Layer Quality Conference

23-24 October, 2019 - Faisalabad Pakistan

Recent advances in layer nutrition

Dr. Gulraiz Ahmad (Ph.D.)
Group Nutritionist/GM, Sadiq Feeds Pvt Ltd.,
drgulraiz@sadiqfeeds.com

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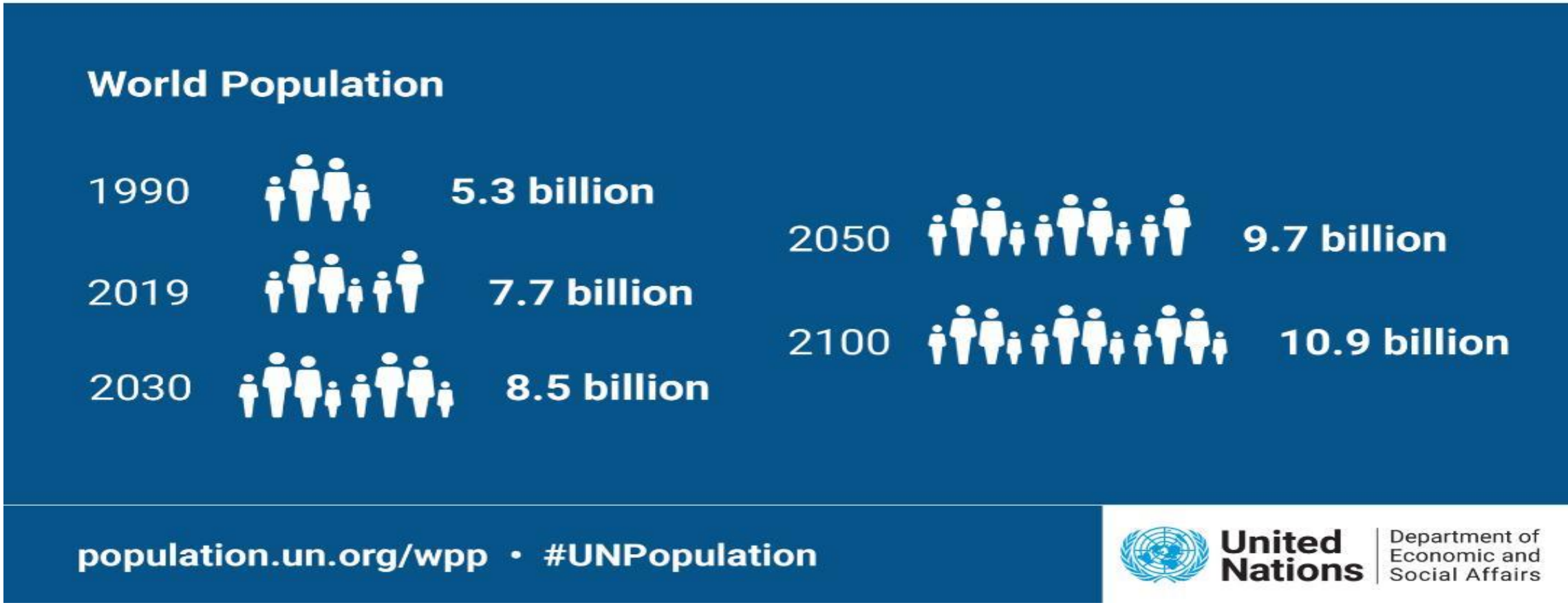
Reference are available on request to author.

Outline

- Layer Statistics
- Recent genetic trend
- Nutrient requirement
- Managing gut health
- Salmonella control in feed
- Optimizing egg size in commercial layers
- MG control in commercial layer
- FLKS

Global population growth

SUSTAINABLE DEVELOPMENT GOALS



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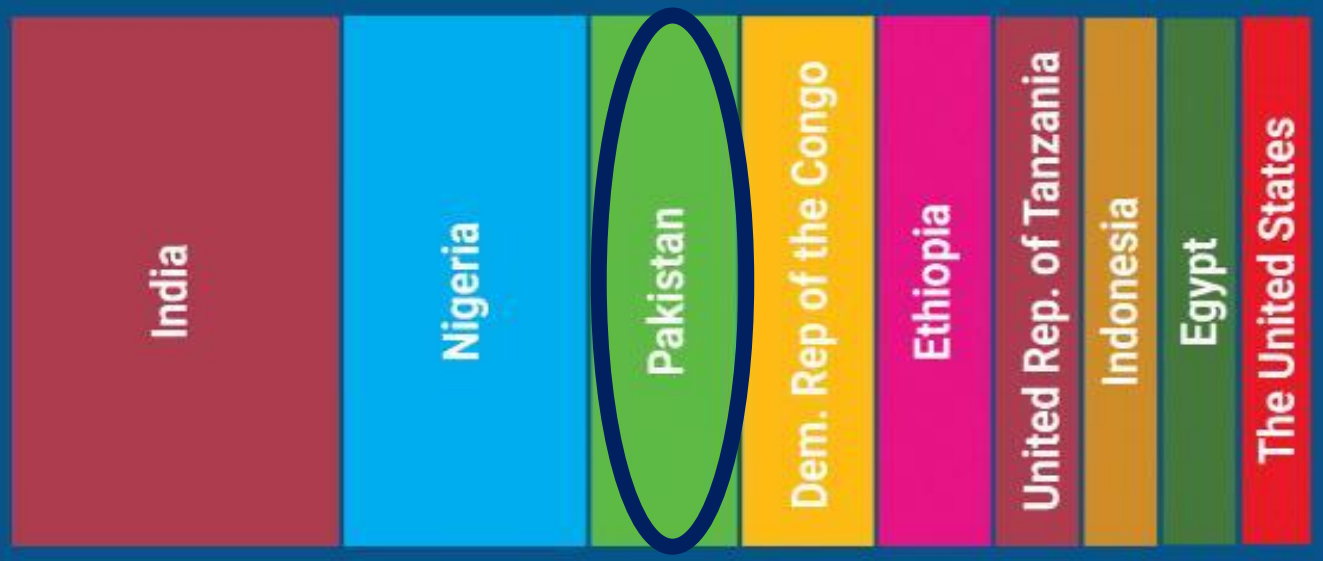
SUSTAINABLE DEVELOPMENT GOALS

More than half of the projected increase in the global population to 2050 will be concentrated in just 9 countries.



population.un.org/wpp • #UNPopulation

United Nations | Department of Economic and Social Affairs

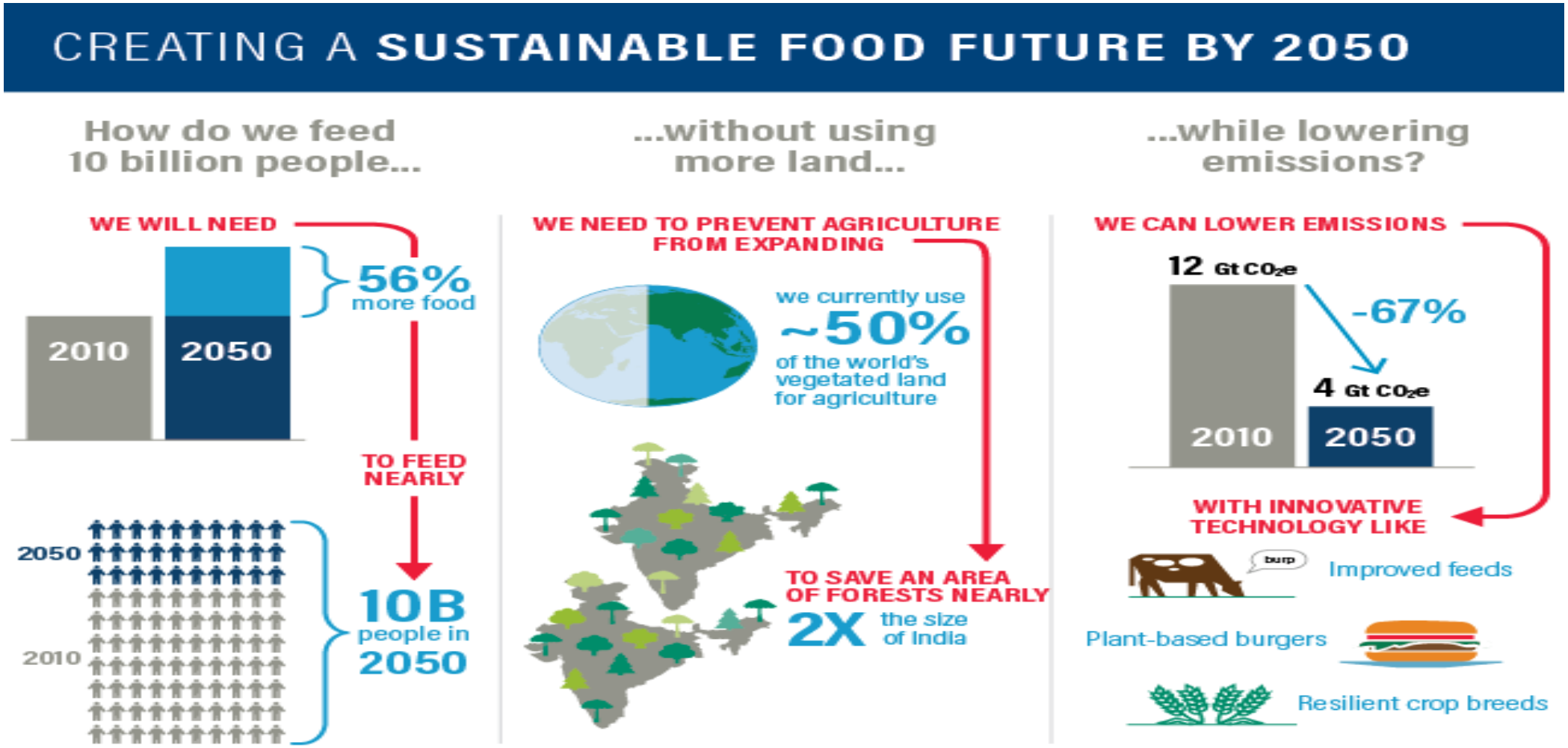

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

A planet under pressure: food

- Over the next 40 years, we'll need to produce as much food as we have in the last 8,000 years of agriculture.

