0.77	0.57	0.50	0.57	0.58	0.61	0.56	0.67	0.70	0.68	0.62
RM 14 %	3	0.71	0.56	0.84	0.58	0.68	0.86	0.84	0.68	0.65	0.68	0.67	0.74	0.67	0.78	0.77	0.77	0.73
RM 14 %	4	0.56	0.29	0.76	0.42	0.56	0.80	0.77	0.48	0.50	0.56	0.55	0.65	0.78	0.68	0.56	0.64	0.62
RM 14 %	5	0.73	0.65	0.87	0.68	0.76	0.89	0.84	0.71	0.72	0.76	0.75	0.79	0.70	0.81	0.79	0.77	0.76
RM 14 %	6	0.69	0.59	0.86	0.65	0.73	0.88	0.83	0.70	0.69	0.72	0.73	0.77	0.69	0.79	0.76	0.76	0.75
RM 14 %	7	0.75	0.68	0.89	0.70	0.77	0.90	0.86	0.74	0.76	0.77	0.78	0.83	0.75	0.84	0.82	0.81	0.79
RM 28 %	1	0.67	0.53	0.82	0.56	0.65	0.84	0.78	0.64	0.59	0.62	0.65	0.69	0.62	0.72	0.70	0.76	0.68
RM 28 %	2	0.69	0.56	0.84	0.59	0.67	0.86	0.80	0.67	0.65	0.67	0.69	0.73	0.63	0.75	0.74	0.76	0.71
RM 28 %	3	0.69	0.53	0.81	0.57	0.66	0.85	0.77	0.65	0.64	0.64	0.66	0.73	0.61	0.73	0.69	0.69	0.69
RM 28 %	4	0.74	0.66	0.88	0.68	0.75	0.89	0.85	0.73	0.75	0.75	0.75	0.81	0.80	0.80	0.78	0.80	0.74
RM 28 %	5	0.72	0.64	0.86	0.66	0.73	0.88	0.82	0.70	0.72	0.75	0.75	0.79	0.70	0.79	0.75	0.77	0.75
RM 28 %	6	0.63	0.55	0.83	0.57	0.66	0.86	0.80	0.65	0.68	0.68	0.68	0.76	0.86	0.77	0.71	0.70	0.66
RM 28 %	7	0.74	0.68	0.88	0.69	0.76	0.90	0.83	0.73	0.76	0.76	0.77	0.82	0.73	0.82	0.80	0.79	0.77
SM 14 %	1	0.64	0.53	0.76	0.49	0.63	0.84	0.74	0.59	0.56	0.64	0.64	0.67	0.58	0.72	0.67	0.70	0.66
SM 14 %	2	0.78	0.69	0.87	0.69	0.77	0.90	0.83	0.75	0.73	0.76	0.78	0.80	0.74	0.82	0.80	0.83	0.79
SM 14 %	3	0.71	0.65	0.85	0.64	0.73	0.88	0.80	0.70	0.68	0.71	0.74	0.76	0.66	0.78	0.77	0.75	0.76
SM 14 %	4	0.75	0.71	0.88	0.71	0.78	0.90	0.86	0.74	0.75	0.77	0.79	0.82	0.73	0.83	0.80	0.79	0.80
SM 14 %	5	0.70	0.66	0.85	0.63	0.73	0.89	0.84	0.70	0.70	0.75	0.76	0.78	0.68	0.80	0.76	0.75	0.77
SM 14 %	6	0.70	0.67	0.86	0.67	0.75	0.88	0.81	0.69	0.69	0.73	0.75	0.78	0.69	0.80	0.76	0.74	0.77
SM 14 %	7	0.66	0.67	0.85	0.64	0.73	0.88	0.82	0.69	0.71	0.75	0.76	0.78	0.69	0.79	0.76	0.75	0.76
SM 28 %	1	0.56	0.54	0.71	0.48	0.61	0.78	0.72	0.55	0.46	0.53	0.59	0.59	0.61	0.65	0.66	0.72	0.65
SM 28 %	2	0.69	0.70	0.84	0.65	0.74	0.86	0.86	0.70	0.68	0.71	0.74	0.76	0.73	0.79	0.80	0.82	0.76
SM 28 %	3	0.63	0.68	0.82	0.62	0.70	0.85	0.81	0.66	0.65	0.60	0.63	0.75	0.65	0.73	0.76	0.78	0.73
SM 28 %	4	0.72	0.74	0.86	0.71	0.78	0.89	0.86	0.72	0.74	0.77	0.77	0.80	0.73	0.82	0.80	0.82	0.80
SM 28 %	5	0.74	0.74	0.86	0.71	0.79	0.89	0.86	0.73	0.76	0.77	0.79	0.82	0.74	0.83	0.79	0.79	0.80
SM 28 %	6	0.73	0.76	0.88	0.73	0.80	0.90	0.84	0.75	0.77	0.79	0.79	0.82	0.76	0.83	0.82	0.81	0.72
SM 28 %	7	0.72	0.74	0.87	0.71	0.78	0.89	0.85	0.75	0.77	0.78	0.77	0.81	0.78	0.82	0.81	0.80	0.62

Appendix A-3. *Ranking of precaecal amino acid digestibility determined for soybean meal (SM) and rapeseed meal (RM) in Experiment 1*

SM	Arg=Glu>Asp=Lys>Ser>Ile=Leu>Phe>Gly>Ala>Thr=Try>Val>Met>Cys
RM	Arg=Glu>Met>Leu>Lys>Gly=Ala=Try>Phe=Ser=Asp=Ile>Cys>Val>Thr

Appendix A-4. *Partial precaecal digestibilities of amino acids and crude protein for rapeseed meal (RM) determined by simple linear regression analysis (using Prism software) and compared between 2 inclusion levels (0 % and 28 % RM) and 3 inclusion levels (0 %, 14 % and 28 % RM) in Experiment 1 (estimate and SE of estimate for the regression coefficient)*

Inclusion level	2	3	P value
Crude Protein	0.75 ± 0.03	0.73 ± 0.03	0.68
Alanine	0.73 ± 0.04	0.69 ± 0.04	0.56
Arginine	0.79 ± 0.02	0.77 ± 0.02	0.63
Aspartic acid	0.66 ± 0.04	0.61 ± 0.05	0.52
Cystine	0.72 ± 0.03	0.71 ± 0.03	0.75
Glutamic acid	0.88 ± 0.02	0.87 ± 0.02	0.65
Glycine	0.71 ± 0.02	0.68 ± 0.03	0.55
Isoleucine	0.75 ± 0.03	0.73 ± 0.03	0.63
Leucine	0.79 ± 0.03	0.77 ± 0.03	0.69
Lysine	0.76 ± 0.03	0.73 ± 0.03	0.57
Methionine	0.86 ± 0.02	0.85 ± 0.02	0.69
Phenylalanine	0.79 ± 0.03	0.78 ± 0.03	0.66
Proline	0.81 ± 0.03	0.81 ± 0.02	0.96
Serine	0.73 ± 0.03	0.71 ± 0.03	0.58
Threonine	0.66 ± 0.03	0.64 ± 0.04	0.57
Tryptophan	0.70 ± 0.04	0.71 ± 0.03	0.84
Valine	0.74 ± 0.04	0.71 ± 0.03	0.67