Source: Living Planet Report 2014. WWF in collaboration with Global Footprint Network, Water Footprint Network and ZSL Living Conservation

Food Future by 2050



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The future of food

NATIONAL GEOGRAPHIC MAGAZINE

The Future of Food

0

At Granja Mantiqueira in Brazil eight million hens lay 5.4 million eggs a day. Conveyor belts whisk the eggs to a packaging facility. Demand for meat has tripled in the developing world in four decades, while egg consumption has increased sevenfold, driving a huge expansion of large-scale animal operations.

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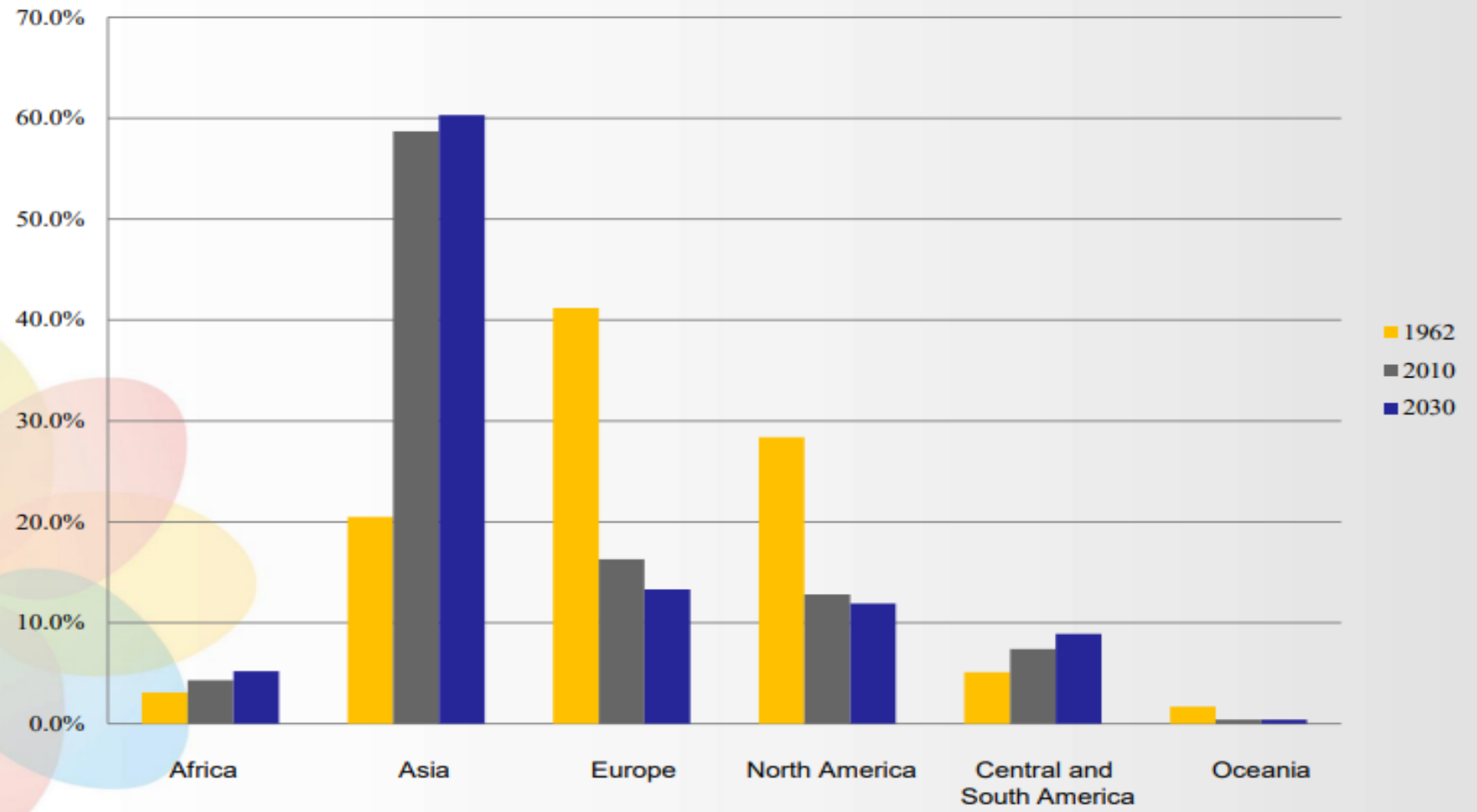
Asia’s egg production has grown rapidly over the past 50 years



www.worldeggorganisation.com
www.worldeggday.com

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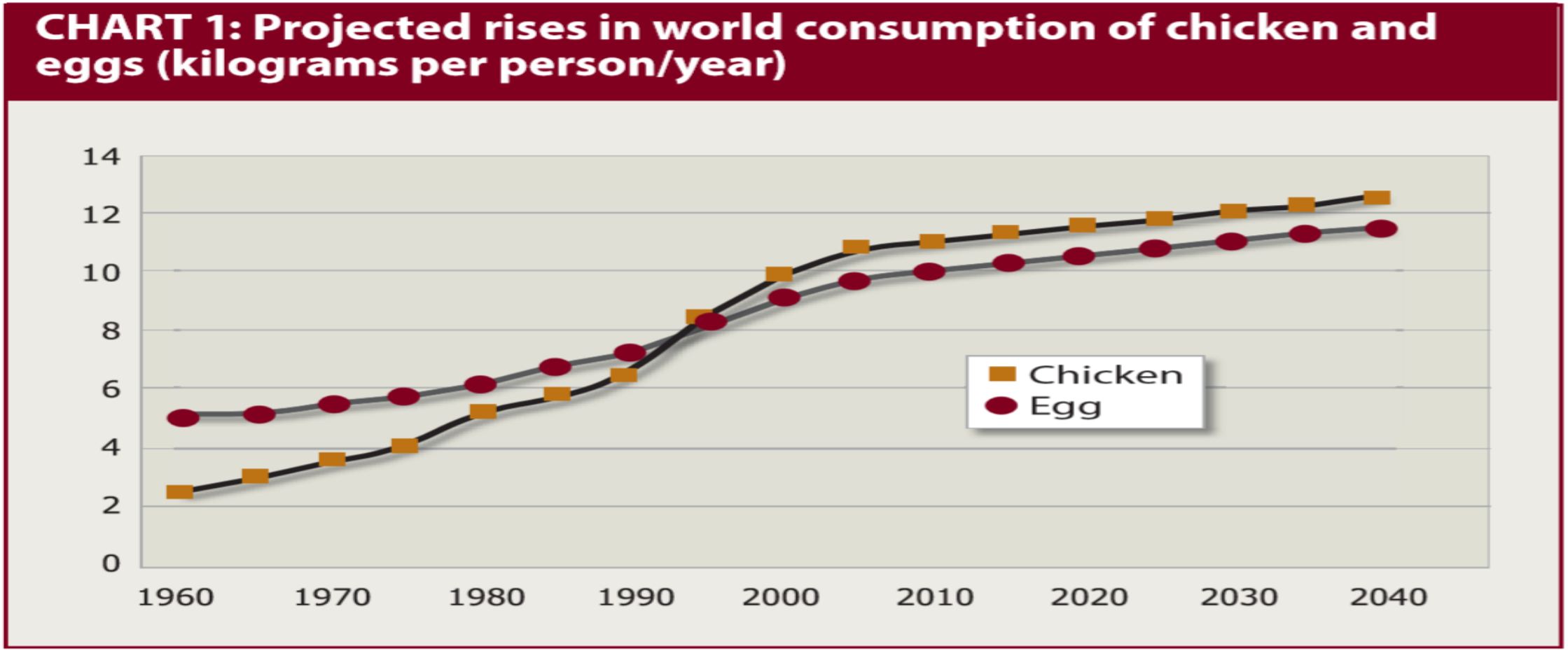
Egg Consumption

In Pakistan, per capita consumption 88 eggs annually. Whereas developed world is consuming over 300 eggs per capita per year. (*Source: PPA 2018-2019)*

Egg Consumption Forecast



By 2020, 72 million Metric Tons of egg will be produced globally which will project the consumption of the eggs by the increasing human population.

Layer Local data

COMMERCIAL LAYER NEW	**30 Millions**
COMMERCIAL LAYER (MOLT)	40 Millions
TOTAL	70 Millions

(Source: PPA 2018-2019).

Top key international layer brands

- **Novogen** (Novogen white, novogen white light, novogen brown and novogen brown light)
- **Hy-line** (W-36 ,W-80, Hy-Line Brown, Hy-Line Silver Brown, Hy-Line Sonia and Hy-Line Pink)
- **Hendrix Genetics** (Dekalb, Shaver, Bovans, ISA, Hisex, and Babcock)
- **H&N International** (Super nick, Nick chick, Crystal nick, Coral, and brown nick)
- **LOHMANN TIERZUCHT** – Germany (LSL classic, LSL brown classic, LSL-lite, LSL brown light, LSL Extra, LSL ultra light, LSL tradition , Lohman sliver, Lohman sandy and Lohman dual)

British Poultry Science

ISSN: 0007-1668 (Print) 1466-1799 (Online) Journal homepage: http://www.tandfonline.com/loi/cbps20

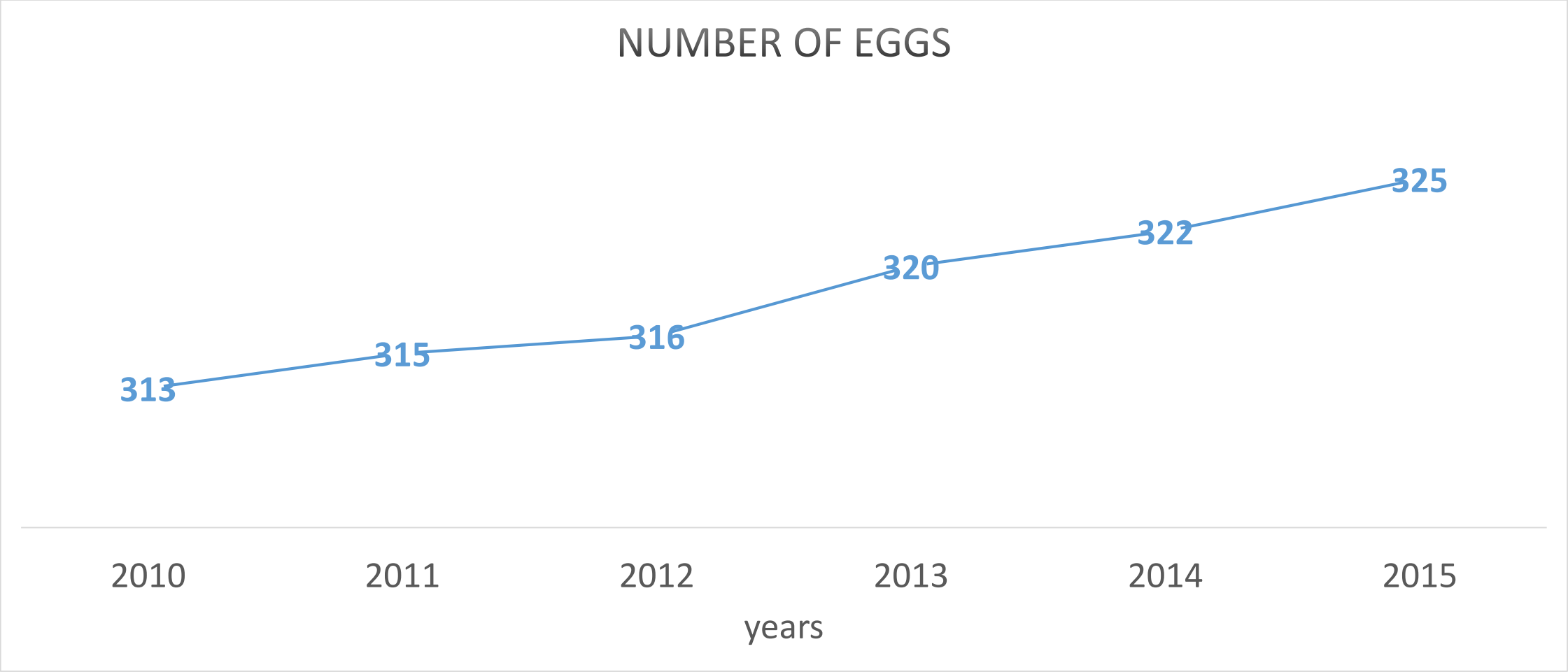
Innovative layer genetics to handle global challenges in egg production

Rudolf Preisinger

To cite this article: Rudolf Preisinger (2018) Innovative layer genetics to handle global challenges in egg production, British Poultry Science, 59:1, 1-6, DOI: 10.1080/00071668.2018.1401828

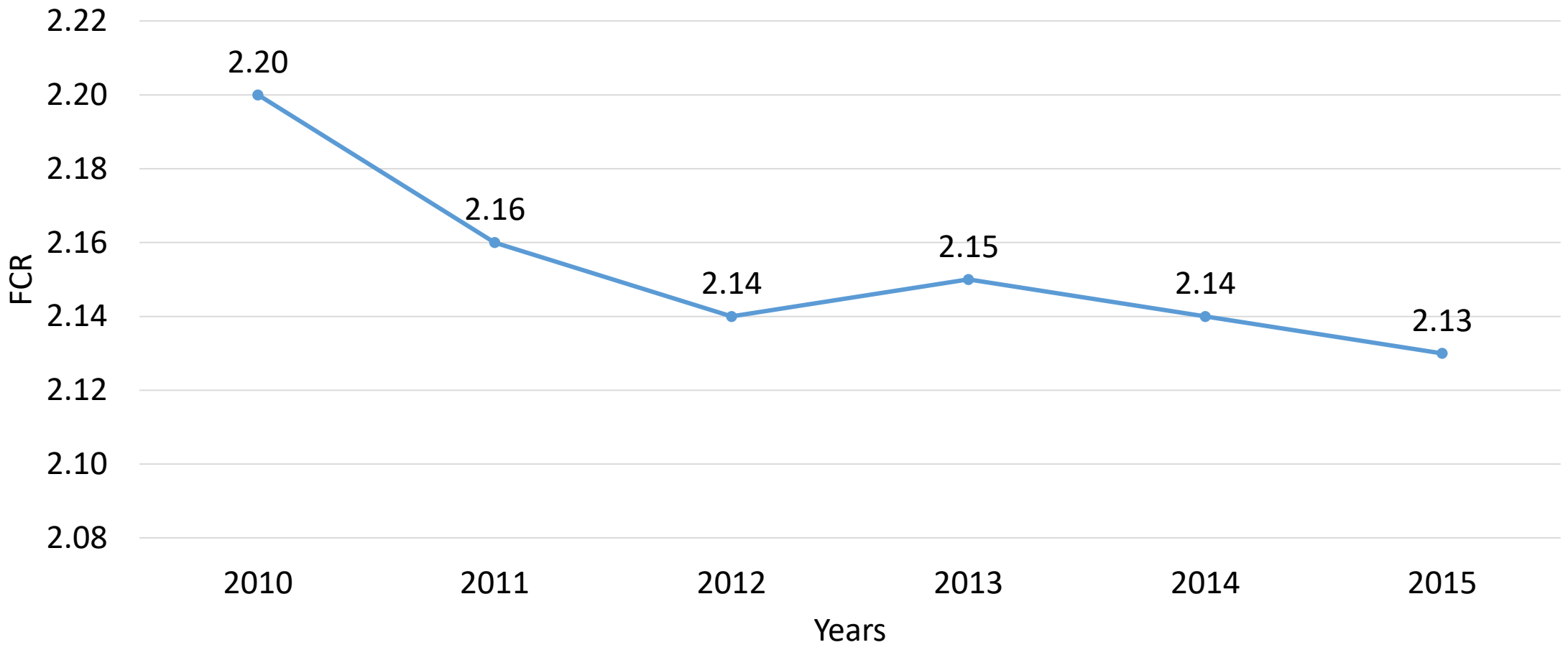
To link to this article: https://doi.org/10.1080/00071668.2018.1401828

Recent genetic trend in egg output (field results)



annual increase of about two to three eggs per year in a 13- month production cycle can be expected

Recent genetic trends in feed efficiency (field results – kg feed/kg egg mass output).



Rudolf Preisinger (2018); BRITISH POULTRY SCIENCE, VOL. 59, NO. 1, 1–6

Type of Layer Breeds

- **White Egg Laying Hens**
  - Comparatively smaller in size.
  - Relatively eat less food, and the color of egg shell is white.
  - ISA White, LOHMANN White, Nick chick, Bab Cock BV-300, Hisex White, Shaver White, Hy-line White, Bovans White and Dekalb white etc.

- **Brown Egg Laying Hens:**
  - Relatively larger in size.
  - They eat more foods, compared to white egg layers.
  - Lay bigger eggs than other laying breeds.
  - Egg shell is brown colored.
  - Isa Brown, Hisex Brown, Shaver 579, LOHMANN brown, Hy-Line Brown, Bab Cock BV-380, Gold Line, Babolna Tetra, Babolna Harko etc

Nutrient requirements

Bovans- White

Nutrients Age Range	Layer I 16/17 – 38 weeks	Layer II * 39 – 51 weeks	Layer III ** 52 – 64 weeks	Layer IV *** 65 – 77 weeks	Layer V **** 78 – end
Feed Cons. Range	21-22.5 lbs/100 95-102 g/bird	21.4-22.9 lbs/100 97-104 g/bird	22-23 lbs/100 100-105 g/bird	22-23 lbs/100 100-105 g/bird	22-23 lbs/100 100-105 g/bird
Crude Protein (%)	18.0 – 18.5	17.5 – 18.0	16.5 – 17.0	15.5 – 16.0	15.0 – 15.5
ME (kcal/kg)	2860 – 2900	2850 – 2880	2840 – 2860	2820 – 2840	2820 – 2840
(kcal/lb)	1300 – 1320	1295 – 1310	1290 – 1300	1280 – 1290	1280 – 1290
Linoleic Acid (%)	1.90	1.60	1.40	1.30	1.30
Amino Acids (%)					
Methionine	0.50	0.46	0.42	0.39	0.36
Methionine + Cystine	0.82	0.77	0.72	0.68	0.62
Lysine	0.98	0.94	0.90	0.86	0.82
Tryptophan	0.22	0.19	0.18	0.17	0.16
Threonine	0.70	0.66	0.63	0.61	0.57
Arginine	0.96	0.92	0.88	0.84	0.80