Appendix A-5. *Partial precaecal digestibilities of amino acids and crude protein for soybean meal (SM) determined by simple linear regression analysis (using Prism software) and compared between 2 inclusion levels (0 % and 28 % SM) and 3 inclusion levels (0 %, 14 % and 28 % SM) in Experiment 1 (estimate and SE of estimate for the regression coefficient)*

Inclusion level	2	3	P value
Crude Protein	0.77 ± 0.04	0.78 ± 0.03	0.85
Alanine	0.73 ± 0.06	0.73 ± 0.05	0.94
Arginine	0.82 ± 0.02	0.81 ± 0.02	0.74
Aspartic acid	0.75 ± 0.03	0.74 ± 0.03	0.89
Cystine	0.71 ± 0.06	0.71 ± 0.05	0.97
Glutamic acid	0.87 ± 0.03	0.88 ± 0.02	0.78
Glycine	0.72 ± 0.04	0.72 ± 0.03	0.99
Isoleucine	0.77 ± 0.04	0.78 ± 0.03	0.86
Leucine	0.78 ± 0.05	0.79 ± 0.04	0.90
Lysine	0.80 ± 0.03	0.79 ± 0.03	0.87
Methionine	0.85 ± 0.04	0.85 ± 0.03	0.89
Phenylalanine	0.80 ± 0.04	0.81 ± 0.03	0.90
Proline	0.85 ± 0.04	0.85 ± 0.03	0.94
Serine	0.77 ± 0.04	0.77 ± 0.03	0.96
Threonine	0.70 ± 0.05	0.70 ± 0.04	0.94
Tryptophan	0.74 ± 0.04	0.73 ± 0.03	0.89
Valine	0.74 ± 0.06	0.75 ± 0.04	0.83

Appendix A-6. Comparison of partial precaecal digestibility of amino acids and crude protein for soybean meal and rapeseed meal between laying hens (Experiment 1) and broilers (Kluth and Rodehutschord, 2006) determined by multiple linear regression analysis

	Soybean meal				Rapeseed meal			
	Laying hens		Broilers		Laying hens		Broilers	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Crude protein	0.70	±0.06	0.81	±0.03	0.63	±0.08	0.82	±0.04
Alanine	0.73	±0.10	0.75	±0.04	0.69	±0.11	0.82	±0.05
Arginine	0.83	±0.03	0.84	±0.03	0.80	±0.04	0.87	±0.05
Aspartic acid	0.80	±0.05	0.75	±0.03	0.67	±0.09	0.76	±0.06
Cystine	0.58	±0.12	0.73	±0.04	0.66	±0.08	0.76	±0.04
Glutamic acid	0.83	±0.05	0.85	±0.02	0.80	±0.07	0.89	±0.03
Glycine	0.74	±0.06	0.72	±0.04	0.69	±0.07	0.75	±0.05
Isoleucine	0.76	±0.06	0.77	±0.04	0.67	±0.09	0.80	±0.05
Leucine	0.76	±0.07	0.78	±0.03	0.72	±0.09	0.84	±0.04
Lysine	0.80	±0.06	0.84	±0.04	0.71	±0.07	0.83	±0.05
Methionine	0.70	±0.11	0.87	±0.03	0.76	±0.09	0.92	±0.03
Phenylalanine	0.75	±0.06	0.85	±0.02	0.67	±0.09	0.79	±0.03
Serine	0.78	±0.06	0.79	±0.03	0.67	±0.08	0.79	±0.04
Threonine	0.72	±0.08	0.78	±0.05	0.63	±0.08	0.77	±0.05
Valine	0.71	±0.09	0.77	±0.04	0.65	±0.09	0.77	±0.05

Appendix B-1. *Hen performance details in Experiment 2 (BD = basal diet, TS = toasted soybeans, MG = maize gluten, BW = body weight, FI = feed intake, EP = egg production, EW = egg weight, IL = ileum length)*

Diet	Replication	Initial BW (g)	Final BW (g)	FI (g/d)	EP (%)	IL (cm)
BD	1	1980	1986	93.8	97.6	56.2
BD	2	1992	1984	89.9	97.6	60.5
BD	3	1943	1944	92.4	92.9	58.7
BD	4	1931	1965	95.0	95.2	63.8
BD	5	1931	1941	92.9	100.0	55.0
BD	6	1915	1928	95.5	95.2	55.5
TS 15 %	1	1999	2117	108.1	97.6	62.7
TS 15 %	2	1800	1915	94.9	90.5	64.2
TS 15 %	3	1919	2001	102.6	100.0	59.3
TS 15 %	4	1828	1930	102.3	100.0	63.8
TS 15 %	5	1932	2033	103.8	97.6	60.2
TS 15 %	6	1933	2043	105.1	95.2	60.5
TS 30 %	1	1980	2078	101.1	100.0	62.3
TS 30 %	2	1833	1914	98.8	97.6	67.7
TS 30 %	3	2039	2110	100.6	100.0	62.8
TS 30 %	4	1908	1997	98.4	100.0	63.2
TS 30 %	5	2001	2033	95.2	100.0	64.3
TS 30 %	6	1858	1971	101.1	95.2	70.3
MG 15 %	1	1983	1992	90.9	100.0	65.7
MG 15 %	2	1928	1929	87.1	95.2	57.3
MG 15 %	3	1846	1861	77.5	90.5	54.8
MG 15 %	4	1938	1949	84.4	97.6	65.2
MG 15 %	5	1991	2004	94.4	100.0	63.5
MG 15 %	6	1876	1975	93.7	95.2	59.0
MG 30 %	1	1922	1991	85.1	92.9	67.5
MG 30 %	2	1876	1921	88.6	97.6	66.3
MG 30 %	3	1876	1935	91.6	97.6	63.5
MG 30 %	4	1846	1877	81.6	97.6	61.0
MG 30 %	5	1843	1849	78.6	95.2	63.8
MG 30 %	6	1917	1942	93.0	95.2	65.7

Appendix B-2. *Digestibility coefficient for the basal diet (BD) and the other diets with different inclusion rates of toasted soybeans (TS) and maize gluten (MG) in Experiment 2*