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Hy Line W-36

FEEDING PHASE	PEAKING					LAYER 2					LAYER 3					LAYER 4					LAYER 5				
PRODUCTION	First egg until production drops 2% below peak					2% below peak to 90%					89–85%					84–80%					Less than 80%				
NUTRITION	**RECOMMENDED CONCENTRATION[1]**																								
Metabolizable energy[2], kcal/kg	2844–2955					2844–2944					2822–2922					2800–2844					2778–2822				
Metabolizable energy[2], MJ/kg	11.91–12.37					11.91–12.33					11.82–12.23					11.72–11.91					11.63–11.82				
	FEED CONSUMPTION (*Typical Feed Consumption)																								
g/day per bird	74	79	**84***	89	94	86	91	**96***	101	106	90	95	**100***	105	110	84	89	**94***	99	104	83	88	**93***	98	103
	Standardized Ileal Digestible Amino Acids																								
Lysine, %	1.09	1.02	**0.96**	0.90	0.86	0.87	0.82	**0.78**	0.74	0.71	0.79	0.75	**0.71**	0.68	0.65	0.83	0.78	**0.74**	0.70	0.67	0.82	0.77	**0.73**	0.69	0.66
Methionine, %	0.53	0.50	**0.47**	0.44	0.42	0.43	0.40	**0.38**	0.36	0.35	0.39	0.37	**0.35**	0.33	0.32	0.41	0.38	**0.36**	0.34	0.33	0.39	0.37	**0.35**	0.33	0.32
Methionine+Cystine,%	0.91	0.86	**0.81**	0.76	0.72	0.73	0.69	**0.66**	0.62	0.59	0.66	0.63	**0.60**	0.57	0.54	0.70	0.66	**0.62**	0.59	0.56	0.67	0.63	**0.60**	0.57	0.54
Threonine, %	0.76	0.71	**0.67**	0.63	0.60	0.61	0.58	**0.55**	0.52	0.50	0.55	0.52	**0.50**	0.47	0.45	0.58	0.55	**0.52**	0.49	0.47	0.57	0.54	**0.51**	0.49	0.46
Tryptophan, %	0.23	0.21	**0.20**	0.19	0.18	0.18	0.17	**0.16**	0.16	0.15	0.17	0.16	**0.15**	0.14	0.14	0.17	0.16	**0.16**	0.15	0.14	0.17	0.16	**0.15**	0.15	0.14
Arginine, %	1.13	1.06	**1.00**	0.94	0.89	0.91	0.86	**0.81**	0.77	0.74	0.82	0.78	**0.74**	0.70	0.67	0.86	0.81	**0.77**	0.73	0.70	0.85	0.80	**0.76**	0.72	0.69
Isoleucine, %	0.85	0.79	**0.75**	0.71	0.67	0.68	0.64	**0.61**	0.58	0.55	0.62	0.58	**0.55**	0.53	0.50	0.65	0.61	**0.58**	0.55	0.52	0.64	0.60	**0.57**	0.54	0.51
Valine, %	0.96	0.90	**0.84**	0.80	0.75	0.77	0.73	**0.69**	0.65	0.62	0.69	0.66	**0.62**	0.60	0.57	0.73	0.69	**0.65**	0.62	0.59	0.72	0.68	**0.64**	0.61	0.58

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Hy Line W-80

FEEDING PHASE PRODUCTION	PEAKING First egg until production drops 2% below peak					LAYER 2 2% below peak to 90%					LAYER 3 89–85%					LAYER 4 84–80%					LAYER 5 Less than 80%				
NUTRITION	**RECOMMENDED CONCENTRATION[1]**																								
Metabolizable energy[2], kcal/lb	1268–1329					1268–1324					1256–1315					1247–1288					1247–1279				
Metabolizable energy[2], kcal/kg	2795–2930					2795–2920					2770–2900					2750–2840					2750–2820				
Metabolizable energy[2], MJ/kg	11.70–12.27					11.70–12.23					11.60–12.14					11.51–11.89					11.51–11.81				
	FEED CONSUMPTION (*Typical Feed Consumption)																								
g/day per bird	93	98	**103***	108	113	98	103	**108***	113	118	99	104	**109***	114	119	98	103	**108***	113	118	97	102	**107***	112	117
lb/day per 100 birds	20.5	21.6	**22.7***	23.8	24.9	21.6	22.7	**23.8***	24.9	26.0	21.8	22.9	**24.0***	25.1	26.2	21.6	22.7	**23.8***	24.9	26.0	21.4	22.5	**23.6***	24.7	25.8
	Standardized Ileal Digestible Amino Acids																								
Lysine, %	0.88	0.84	**0.80**	0.76	0.73	0.81	0.77	**0.73**	0.70	0.67	0.77	0.73	**0.70**	0.67	0.64	0.74	0.71	**0.68**	0.65	0.62	0.73	0.70	**0.66**	0.63	0.61
Methionine, %	0.42	0.40	**0.38**	0.37	0.35	0.39	0.37	**0.35**	0.34	0.32	0.37	0.35	**0.33**	0.32	0.31	0.35	0.33	**0.32**	0.31	0.29	0.35	0.33	**0.31**	0.30	0.29
Methionine+Cystine,%	0.76	0.72	**0.68**	0.65	0.62	0.69	0.66	**0.63**	0.60	0.58	0.66	0.63	**0.60**	0.57	0.55	0.63	0.60	**0.57**	0.55	0.53	0.61	0.58	**0.56**	0.53	0.51
Threonine, %	0.62	0.59	**0.56**	0.53	0.51	0.56	0.54	**0.51**	0.49	0.47	0.54	0.51	**0.49**	0.47	0.45	0.52	0.50	**0.47**	0.45	0.43	0.51	0.49	**0.46**	0.44	0.42
Tryptophan, %	0.19	0.18	**0.17**	0.16	0.15	0.17	0.16	**0.15**	0.15	0.14	0.16	0.15	**0.15**	0.14	0.13	0.16	0.15	**0.14**	0.14	0.13	0.15	0.15	**0.14**	0.13	0.13
Arginine, %	0.92	0.87	**0.83**	0.79	0.75	0.84	0.80	**0.76**	0.73	0.70	0.80	0.76	**0.73**	0.69	0.66	0.77	0.74	**0.70**	0.67	0.64	0.76	0.72	**0.69**	0.66	0.63
Isoleucine, %	0.69	0.65	**0.62**	0.59	0.57	0.63	0.60	**0.57**	0.55	0.52	0.60	0.57	**0.54**	0.52	0.50	0.58	0.55	**0.53**	0.50	0.48	0.57	0.54	**0.52**	0.49	0.47
Valine, %	0.78	0.74	**0.70**	0.67	0.64	0.71	0.67	**0.64**	0.61	0.59	0.68	0.64	**0.61**	0.59	0.56	0.66	0.62	**0.59**	0.57	0.54	0.64	0.61	**0.58**	0.56	0.53

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LSL-Lite (19-45 weeks)

Nutrient		Requirement g/Hen/Day	Daily Feed Consumption			
			105 g	110 g	115 g	120 g
Protein	%	18.50	17.62	16.82	16.09	15.42
Calcium**	%	4.10	3.90	3.73	3.57	3.42
Phosphorus***	%	0.60	0.57	0.55	0.52	0.50
Av. Phosphorus	%	0.42	0.40	0.38	0.37	0.35
Sodium	%	0.18	0.17	0.16	0.16	0.15
Chlorine	%	0.18	0.17	0.16	0.16	0.15
Lysine	%	0.87	0.82	0.79	0.75	0.72
Dig. Lysine	%	0.71	0.68	0.65	0.62	0.59
Methionine	%	0.44	0.42	0.40	0.38	0.37
Dig. Methionine	%	0.36	0.34	0.33	0.31	0.30
Meth./Cyst.	%	0.80	0.76	0.73	0.69	0.67
Dig. M/C	%	0.66	0.62	0.60	0.57	0.55
Arginine	%	0.91	0.87	0.83	0.80	0.76
Dig. Arginine	%	0.75	0.71	0.68	0.65	0.63

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46-65 Weeks

Nutrient		Requirement g/Hen/Day	Daily Feed Consumption			
			105 g	110 g	115 g	120 g
Protein	%	17.76	16.91	16.15	15.44	14.80
Calcium**	%	4.40	4.19	4.00	3.83	3.67
Phosphorus ***	%	0.58	0.55	0.52	0.50	0.48
Av. Phosphorus	%	0.40	0.38	0.37	0.35	0.34
Sodium	%	0.17	0.16	0.16	0.15	0.14
Chlorine	%	0.17	0.16	0.16	0.15	0.14
Lysine	%	0.83	0.79	0.76	0.72	0.69
Dig. Lysine	%	0.68	0.65	0.62	0.59	0.57
Methionine	%	0.42	0.40	0.38	0.37	0.35
Dig. Methionine	%	0.35	0.33	0.31	0.30	0.29
Meth./Cyst.	%	0.77	0.73	0.70	0.67	0.64
Dig. M/C	%	0.63	0.60	0.57	0.55	0.52
Arginine	%	0.88	0.84	0.80	0.76	0.73
Dig. Arginine	%	0.72	0.69	0.65	0.63	0.60

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Above 65 weeks

Nutrient		Requirement g/Hen/Day	Daily Feed Consumption			
			105 g	110 g	115 g	120 g
Protein	%	16.84	16.03	15.30	14.64	14.03
Calcium**	%	4.50	4.29	4.09	3.91	3.75
Phosphorus ***	%	0.55	0.52	0.50	0.47	0.46
Av. Phosphorus	%	0.38	0.36	0.35	0.33	0.32
Sodium	%	0.16	0.16	0.15	0.14	0.14
Chlorine	%	0.16	0.16	0.15	0.14	0.14
Lysine	%	0.79	0.75	0.72	0.69	0.66
Dig. Lysine	%	0.65	0.62	0.59	0.56	0.54
Methionine	%	0.40	0.38	0.36	0.35	0.33
Dig. Methionine	%	0.33	0.31	0.30	0.28	0.27
Meth./Cyst.	%	0.73	0.69	0.66	0.63	0.61
Dig. M/C	%	0.60	0.57	0.54	0.52	0.50
Arginine	%	0.83	0.79	0.76	0.72	0.69
Dig. Arginine	%	0.68	0.65	0.62	0.59	0.57

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Layer Nutrition

- Energy
- Protein / Amino acids
- Minerals
- Vitamins

Energy Requirement

The energy requirement of laying hen will continue

- Maintenance (determined by body weight)
- Eggs output
- Feather cover

Limitations of AME

- Ingredient values may not be additive in diet formulations
- Variations in published data due to,
  - Methodology differences, including bird factors (age, gender, production stage)
  - Ingredient factors
- Does not take account of energy lost as heat

V. Ravindran

Reported variability in AME values of lipids

	Range (Kcal/kg)
Beef tallow	5736-10755
Poultry fat	7887-10516
Soybean oil	7887-10755
Palm oil	5258-7648

V. Ravindran

ENERGY EVALUATION

Country – Table	Corn		Wheat		Soya bean meal 48%	
	Kcal/kg	MJ/Kg	Kcal/kg	MJ/Kg	Kcal/kg	MJ/Kg
Brazil – Rostagno (1)	3 381	14.15	3 046	12.74	2 302	9.63
Europe – Janssen (2)	3 289	13.79	3 036	12.69	2 323	9.72
France – INRA (3)	3 203	13.40	2 988	12.50	2 280	9.53
Netherlands – CVB (4)	3 415	14.29	3 258	13.63	2 309	9.66
USA – Feedstuffs (5)	3 390	14.18	3 210	13.43	2 458	10.28

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Metabolizable energy of corn, soybean meal and wheat for laying hens

Shahram Barzegar,* Shu-Biao Wu,* Jean Noblet,† and Robert A. Swick*,[1]

*School of Environmental and Rural Science, University of New England, Armidale NSW 2351, Australia; and
†INRA, UMR1348 Pegase, F-35590 Saint Gilles, France

2019 Poultry Science 0:1–7
http://dx.doi.org/10.3382/ps/pez333

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Metabolizable energy of corn, soybean meal and wheat for laying hens

Ingredient	By reference diet substitution method	Regression equation
Corn	3134	3722
SBM	2774	2496
Wheat	3067	3479

Energy values, kcal/kg DM

Barzegar et al. 2019: Poult. Sci. J. 0:1-7

How can we improve the accuracy of AME ?