Diet	Rep.	CYS	ASP	MET	THR	SER	GLU	PRO	GLY	ALA	VAL	ILE	LEU	TRY	PHE	LYS	ARG	Nitrogen
BD	1	0.77	0.55	0.79	0.55	0.75	0.91	0.89	0.72	0.67	0.75	0.79	0.78	0.66	0.81	0.73	0.73	0.78
BD	2	0.74	0.51	0.79	0.51	0.74	0.91	0.88	0.71	0.67	0.73	0.77	0.79	0.67	0.82	0.71	0.64	0.79
BD	3	0.77	0.73	0.91	0.72	0.80	0.96	0.92	0.79	0.83	0.83	0.87	0.89	0.81	0.90	0.88	0.79	0.89
BD	4	0.85	0.74	0.90	0.75	0.86	0.96	0.95	0.82	0.84	0.86	0.88	0.89	0.79	0.90	0.87	0.83	0.89
BD	5	0.83	0.76	0.91	0.74	0.86	0.96	0.92	0.84	0.86	0.86	0.89	0.90	0.82	0.92	0.85	0.84	0.90
BD	6	0.84	0.74	0.89	0.71	0.84	0.95	0.90	0.81	0.84	0.85	0.88	0.90	0.79	0.91	0.87	0.82	0.88
TS 15 %	1	0.78	0.73	0.80	0.68	0.81	0.92	0.89	0.78	0.75	0.79	0.81	0.83	0.74	0.85	0.80	0.78	0.85
TS 15 %	2	0.81	0.78	0.85	0.73	0.84	0.93	0.90	0.81	0.80	0.83	0.85	0.86	0.78	0.88	0.86	0.86	0.88
TS 15 %	3	0.85	0.82	0.89	0.78	0.87	0.95	0.94	0.85	0.85	0.86	0.89	0.89	0.82	0.91	0.89	0.88	0.90
TS 15 %	4	0.82	0.78	0.85	0.73	0.84	0.94	0.91	0.81	0.81	0.83	0.86	0.87	0.79	0.89	0.85	0.85	0.88
TS 15 %	5	0.82	0.81	0.88	0.76	0.86	0.95	0.91	0.84	0.84	0.86	0.88	0.88	0.81	0.90	0.87	0.88	0.89
TS 15 %	6	0.82	0.82	0.89	0.76	0.86	0.95	0.94	0.84	0.85	0.85	0.88	0.89	0.81	0.91	0.88	0.88	0.90
TS 30 %	1	0.77	0.77	0.85	0.71	0.82	0.92	0.87	0.78	0.78	0.80	0.83	0.84	0.74	0.87	0.83	0.85	0.83
TS 30 %	2	0.82	0.84	0.90	0.78	0.87	0.94	0.92	0.84	0.85	0.86	0.89	0.89	0.81	0.91	0.89	0.92	0.88
TS 30 %	3	0.83	0.85	0.92	0.81	0.88	0.96	0.94	0.86	0.88	0.88	0.91	0.91	0.84	0.92	0.90	0.91	0.91
TS 30 %	4	0.83	0.83	0.88	0.77	0.86	0.94	0.91	0.83	0.84	0.85	0.87	0.88	0.81	0.90	0.85	0.88	0.87
TS 30 %	5	0.85	0.87	0.93	0.83	0.89	0.96	0.93	0.87	0.89	0.89	0.91	0.91	0.85	0.93	0.91	0.93	0.90
TS 30 %	6	0.82	0.85	0.92	0.81	0.88	0.95	0.93	0.85	0.87	0.87	0.90	0.90	0.84	0.92	0.89	0.91	0.89
MG 15 %	1	0.75	0.67	0.82	0.67	0.79	0.90	0.88	0.75	0.78	0.78	0.81	0.83	0.66	0.84	0.74	0.77	0.81
MG 15 %	2	0.79	0.70	0.86	0.71	0.83	0.93	0.92	0.78	0.84	0.83	0.86	0.89	0.72	0.89	0.76	0.81	0.85
MG 15 %	3	0.84	0.82	0.92	0.80	0.88	0.96	0.94	0.84	0.91	0.89	0.91	0.93	0.81	0.93	0.87	0.89	0.90
MG 15 %	4	0.82	0.79	0.90	0.76	0.86	0.95	0.93	0.82	0.89	0.87	0.88	0.92	0.76	0.91	0.79	0.84	0.87
MG 15 %	5	0.84	0.83	0.92	0.81	0.89	0.96	0.94	0.85	0.91	0.89	0.91	0.94	0.81	0.93	0.87	0.90	0.90
MG 15 %	6	0.83	0.84	0.93	0.82	0.89	0.96	0.94	0.84	0.91	0.89	0.91	0.94	0.81	0.93	0.88	0.89	0.90
MG 30 %	1	0.80	0.77	0.87	0.75	0.85	0.92	0.91	0.80	0.86	0.83	0.85	0.89	0.75	0.89	0.79	0.84	0.86
MG 30 %	2	0.76	0.75	0.84	0.72	0.82	0.89	0.88	0.78	0.83	0.80	0.82	0.85	0.71	0.86	0.78	0.82	0.83
MG 30 %	3	0.84	0.83	0.93	0.82	0.89	0.95	0.94	0.84	0.92	0.89	0.91	0.94	0.80	0.93	0.86	0.89	0.91
MG 30 %	4	0.82	0.83	0.91	0.82	0.88	0.94	0.94	0.84	0.90	0.88	0.90	0.92	0.83	0.92	0.86	0.88	0.90
MG 30 %	5	0.79	0.77	0.88	0.74	0.85	0.94	0.92	0.78	0.89	0.84	0.86	0.92	0.71	0.91	0.73	0.82	0.86
MG 30 %	6	0.88	0.88	0.95	0.87	0.92	0.97	0.96	0.88	0.94	0.92	0.93	0.96	0.85	0.95	0.88	0.91	0.92

Appendix B-3. *Ranking of precaecal amino acid digestibility determined for toasted soybeans (TS) and rapeseed meal (MG) in Experiment 2*

TS	Arg>Glu=Met>Phe>Ile=Leu=Pro=Ser=Ala>Asp=Lys>Val>Gly>Thr=Try>Cys
MG	Pro>Phe=Glu=Ala=Leu>Arg=Met=Ser>Ile>Val>Asp=Thr>Gly>Cys>Lys>Try

Appendix B-4. *Partial precaecal digestibilities of amino acids and nitrogen for maize gluten (MG) determined by simple linear regression analysis (using Prism software) and compared between 2 inclusion levels (0 % and 30 % MG) and 3 inclusion levels (0 %, 15 % and 30 % MG) in Experiment 2 (estimate and SE of estimate for the regression coefficient)*

Inclusion level	2	3	P value
Nitrogen	0.92 ± 0.04	0.91 ± 0.04	0.97
Alanine	0.94 ± 0.03	0.94 ± 0.03	0.99
Arginine	0.93 ± 0.04	0.93 ± 0.04	0.99
Aspartic acid	0.90 ± 0.04	0.89 ± 0.04	0.98
Cystine	0.87 ± 0.06	0.87 ± 0.05	0.94
Glutamic acid	0.93 ± 0.03	0.94 ± 0.03	0.97
Glycine	0.88 ± 0.04	0.88 ± 0.04	0.99
Isoleucine	0.92 ± 0.04	0.92 ± 0.04	0.99
Leucine	0.94 ± 0.03	0.94 ± 0.03	0.99
Lysine	0.85 ± 0.08	0.85 ± 0.08	0.99
Methionine	0.93 ± 0.03	0.93 ± 0.03	0.99
Phenylalanine	0.94 ± 0.03	0.94 ± 0.03	0.99
Proline	0.95 ± 0.03	0.95 ± 0.03	0.97
Serine	0.93 ± 0.03	0.93 ± 0.03	0.99
Threonine	0.89 ± 0.05	0.89 ± 0.05	0.99
Tryptophan	0.83 ± 0.08	0.83 ± 0.08	0.97
Valine	0.92 ± 0.04	0.92 ± 0.04	0.99

Appendix B-5. *Partial precaecal digestibilities of amino acids and nitrogen for toasted soybeans (TS) determined by simple linear regression analysis (using Prism software) and compared between 2 inclusion levels (0 % and 30 % TS) and 3 inclusion levels (0 %, 15 % and 30 % TS) in Experiment 2 (estimate and SE of estimate for the regression coefficient)*