- Standardized the methodology and bird factors
  - Same methodology, same age

- Then actual ingredient variation could be measured

Aust. Poult. Science Symp. 2019 30

LAYER NUTRITION – A FUTURE VISION

R. KLEYN[1]

Protein or AA requirement

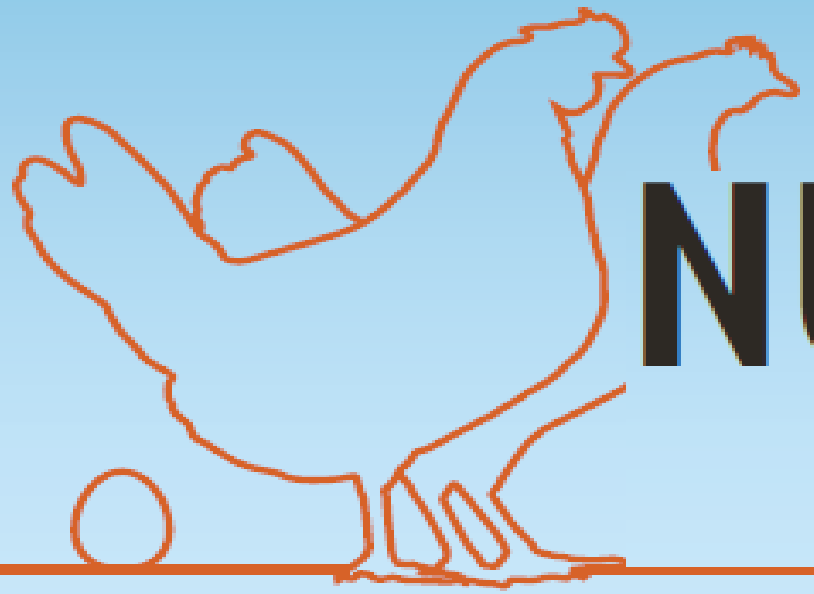
- The provision of the correct level of essential amino acids in the diet is of concern.

- The crude protein minima is unlikely to lead to increase eggs numbers but it will increase egg size.

- The rule of thumb suggest that, for each additional gram of protein a birds consume, the eggs size will increase by 1.4 g.

R. KLEYN. 2019; Aust. Poult. Science Symp.

NUTRITION Guide



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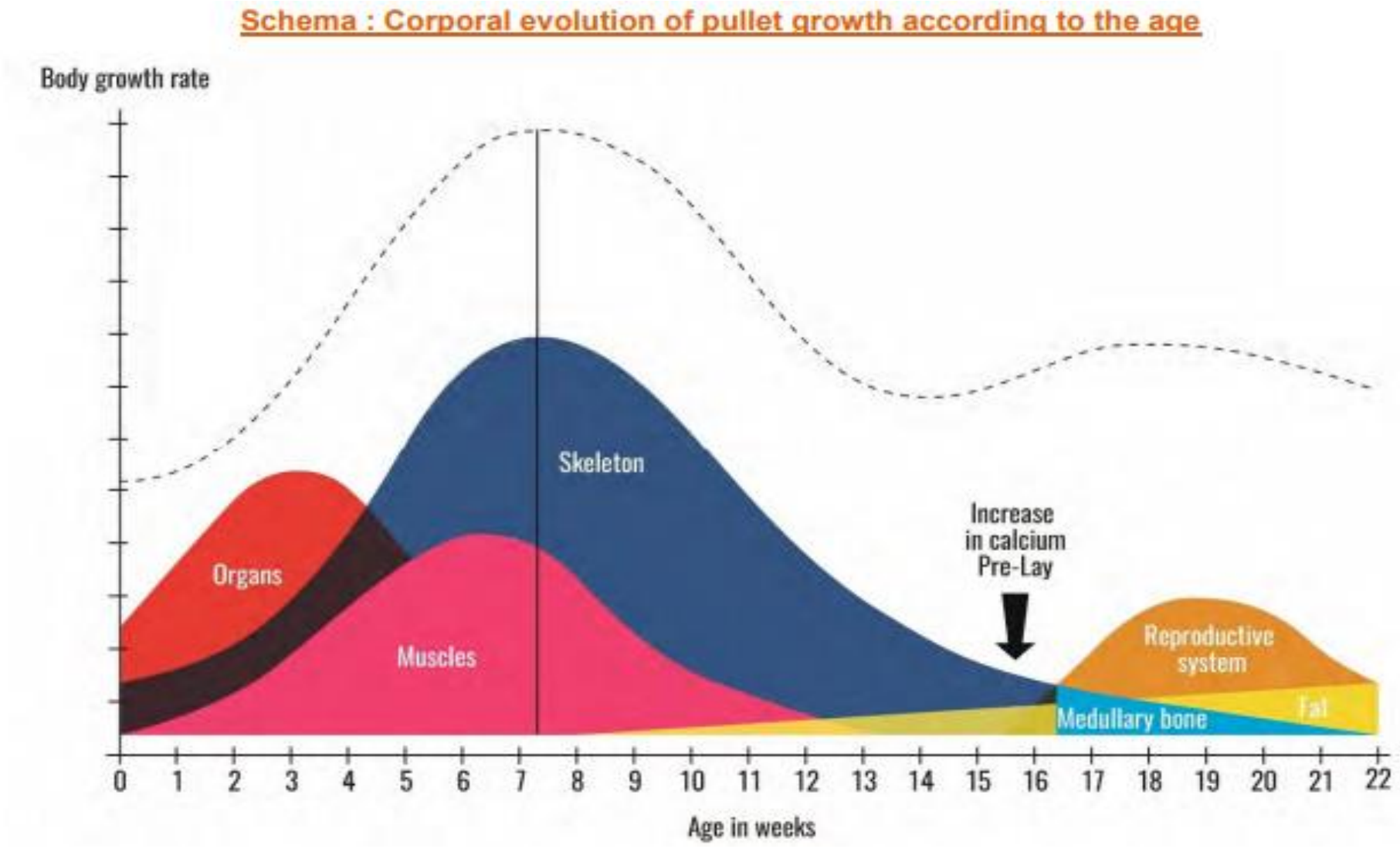
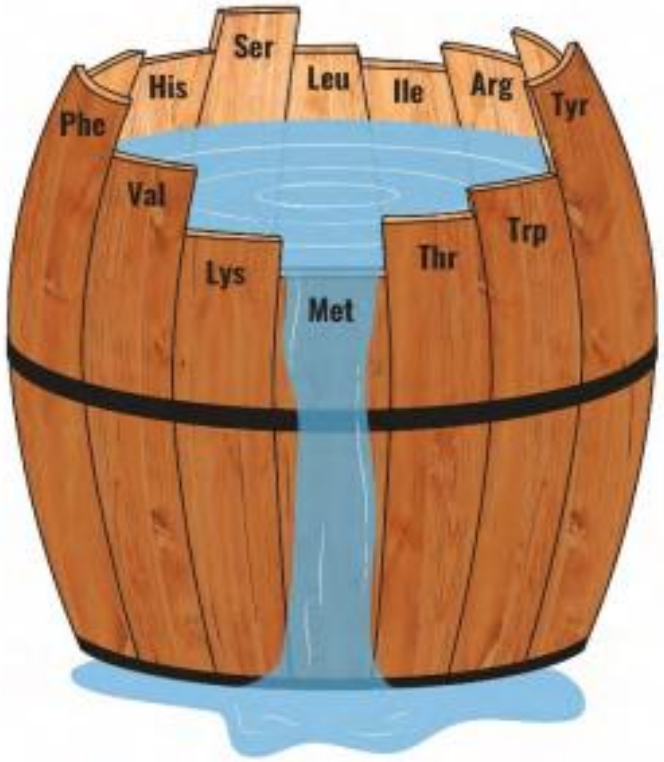
PROTEINS AND AMINO ACIDS REQUIREMENTS



Conti.

- The use more and more of synthetic amino acids has changed the balance in diet formulation.



Summary of daily amino acid requirements

Digestible Amino Acids	Requirement in mg / day
Lysine	800
Methionine	430
Methionine + Cystine	690
Tryptophan	180
Arginine	990
Threonine	550
Valine	770
Isoleucine	720

IPR

AA	NRC (1994)	CVB	Coon & Zhang (1999)	Leeson and summers	Bregendhal (2008)	Rostang o (2017)	Reported Research
Lysine	100	100	100	100	100	100	100
Arginine	101	-	130	103	-	100	-
Isoleucine	94	79	86	79	79	78	-
Methionine	43	50	49	51	47	54	-
M+C	84	93	81	88	94	98	-
Threonine	68	66	73	80	77	77	70-84
Tryptophan	23	19	20	21	22	23	16-25
Valine	101	86	102	89	93	93	80-93

CALCULATION OF REQUIREMENTS (AA)

- (Daily amino acid requirements * 100) / Daily feed intake.

For example, if the daily requirement for lysine is estimated to 800 mg / day and the average intake is 110 g, the following percentage of lysine will be calculated : (800 mg * 100) / 110 = 0.727% of digestible lysine in the feed.

Recent research work

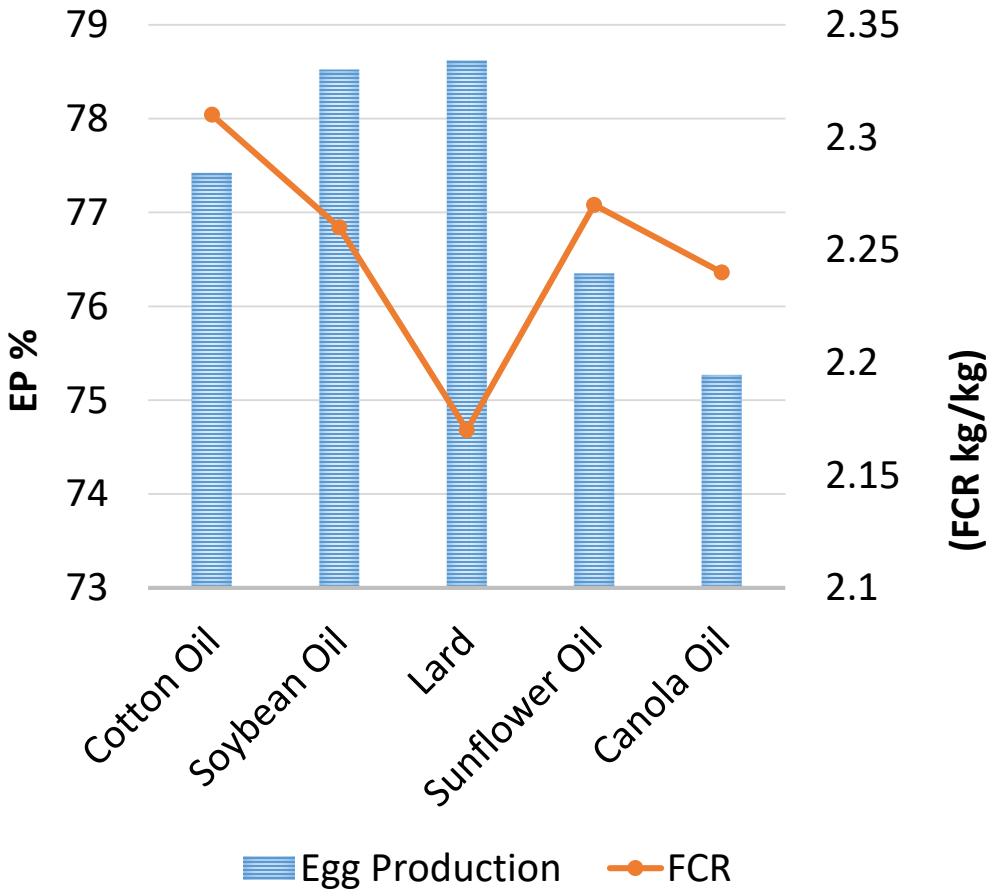
Influence of Different Fat Sources on the Performance, Egg Quality, and Lipid Profile of Egg Yolks of Commercial Layers in the Second Laying Cycle[1]

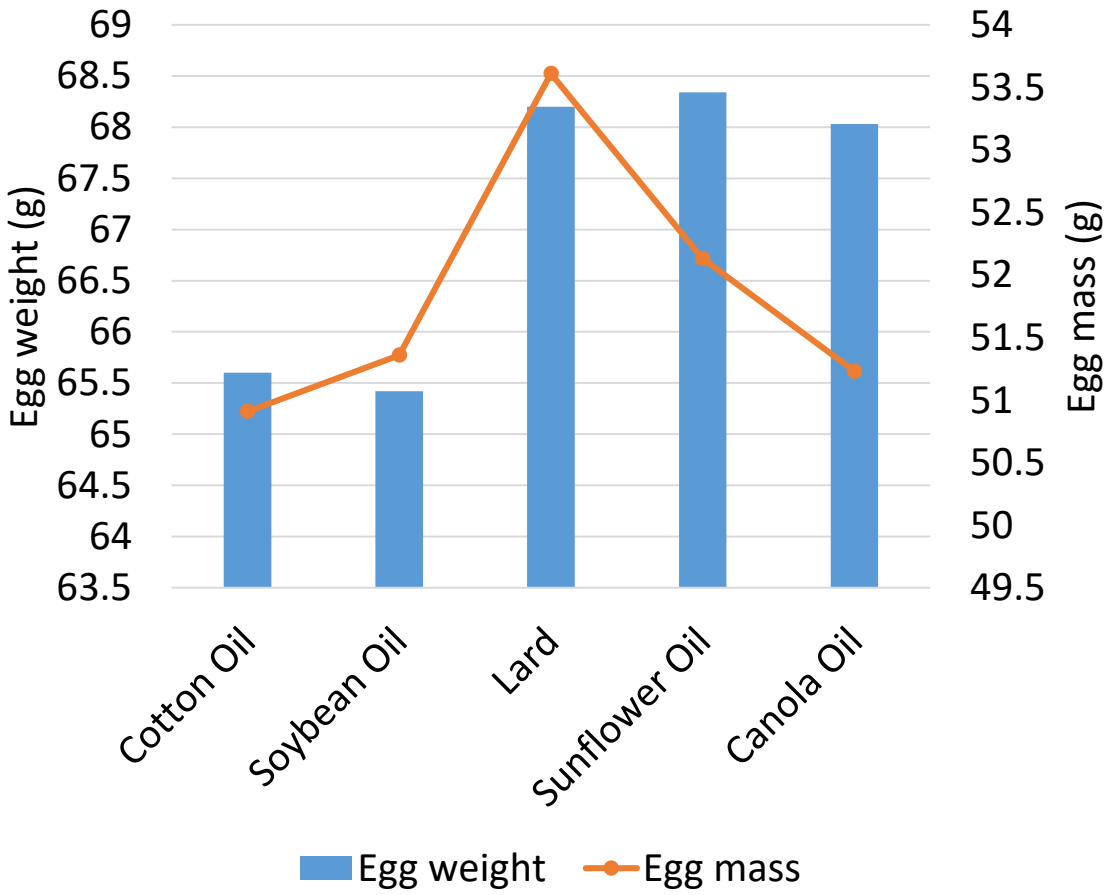
R. da Silva Filardi,*[,2] O. M. Junqueira,* A. C. de Laurentiz,* E. M. Casartelli,* E. Aparecida Rodrigues,* and L. Francelino Araújo†

*Departamento de Zootecnia, Faculdade de Ciências Agrárias e Veterinárias, Universidade Estadual Paulista, Jaboticabal, SP, 14884-900, Brazil; and †Faculdade de Zootecnia e Engenharia de Alimentos, USP, Pirassununga, SP, Brazil