Inclusion level	2	3	P value
Nitrogen	0.92 ± 0.04	0.92 ± 0.03	0.96
Alanine	0.91 ± 0.04	0.91 ± 0.04	0.96
Arginine	0.96 ± 0.02	0.95 ± 0.02	0.97
Aspartic acid	0.90 ± 0.03	0.90 ± 0.03	0.95
Cystine	0.85 ± 0.04	0.85 ± 0.04	0.96
Glutamic acid	0.95 ± 0.02	0.95 ± 0.02	0.96
Glycine	0.89 ± 0.03	0.88 ± 0.03	0.95
Isoleucine	0.92 ± 0.03	0.92 ± 0.03	0.97
Leucine	0.93 ± 0.04	0.92 ± 0.03	0.95
Lysine	0.92 ± 0.03	0.91 ± 0.03	0.94
Methionine	0.94 ± 0.04	0.94 ± 0.04	0.95
Phenylalanine	0.94 ± 0.03	0.94 ± 0.02	0.96
Proline	0.93 ± 0.05	0.93 ± 0.04	0.96
Serine	0.92 ± 0.03	0.92 ± 0.03	0.93
Threonine	0.88 ± 0.04	0.87 ± 0.04	0.93
Tryptophan	0.86 ± 0.04	0.86 ± 0.04	0.94
Valine	0.91 ± 0.04	0.90 ± 0.03	0.94

Appendix C-1. *Production performance data details for intact (IN) and caecectomised (CA) laying hens in Experiment 3 (BW = body weight, DMI = dry matter intake, EDM = excreted dry matter, DDM = disappeared dry matter, EP = egg production)*

Treatment	Replication	Initial BW (g)	Final BW (g)	DMI (g/d)	EDM (%)	DDM (g/d)	EP (%)
IN	1	2041	1980	103.2	37.7	65.5	100
IN	2	1620	1626	96.8	31.7	65.1	100
IN	3	2070	1945	104.2	36.7	67.6	100
IN	4	1815	1748	103.5	34.6	68.9	100
IN	5	1867	1825	94.5	31.2	63.3	83
IN	6	1845	1730	104.3	38.2	66.2	100
CA	1	1762	1639	102.3	38.3	64.0	100
CA	2	2045	1850	104.5	40.9	63.6	100
CA	3	1863	1693	100.1	36.0	64.1	100
CA	4	1825	1740	96.2	35.7	60.6	100
CA	5	1858	1750	101.4	37.4	63.9	100
CA	6	1885	1733	103.5	38.1	65.4	100

Appendix C-2. *Comparison of unexcreted proportion of dry matter, nitrogen and amino acid, and energy metabolisability between intact (IN) and caeectomised (CA) laying hens in Experiment 3*

Treat.	Rep.	DM	N	CYS	ASP	MET	THR	SER	GLU	PRO	GLY	ALA	VAL	ILE	LEU	PHE	LYS	ARG	Energy
IN	1	0.63	0.38	0.81	0.81	0.83	0.76	0.82	0.89	0.88	0.72	0.72	0.80	0.82	0.83	0.84	0.83	0.89	0.72
IN	2	0.67	0.43	0.81	0.83	0.87	0.77	0.84	0.90	0.89	0.71	0.77	0.83	0.85	0.86	0.86	0.84	0.91	0.74
IN	3	0.65	0.39	0.78	0.80	0.86	0.73	0.81	0.89	0.88	0.68	0.74	0.81	0.84	0.85	0.86	0.83	0.90	0.74
IN	4	0.67	0.40	0.82	0.82	0.81	0.77	0.83	0.89	0.90	0.73	0.72	0.81	0.82	0.84	0.85	0.82	0.88	0.73
IN	5	0.67	0.42	0.79	0.83	0.83	0.78	0.83	0.89	0.89	0.68	0.75	0.81	0.82	0.83	0.85	0.83	0.89	0.74
IN	6	0.63	0.37	0.80	0.82	0.79	0.76	0.83	0.89	0.89	0.60	0.73	0.80	0.81	0.83	0.84	0.82	0.90	0.72
CA	1	0.63	0.35	0.79	0.80	0.79	0.73	0.81	0.87	0.88	0.64	0.69	0.78	0.81	0.82	0.81	0.80	0.88	0.72
CA	2	0.61	0.38	0.77	0.80	0.88	0.71	0.79	0.89	0.87	0.63	0.76	0.81	0.84	0.85	0.84	0.83	0.90	0.70
CA	3	0.64	0.44	0.79	0.81	0.86	0.75	0.81	0.89	0.88	0.65	0.77	0.82	0.84	0.85	0.86	0.82	0.91	0.71
CA	4	0.63	0.41	0.76	0.80	0.86	0.72	0.80	0.89	0.87	0.58	0.76	0.81	0.84	0.85	0.85	0.82	0.92	0.70
CA	5	0.63	0.36	0.77	0.80	0.86	0.73	0.80	0.89	0.89	0.59	0.76	0.82	0.82	0.85	0.85	0.82	0.90	0.71
CA	6	0.63	0.41	0.77	0.81	0.84	0.74	0.80	0.89	0.88	0.61	0.76	0.81	0.84	0.84	0.85	0.82	0.90	0.71

Appendix D-1. *Production performance of caecectomised laying hens in different ages of Experiment 4 (BW = body weight, DMI = dry matter intake, EDM = excreted dry matter, DDM = disappeared dry matter, EP = egg production)*

Week	Replication	Initial BW (g)	Final BW (g)	DMI (g/d)	EDM (%)	DDM (g/d)	EP (%)
27	1	1762	1639	102.3	38.3	64.0	100
27	2	2045	1850	104.5	40.9	63.6	100
27	3	1863	1693	100.1	36.0	64.1	100
27	4	1825	1740	96.2	35.7	60.6	100
27	5	1858	1750	101.4	37.4	63.9	100
27	6	1885	1733	103.5	38.1	65.4	100
40	1	1850	1900	101.3	36.0	65.3	100
40	2	1795	1800	103.3	34.4	68.9	100
40	3	1995	1946	102.3	39.1	63.2	80
40	4	1729	1750	103.4	36.6	66.9	100
40	5	2100	2125	106.8	37.3	69.5	100
40	6	1862	1839	104.0	42.9	61.1	100
57	1	2011	1975	102.1	34.4	67.7	100
57	2	2019	2010	104.5	35.5	69.0	86
57	3	2001	1958	101.3	36.5	64.8	86
57	4	1869	1870	104.4	38.0	66.4	86
57	5	2385	2360	102.2	36.0	66.2	100
57	6	1975	1881	103.5	35.4	68.1	100

Appendix D-2. *Comparison of unexcreted proportion of dry matter, nitrogen and amino acid, and energy metabolisability in different age of hens in Experiment 4*