2005 J. Appl. Poult. Res. 14:258–264

Fat Sources

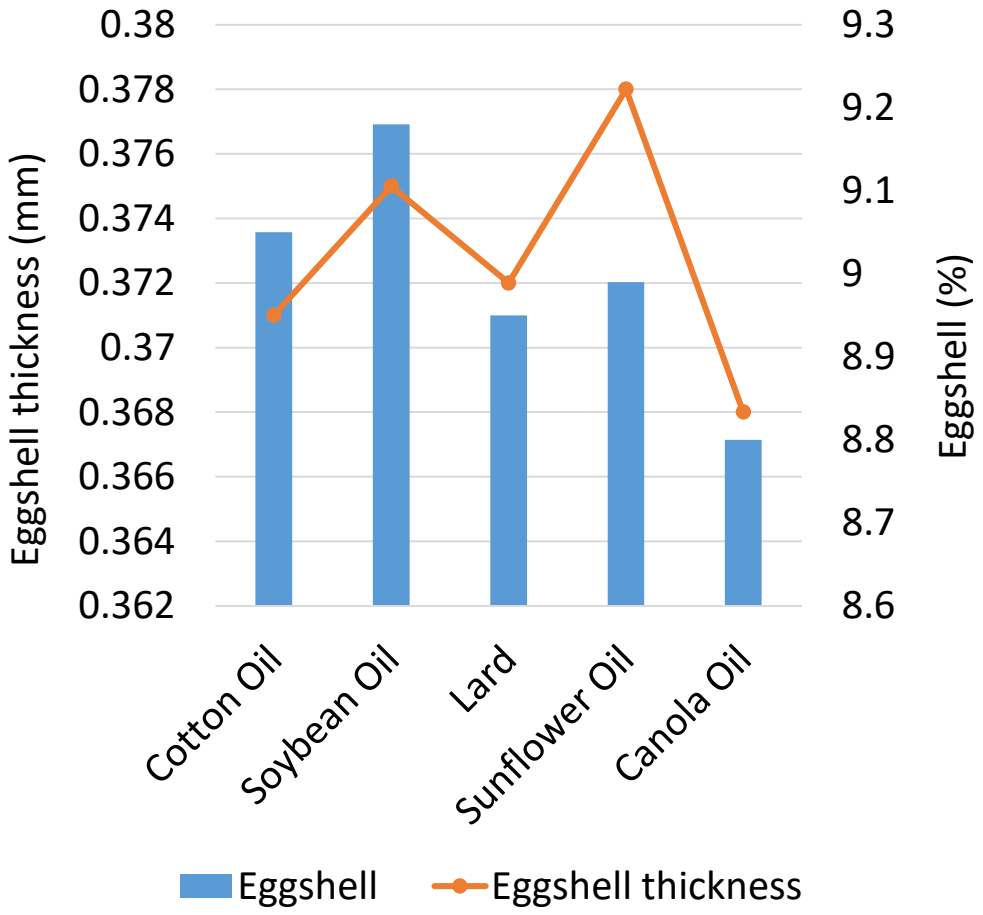


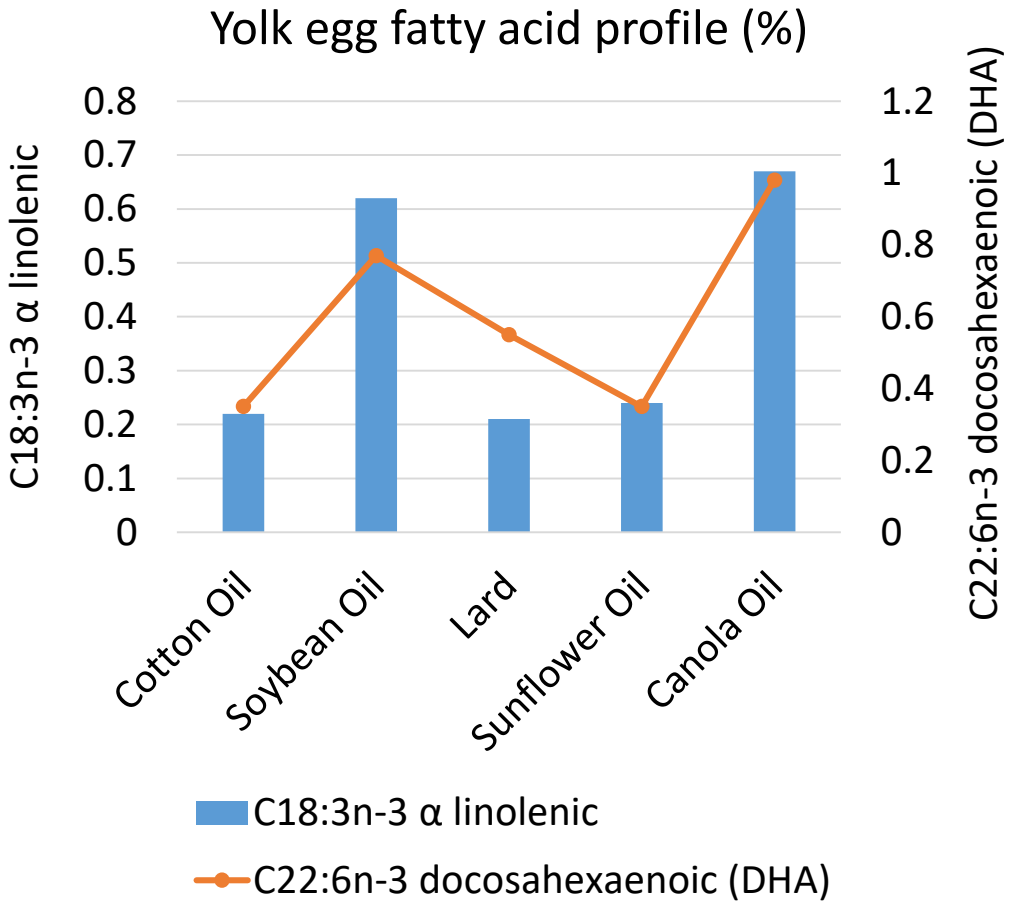


70-wk-old ISA Brown layers
distributed to 4 replicates of 8 birds per treatment

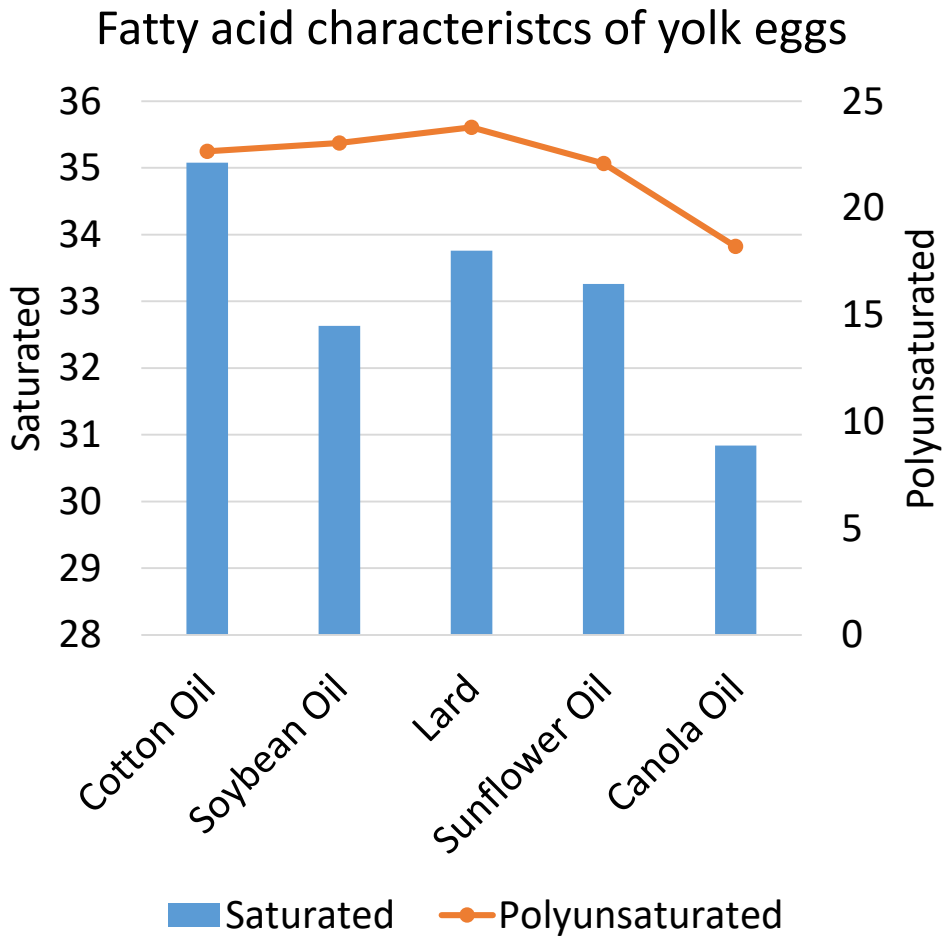
R. da Silva Filard et al. 2005 J. Appl. Poult. Res. 14:258–264

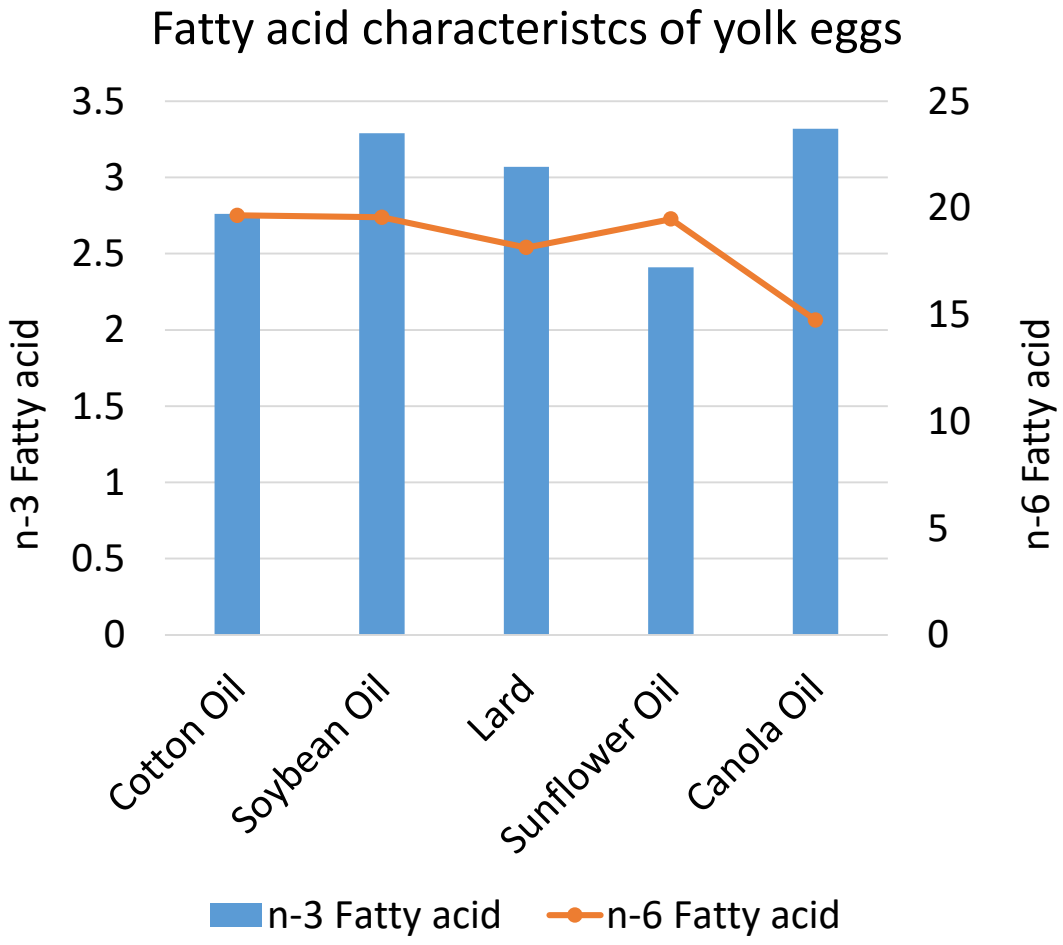
Conti.