Week	27						40						57					
Replication	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Dry matter	0.62	0.61	0.64	0.63	0.63	0.63	0.64	0.67	0.62	0.65	0.65	0.59	0.66	0.66	0.64	0.64	0.65	0.66
Nitrogen	0.35	0.38	0.44	0.41	0.36	0.41	0.43	0.46	0.40	0.46	0.42	0.36	0.51	0.47	0.45	0.49	0.45	0.50
Alanine	0.69	0.76	0.77	0.76	0.76	0.77	0.76	0.77	0.72	0.74	0.77	0.73	0.82	0.77	0.79	0.78	0.78	0.79
Arginine	0.88	0.90	0.91	0.89	0.87	0.88	0.87	0.88	0.86	0.83	0.87	0.84	0.91	0.87	0.88	0.86	0.88	0.88
Aspartic acid	0.80	0.80	0.81	0.78	0.79	0.79	0.81	0.82	0.79	0.79	0.83	0.79	0.82	0.79	0.80	0.79	0.80	0.80
Cystine	0.79	0.77	0.79	0.76	0.74	0.73	0.77	0.74	0.67	0.70	0.71	0.70	0.80	0.76	0.79	0.76	0.77	0.77
Glutamic acid	0.87	0.89	0.89	0.89	0.89	0.89	0.90	0.90	0.89	0.88	0.90	0.88	0.91	0.89	0.90	0.90	0.90	0.90
Glycine	0.64	0.62	0.65	0.61	0.62	0.65	0.63	0.70	0.62	0.63	0.62	0.57	0.72	0.68	0.66	0.67	0.58	0.63
Isoleucine	0.81	0.84	0.84	0.84	0.84	0.84	0.83	0.84	0.82	0.81	0.84	0.81	0.86	0.82	0.83	0.83	0.83	0.83
Leucine	0.82	0.85	0.85	0.85	0.85	0.85	0.86	0.87	0.84	0.84	0.85	0.83	0.87	0.85	0.85	0.84	0.85	0.85
Lysine	0.81	0.83	0.82	0.83	0.83	0.81	0.84	0.83	0.79	0.79	0.84	0.79	0.84	0.82	0.84	0.81	0.80	0.82
Methionine	0.80	0.88	0.86	0.83	0.81	0.82	0.85	0.84	0.84	0.84	0.87	0.81	0.91	0.86	0.86	0.87	0.86	0.88
Phenylalanine	0.81	0.84	0.86	0.84	0.85	0.84	0.84	0.85	0.82	0.82	0.85	0.81	0.89	0.87	0.87	0.87	0.87	0.86
Proline	0.88	0.86	0.88	0.83	0.84	0.84	0.90	0.92	0.89	0.88	0.92	0.86	0.89	0.87	0.87	0.85	0.87	0.86
Serine	0.81	0.79	0.81	0.79	0.79	0.80	0.82	0.83	0.80	0.80	0.82	0.79	0.84	0.80	0.82	0.82	0.81	0.81
Threonine	0.73	0.71	0.75	0.71	0.73	0.73	0.74	0.75	0.70	0.71	0.76	0.70	0.78	0.74	0.75	0.73	0.73	0.73
Valine	0.78	0.81	0.82	0.79	0.81	0.80	0.81	0.81	0.78	0.78	0.80	0.77	0.87	0.83	0.83	0.79	0.82	0.82
Energy	0.71	0.69	0.70	0.69	0.70	0.70	0.69	0.73	0.69	0.70	0.72	0.66	0.73	0.72	0.72	0.70	0.71	0.72

Appendix E-1. *TiO₂ concentration in excreta (g/kg in DM) following TiO₂ withdrawal from the feed for different replications (Rep) in Experiment 5*

Day	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	24.4	20.9	25.6	20.8	21.6
1	6.63	3.51	7.42	4.63	3.56
2	0.20	0.31	0.21	0.55	0.35
3	0.18	0.26	0.42	0.29	0.37
4	0.04	0.14	0.17	0.17	0.15

Appendix F-1. *Recovery rate (%) of TiO₂ in excreta of caecectomised laying hens fed with different diets (BD = basal diet, TS = toasted soybeans, MG = maize gluten) in Experiment 6*

Replication	BD	15 % TS	30 % TS	15 % MG	30 % MG
1	89.2	98.1	93.5	96.1	99.7
2	99.9	98.2	97.4	90.7	88.7
3	88.9	83.8	94.6	88.5	88.9
4	84.6	96.8	90.0	94.3	86.6
5	79.3	92.2	89.3	88.6	92.8
6	83.6	87.7	89.3	89.7	89.0
7	69.7	82.9	89.1	91.2	89.4

Appendix F-2. *Hen performance details in Experiment 6 (BD = basal diet, TS = toasted soybeans, MG = maize gluten, BW = body weight, FI = feed intake, EP = egg production, EW = egg weight, IL = ileum length)*

Diet	Replication	Hen No.	Initial BW (g)	Final BW (g)	FI (g/d)	EP (%)
BD	1	2	2045	2110	102.2	71.4
BD	2	3	1616	1613	82.1	57.1
BD	3	7	1885	1706	56.7	83.3
BD	4	8	1931	1720	68.0	83.3
BD	5	11	2300	2218	100.3	100
BD	6	12	2028	1989	104.8	85.7
BD	7	13	1940	1784	89.9	100
TS 15 %	1	4	2008	2131	93.9	28.6
TS 15 %	2	6	1990	2082	96.1	71.4
TS 15 %	3	10	1870	1855	59.5	83.3
TS 15 %	4	11	2247	2300	115.6	100
TS 15 %	5	12	1913	2028	115.9	100
TS 15 %	6	1	1820	1910	105.4	100
TS 15 %	7	14	2403	2390	115.2	100
TS 30 %	1	7	1820	1863	85.3	57.1
TS 30 %	2	8	1861	1891	84.0	0
TS 30 %	3	10	1810	1902	115.4	100
TS 30 %	4	13	1881	1940	115.4	100
TS 30 %	5	14	2325	2403	113.3	100
TS 30 %	6	2	1995	2135	116.1	100
TS 30 %	7	3	1652	1719	91.3	100
MG 15 %	1	11	2203	2180	92.2	85.7
MG 15 %	2	1	1932	1820	92.7	100
MG 15 %	3	2	2115	1995	75.2	100
MG 15 %	4	3	1709	1652	79.1	100
MG 15 %	5	4	2171	2229	102.2	85.7
MG 15 %	6	5	1794	1820	94.5	100
MG 15 %	7	6	2026	1988	87.1	85.7
MG 30 %	1	13	1857	1830	67.1	14.3
MG 30 %	2	14	2209	2291	111.9	85.7
MG 30 %	3	4	2177	2171	109.2	100
MG 30 %	4	5	1967	1794	77.9	50.0
MG 30 %	5	6	2039	2026	85.2	83.3
MG 30 %	6	7	1706	1726	80.6	85.7
MG 30 %	7	8	1720	1723	84.7	85.7

Appendix F-3. *Unexcreted proportions of nitrogen and amino acids for the basal diet (BD) and the other diets with different inclusion rates of toasted soybeans (TS) and maize gluten (MG) in Experiment 6, Data based on marker calculation*

Diet	Rep.	CYS	ASP	MET	THR	SER	GLU	PRO	GLY	ALA	VAL	ILE	LEU	TRY	PHE	LYS	ARG	Nitrogen
BD	1	0.86	0.82	0.93	0.84	0.93	0.97	0.96	0.48	0.85	0.90	0.92	0.94	0.86	0.94	0.87	0.90	0.42
BD	2	0.86	0.83	0.94	0.83	0.93	0.97	0.96	0.56	0.85	0.92	0.92	0.94	0.86	0.95	0.88	0.91	0.44
BD	3	0.84	0.77	0.92	0.79	0.90	0.96	0.95	0.55	0.82	0.92	0.91	0.93	0.85	0.94	0.85	0.89	0.39
BD	4	0.88	0.79	0.93	0.77	0.89	0.97	0.96	0.42	0.86	0.91	0.92	0.94	0.85	0.95	0.82	0.89	0.41
BD	5	0.86	0.80	0.91	0.79	0.90	0.96	0.95	0.46	0.82	0.89	0.90	0.92	0.85	0.93	0.83	0.89	0.44
BD	6	0.87	0.79	0.93	0.79	0.90	0.96	0.95	0.36	0.84	0.90	0.91	0.93	0.85	0.95	0.83	0.88	0.45
BD	7	0.86	0.78	0.92	0.77	0.89	0.96	0.94	0.37	0.83	0.89	0.90	0.92	0.85	0.94	0.84	0.89	0.39
TS 15 %	1	0.82	0.85	0.93	0.81	0.92	0.96	0.94	0.47	0.84	0.91	0.91	0.93	0.85	0.94	0.89	0.92	0.35
TS 15 %	2	0.83	0.83	0.91	0.81	0.90	0.96	0.94	0.61	0.83	0.88	0.90	0.91	0.85	0.93	0.89	0.92	0.48
TS 15 %	3	0.84	0.85	0.92	0.81	0.90	0.96	0.95	0.38	0.84	0.90	0.91	0.93	0.86	0.94	0.84	0.92	0.29
TS 15 %	4	0.80	0.84	0.92	0.79	0.90	0.96	0.95	0.67	0.86	0.91	0.90	0.94	0.85	0.94	0.89	0.93	0.41
TS 15 %	5	0.83	0.84	0.90	0.81	0.89	0.95	0.93	0.66	0.81	0.89	0.88	0.91	0.84	0.92	0.89	0.91	0.45
TS 15 %	6	0.86	0.81	0.90	0.77	0.89	0.95	0.93	0.58	0.82	0.89	0.87	0.91	0.84	0.91	0.87	0.94	0.42
TS 15 %	7	0.86	0.87	0.92	0.82	0.91	0.97	0.95	0.41	0.88	0.92	0.92	0.94	0.88	0.95	0.86	0.94	0.35
TS 30 %	1	0.80	0.83	0.91	0.80	0.89	0.95	0.95	0.43	0.81	0.89	0.89	0.90	0.84	0.93	0.87	0.93	0.32
TS 30 %	2	0.83	0.87	0.95	0.83	0.91	0.96	0.94	0.43	0.85	0.91	0.91	0.93	0.87	0.94	0.90	0.94	0.21
TS 30 %	3	0.86	0.88	0.95	0.87	0.93	0.97	0.95	0.63	0.87	0.91	0.93	0.94	0.89	0.95	0.91	0.95	0.32
TS 30 %	4	0.78	0.85	0.93	0.80	0.89	0.95	0.94	0.59	0.85	0.92	0.91	0.92	0.86	0.94	0.89	0.93	0.31
TS 30 %	5	0.83	0.89	0.95	0.85	0.92	0.96	0.95	0.70	0.89	0.93	0.92	0.94	0.87	0.95	0.91	0.95	0.31
TS 30 %	6	0.85	0.87	0.94	0.83	0.91	0.96	0.95	0.49	0.87	0.92	0.91	0.93	0.87	0.94	0.89	0.94	0.31
TS 30 %	7	0.86	0.90	0.94	0.85	0.92	0.97	0.95	0.47	0.88	0.92	0.93	0.94	0.88	0.95	0.88	0.95	0.32
MG 15 %	1	0.84	0.85	0.96	0.83	0.91	0.97	0.96	0.34	0.92	0.95	0.93	0.96	0.86	0.96	0.84	0.93	0.30
MG 15 %	2	0.83	0.83	0.93	0.81	0.91	0.96	0.95	0.42	0.89	0.90	0.91	0.95	0.83	0.94	0.79	0.92	0.29
MG 15 %	3	0.81	0.83	0.93	0.82	0.91	0.96	0.95	0.32	0.89	0.90	0.89	0.95	0.85	0.94	0.83	0.92	0.25
MG 15 %	4	0.84	0.86	0.95	0.84	0.92	0.97	0.96	0.32	0.91	0.92	0.92	0.96	0.85	0.95	0.87	0.92	0.29
MG 15 %	5	0.84	0.85	0.94	0.84	0.92	0.97	0.97	0.58	0.91	0.93	0.91	0.96	0.83	0.96	0.87	0.94	0.26
MG 15 %	6	0.78	0.83	0.94	0.84	0.91	0.96	0.96	0.48	0.89	0.91	0.92	0.95	0.83	0.93	0.85	0.91	0.28
MG 15 %	7	0.84	0.85	0.94	0.84	0.92	0.97	0.95	0.46	0.91	0.92	0.93	0.96	0.84	0.95	0.82	0.92	0.29
MG 30 %	1	0.82	0.84	0.95	0.83	0.92	0.96	0.95	0.44	0.91	0.91	0.92	0.96	0.80	0.95	0.84	0.92	0.29
MG 30 %	2	0.82	0.87	0.95	0.87	0.93	0.97	0.97	0.40	0.93	0.95	0.93	0.96	0.86	0.96	0.85	0.93	0.29
MG 30 %	3	0.81	0.87	0.94	0.85	0.92	0.96	0.96	0.57	0.92	0.92	0.92	0.96	0.85	0.95	0.88	0.93	0.30
MG 30 %	4	0.81	0.83	0.93	0.83	0.91	0.95	0.94	0.42	0.90	0.90	0.90	0.94	0.80	0.94	0.79	0.91	0.33
MG 30 %	5	0.82	0.86	0.94	0.85	0.92	0.96	0.94	0.43	0.91	0.91	0.89	0.95	0.84	0.95	0.87	0.94	0.29
MG 30 %	6	0.85	0.89	0.95	0.89	0.94	0.97	0.97	0.50	0.93	0.93	0.94	0.97	0.87	0.96	0.87	0.94	0.33
MG 30 %	7	0.86	0.87	0.94	0.86	0.92	0.96	0.95	0.44	0.92	0.91	0.92	0.95	0.85	0.95	0.82	0.91	0.36

Appendix F-4. *Unexcreted proportions of nitrogen and amino acids for the basal diet (BD) and the other diets with different inclusion rates of toasted soybeans (TS) and maize gluten (MG) in Experiment 6, Data based on total excreta calculation*

Diet	Rep.	CYS	ASP	MET	THR	SER	GLU	PRO	GLY	ALA	VAL	ILE	LEU	TRY	PHE	LYS	ARG	Nitrogen
BD	1	0.87	0.84	0.94	0.86	0.94	0.97	0.97	0.54	0.86	0.91	0.93	0.95	0.88	0.95	0.88	0.91	0.48
BD	2	0.85	0.82	0.94	0.83	0.92	0.97	0.96	0.54	0.85	0.91	0.92	0.94	0.85	0.95	0.88	0.90	0.41
BD	3	0.85	0.80	0.93	0.81	0.91	0.97	0.96	0.60	0.84	0.93	0.92	0.94	0.87	0.95	0.86	0.90	0.46
BD	4	0.90	0.83	0.94	0.81	0.91	0.97	0.96	0.51	0.88	0.92	0.93	0.95	0.88	0.96	0.85	0.91	0.50
BD	5	0.89	0.84	0.93	0.83	0.92	0.97	0.96	0.57	0.86	0.92	0.92	0.94	0.88	0.95	0.86	0.92	0.55
BD	6	0.89	0.83	0.94	0.82	0.91	0.97	0.96	0.47	0.87	0.92	0.93	0.94	0.88	0.95	0.86	0.90	0.54
BD	7	0.90	0.85	0.94	0.84	0.92	0.97	0.96	0.56	0.88	0.92	0.93	0.95	0.90	0.96	0.89	0.92	0.58
TS 15 %	1	0.83	0.86	0.94	0.82	0.92	0.96	0.95	0.50	0.85	0.92	0.92	0.93	0.86	0.94	0.90	0.93	0.38
TS 15 %	2	0.84	0.84	0.92	0.82	0.91	0.96	0.95	0.63	0.84	0.89	0.90	0.91	0.86	0.93	0.89	0.92	0.51
TS 15 %	3	0.87	0.88	0.93	0.84	0.92	0.97	0.96	0.50	0.87	0.92	0.92	0.94	0.89	0.95	0.87	0.94	0.43
TS 15 %	4	0.81	0.85	0.93	0.80	0.90	0.96	0.95	0.69	0.87	0.91	0.91	0.94	0.86	0.94	0.90	0.93	0.45
TS 15 %	5	0.84	0.85	0.92	0.83	0.90	0.96	0.94	0.70	0.83	0.90	0.89	0.92	0.86	0.93	0.90	0.92	0.52
TS 15 %	6	0.88	0.84	0.91	0.81	0.90	0.96	0.94	0.65	0.85	0.91	0.89	0.92	0.86	0.93	0.89	0.95	0.51
TS 15 %	7	0.89	0.90	0.94	0.86	0.93	0.97	0.96	0.53	0.90	0.93	0.93	0.95	0.90	0.96	0.89	0.95	0.48
TS 30 %	1	0.81	0.84	0.91	0.81	0.90	0.95	0.95	0.46	0.82	0.89	0.89	0.91	0.85	0.93	0.88	0.94	0.35
TS 30 %	2	0.83	0.87	0.95	0.83	0.91	0.96	0.95	0.43	0.85	0.91	0.91	0.93	0.87	0.94	0.90	0.94	0.21
TS 30 %	3	0.86	0.89	0.95	0.87	0.93	0.97	0.96	0.64	0.88	0.91	0.93	0.94	0.89	0.95	0.91	0.95	0.34
TS 30 %	4	0.80	0.86	0.94	0.82	0.90	0.96	0.94	0.63	0.86	0.93	0.92	0.93	0.87	0.94	0.90	0.94	0.36
TS 30 %	5	0.84	0.90	0.95	0.86	0.92	0.97	0.96	0.73	0.90	0.94	0.92	0.95	0.88	0.96	0.92	0.96	0.37
TS 30 %	6	0.86	0.88	0.94	0.84	0.92	0.96	0.95	0.54	0.88	0.93	0.92	0.93	0.88	0.95	0.90	0.95	0.37
TS 30 %	7	0.88	0.91	0.95	0.86	0.93	0.97	0.95	0.52	0.89	0.93	0.93	0.95	0.89	0.96	0.89	0.96	0.38
MG 15 %	1	0.86	0.86	0.96	0.84	0.92	0.97	0.97	0.40	0.92	0.95	0.94	0.97	0.87	0.96	0.85	0.93	0.36
MG 15 %	2	0.86	0.85	0.94	0.84	0.92	0.96	0.96	0.50	0.90	0.91	0.92	0.96	0.85	0.95	0.82	0.93	0.38
MG 15 %	3	0.84	0.86	0.94	0.85	0.93	0.97	0.96	0.43	0.90	0.92	0.91	0.96	0.87	0.95	0.86	0.93	0.37
MG 15 %	4	0.86	0.88	0.96	0.86	0.93	0.97	0.96	0.39	0.92	0.93	0.93	0.96	0.87	0.95	0.88	0.93	0.36
MG 15 %	5	0.86	0.87	0.95	0.87	0.93	0.97	0.97	0.65	0.92	0.94	0.93	0.97	0.86	0.97	0.89	0.95	0.38
MG 15 %	6	0.81	0.86	0.95	0.86	0.93	0.96	0.97	0.56	0.91	0.92	0.93	0.95	0.85	0.94	0.87	0.92	0.38
MG 15 %	7	0.87	0.87	0.95	0.86	0.93	0.97	0.96	0.53	0.92	0.93	0.94	0.96	0.86	0.96	0.84	0.93	0.38
MG 30 %	1	0.80	0.82	0.95	0.81	0.91	0.95	0.94	0.38	0.90	0.90	0.91	0.95	0.78	0.95	0.83	0.92	0.21
MG 30 %	2	0.82	0.87	0.95	0.87	0.93	0.97	0.97	0.40	0.93	0.95	0.93	0.96	0.86	0.96	0.85	0.93	0.30
MG 30 %	3	0.81	0.87	0.94	0.85	0.92	0.96	0.96	0.57	0.92	0.92	0.92	0.96	0.85	0.95	0.88	0.93	0.31
MG 30 %	4	0.81	0.84	0.93	0.83	0.92	0.95	0.94	0.44	0.90	0.90	0.90	0.95	0.80	0.94	0.80	0.92	0.35
MG 30 %	5	0.82	0.85	0.94	0.84	0.92	0.96	0.94	0.41	0.91	0.91	0.89	0.95	0.84	0.95	0.87	0.94	0.26
MG 30 %	6	0.85	0.89	0.95	0.89	0.94	0.97	0.97	0.50	0.93	0.93	0.94	0.97	0.87	0.96	0.87	0.94	0.34
MG 30 %	7	0.86	0.87	0.94	0.86	0.92	0.96	0.95	0.44	0.92	0.91	0.92	0.95	0.85	0.95	0.82	0.91	0.36

Appendix F-5. *Amino acid analysis of purified (99 %) synthetic uric acid (%)*

	Replication 1	Replication 2
Alanine	0.00	0.00
Arginine	0.00	0.00
Aspartic acid	0.00	0.00
Cystine	0.23	0.20
Glutamic acid	0.00	0.00
Glycine	3.91	6.66
Isoleucine	0.00	0.00
Leucine	0.00	0.00
Lysine	0.00	0.00
Methionine	0.00	0.00
Phenylalanine	0.00	0.00
Proline	0.00	0.00
Serine	0.00	0.00
Threonine	0.00	0.00
Tryptophan	0.00	0.00
Valine	0.00	0.00
NH ₄ ⁺	11.52	12.39

Appendix F-6. *Ranking of total tract amino acid digestibility determined for toasted soybeans (TS) and maize gluten (MG) in Experiment 6*

TS	Arg=Met>Glu=Phe>Lys>Ile=Leu=Pro=Ser=Val>Asp>Ala=Try>Thr>Cys>Gly
MG	Leu>Met=Phe>Arg=Glu=Pro>Ala=Ser=Val>Ile>Asp>Thr>Lys>Try>Cys>Gly

Appendix F-7. *Comparison of partial total tract digestibility of amino acids and nitrogen metabolisablty for toasted soybeans between calculations based on marker and total excreta collection by simple linear regression analysis in Experiment 6*

	Marker			Total collection			P Value
	Estimate	SE	R ²	Estimate	SE	R ²	
Nitrogen	0.30	± 0.05	0.65	0.33	± 0.06	0.61	0.69
Alanine	0.88	± 0.01	0.99	0.88	± 0.01	0.99	0.93
Arginine	0.96	± 0.00	1.00	0.96	± 0.00	1.00	0.96
Aspartic acid	0.89	± 0.01	1.00	0.89	± 0.01	1.00	0.85
Cystine	0.81	± 0.02	0.99	0.82	± 0.02	0.99	0.79
Glutamic acid	0.96	± 0.00	1.00	0.96	± 0.00	1.00	0.84
Glycine	0.67	± 0.06	0.86	0.67	± 0.06	0.88	1.00
Isoleucine	0.92	± 0.01	1.00	0.92	± 0.01	1.00	0.88
Leucine	0.93	± 0.01	1.00	0.93	± 0.01	1.00	0.89
Lysine	0.92	± 0.01	1.00	0.92	± 0.01	1.00	1.00
Methionine	0.95	± 0.01	1.00	0.95	± 0.01	1.00	0.96
Phenylalanine	0.95	± 0.01	1.00	0.95	± 0.01	1.00	0.90
Proline	0.94	± 0.01	1.00	0.95	± 0.01	1.00	0.90
Serine	0.91	± 0.01	1.00	0.91	± 0.01	1.00	0.85
Threonine	0.85	± 0.01	0.99	0.85	± 0.01	1.00	0.86
Tryptophan	0.87	± 0.01	1.00	0.88	± 0.01	1.00	0.76
Valine	0.92	± 0.01	1.00	0.93	± 0.01	1.00	0.95

Appendix F-8. *Comparison of partial total tract digestibility of amino acids and nitrogen metabolisability for maize gluten between calculations based on marker and total excreta collection by simple linear regression analysis in Experiment 6*

	Marker			Total collection			P Value
	Estimate	SE	R ²	Estimate	SE	R ²	
Nitrogen	0.23	± 0.03	0.74	0.18	± 0.04	0.52	0.36
Alanine	0.95	± 0.01	1.00	0.94	± 0.01	1.00	0.42
Arginine	0.95	± 0.01	1.00	0.94	± 0.01	1.00	0.50
Aspartic acid	0.90	± 0.01	1.00	0.88	± 0.01	1.00	0.36
Cystine	0.80	± 0.02	0.99	0.79	± 0.02	0.99	0.72
Glutamic acid	0.96	± 0.00	1.00	0.96	± 0.01	1.00	0.69
Glycine	0.49	± 0.06	0.80	0.45	± 0.06	0.75	0.60
Isoleucine	0.92	± 0.01	1.00	0.92	± 0.01	1.00	0.66
Leucine	0.97	± 0.00	1.00	0.97	± 0.00	1.00	0.51
Lysine	0.86	± 0.02	0.99	0.85	± 0.02	0.99	0.76
Methionine	0.95	± 0.01	1.00	0.95	± 0.00	1.00	0.54
Phenylalanine	0.96	± 0.00	1.00	0.96	± 0.00	1.00	0.56
Proline	0.96	± 0.01	1.00	0.96	± 0.01	1.00	0.62
Serine	0.93	± 0.01	1.00	0.93	± 0.01	1.00	0.40
Threonine	0.89	± 0.01	1.00	0.87	± 0.01	1.00	0.40
Tryptophan	0.84	± 0.02	0.99	0.83	± 0.02	0.99	0.64
Valine	0.94	± 0.01	1.00	0.93	± 0.01	1.00	0.65

Appendix F-9. *Partial total tract digestibility of amino acids and nitrogen metabolisablity for maize gluten (MG) determined by simple linear regression analysis (using Prism software) and compared between 2 inclusion levels (0 % and 30 % MG) and 3 inclusion levels (0 %, 15 % and 30 % MG) in Experiment 6 (estimate and SE of estimate for the regression coefficient)*

Inclusion level	2	3	P value
Nitrogen	0.23 ± 0.03	0.23 ± 0.03	0.96
Alanine	0.95 ± 0.01	0.95 ± 0.01	0.95
Arginine	0.95 ± 0.01	0.95 ± 0.01	0.91
Aspartic acid	0.90 ± 0.01	0.90 ± 0.01	0.90
Cystine	0.79 ± 0.02	0.80 ± 0.02	0.90
Glutamic acid	0.96 ± 0.01	0.96 ± 0.00	0.84
Glycine	0.48 ± 0.05	0.49 ± 0.06	0.83
Isoleucine	0.92 ± 0.01	0.92 ± 0.01	0.90
Leucine	0.97 ± 0.00	0.97 ± 0.00	0.94
Lysine	0.87 ± 0.03	0.86 ± 0.02	0.88
Methionine	0.96 ± 0.01	0.96 ± 0.01	0.99
Phenylalanine	0.96 ± 0.00	0.96 ± 0.01	0.87
Proline	0.96 ± 0.01	0.96 ± 0.01	0.89
Serine	0.94 ± 0.01	0.93 ± 0.01	0.91
Threonine	0.89 ± 0.01	0.89 ± 0.01	0.87
Tryptophan	0.85 ± 0.02	0.84 ± 0.02	0.89
Valine	0.94 ± 0.01	0.94 ± 0.01	0.88

Appendix F-10. *Partial total tract digestibility of amino acids and nitrogen metabolisablity for toasted soybeans (TS) determined by simple linear regression (using Prism software) analysis and compared between 2 inclusion levels (0 % and 30 % TS) and 3 inclusion levels (0 %, 15 % and 30 % TS) in Experiment 6 (estimate and SE of estimate for the regression coefficient)*

Inclusion level	2	3	P value
Nitrogen	0.23 ± 0.04	0.30 ± 0.05	0.29
Alanine	0.89 ± 0.01	0.88 ± 0.02	0.89
Arginine	0.96 ± 0.01	0.96 ± 0.01	0.88
Aspartic acid	0.90 ± 0.01	0.89 ± 0.01	0.83
Cystine	0.81 ± 0.03	0.81 ± 0.02	0.98
Glutamic acid	0.96 ± 0.01	0.96 ± 0.01	0.95
Glycine	0.64 ± 0.07	0.67 ± 0.06	0.76
Isoleucine	0.92 ± 0.01	0.92 ± 0.01	0.85
Leucine	0.93 ± 0.01	0.93 ± 0.01	0.94
Lysine	0.92 ± 0.01	0.92 ± 0.01	0.94
Methionine	0.95 ± 0.01	0.95 ± 0.01	0.95
Phenylalanine	0.95 ± 0.01	0.95 ± 0.01	0.79
Proline	0.94 ± 0.01	0.95 ± 0.01	0.90
Serine	0.92 ± 0.01	0.91 ± 0.01	0.80
Threonine	0.85 ± 0.02	0.85 ± 0.02	0.95
Tryptophan	0.88 ± 0.01	0.88 ± 0.01	0.75
Valine	0.93 ± 0.01	0.93 ± 0.01	0.81