0.38
0.378
0.376
0.374
0.372
0.37
0.368
0.366
0.364
0.362
Eggshell thickness (mm)
9.3
9.2
9.1
9
8.9
8.8
8.7
8.6
Eggshell (%)
Cotton Oil
Soybean Oil
Lard
Sunflower Oil
Canola Oil
Eggshell
Eggshell thickness

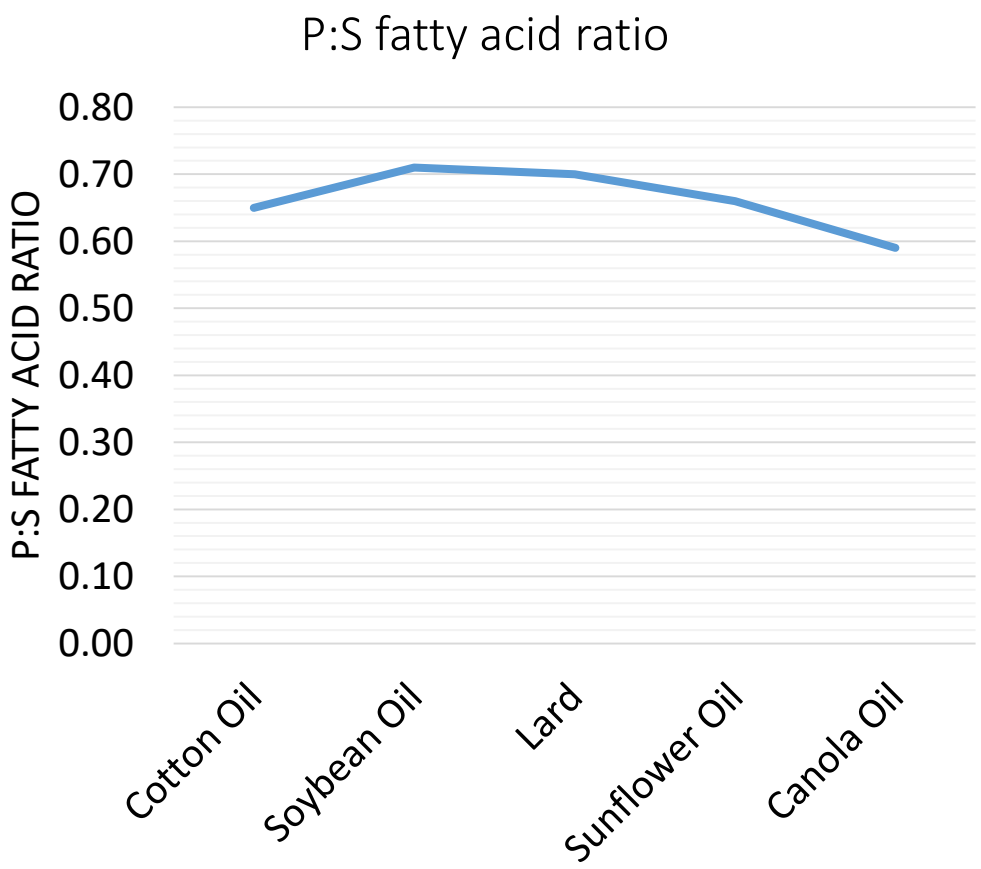

Yolk egg fatty acid profile (%)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
C18:3n-3 α linolenic
1.2
1
0.8
0.6
0.4
0.2
0
C22:6n-3 docosahexaenoic (DHA)
Cotton Oil
Soybean Oil
Lard
Sunflower Oil
Canola Oil
C18:3n-3 α linolenic
C22:6n-3 docosahexaenoic (DHA)

Conti.


Fatty acid characteristcs of yolk eggs
36
35
34
33
32
31
30
29
28
Saturated
25
20
15
10
5
0
Polyunsaturated
Cotton Oil
Soybean Oil
Lard
Sunflower Oil
Canola Oil
Saturated
Polyunsaturated


Fatty acid characteristcs of yolk eggs
3.5
3
2.5
2
1.5
1
0.5
0
n-3 Fatty acid
25
20
15
10
5
0
n-6 Fatty acid
Cotton Oil
Soybean Oil
Lard
Sunflower Oil
Canola Oil
n-3 Fatty acid
n-6 Fatty acid

Conti.



- The evaluated fat sources did not cause differences in the performance or the egg quality.
- The different fat sources resulted in changes in the profile of fatty acids of the yolk.
- The addition of canola oil decreased the concentration of saturated fatty acids, increased the concentrations of monounsaturated fatty acid, *α*-linolenic and DHA,

Italian Journal of Animal Science

ISSN: (Print) 1828-051X (Online) Journal homepage: https://www.tandfonline.com/loi/tjas20

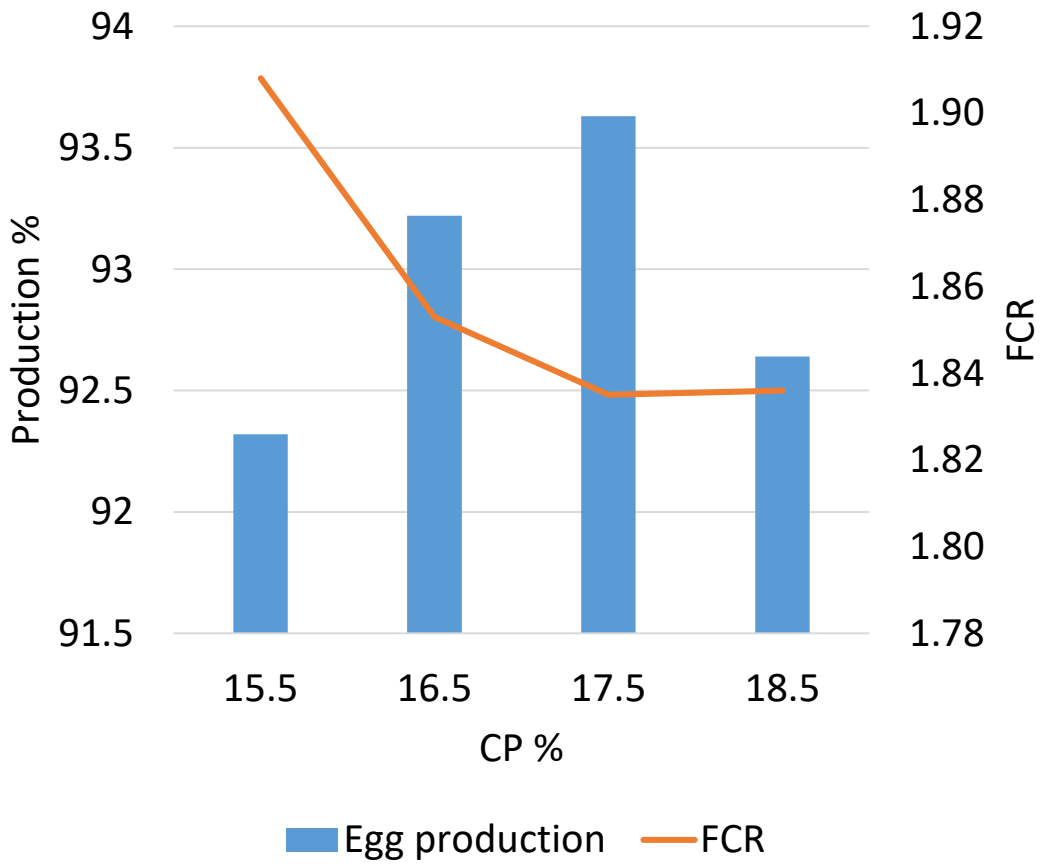
Investigation on the Effects of Various Protein Levels with Constant Ratio of Digestible Sulfur Amino Acids and Threonine to Lysine on Performance, Egg Quality and Protein Retention in Two Strains of Laying Hens

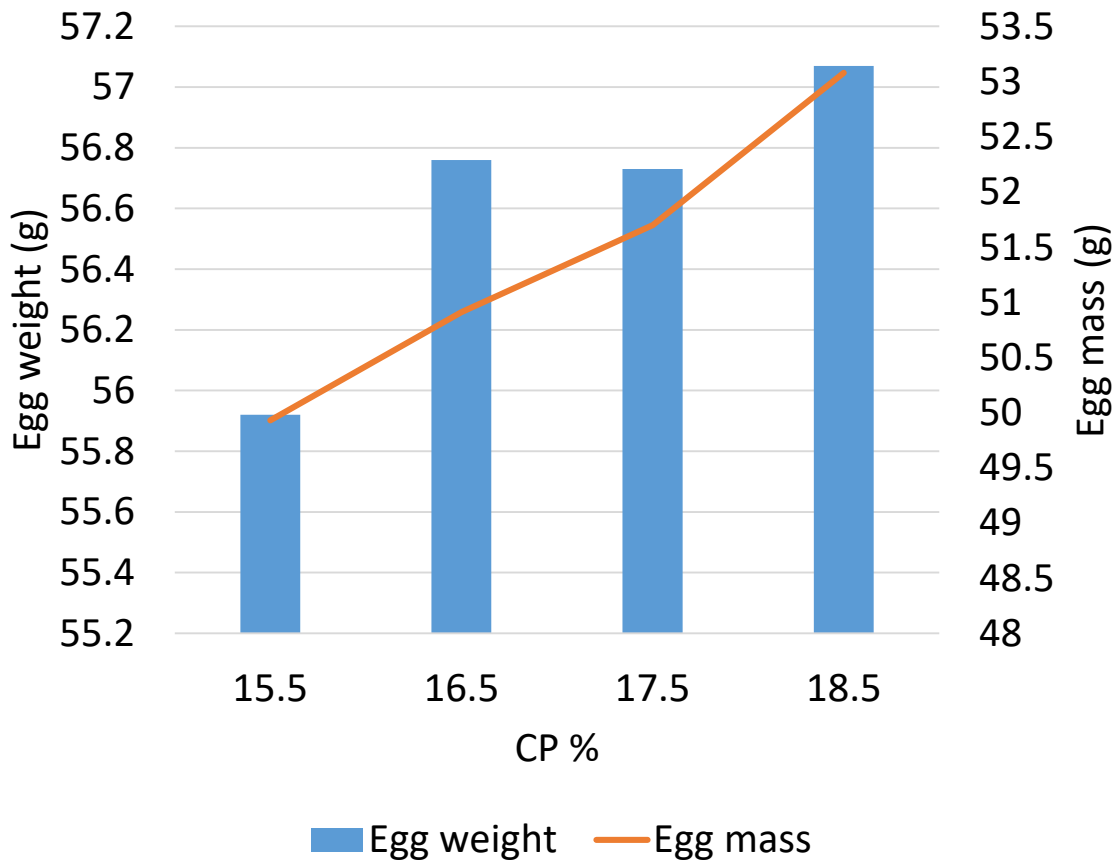
Seyed N. Mousavi, Saeed Khalaji, Abdollah Ghasemi-Jirdehi & Farhad Foroudi

To cite this article: Seyed N. Mousavi, Saeed Khalaji, Abdollah Ghasemi-Jirdehi & Farhad Foroudi (2013) Investigation on the Effects of Various Protein Levels with Constant Ratio of Digestible Sulfur Amino Acids and Threonine to Lysine on Performance, Egg Quality and Protein Retention in Two Strains of Laying Hens, Italian Journal of Animal Science, 12:1, e2, DOI: 10.4081/ijas.2013.e2

To link to this article: https://doi.org/10.4081/ijas.2013.e2

Effect different protein levels on hen performance





Based on the results of this experiment, a reduction in dietary protein level (from 18.5% to 15.5%), without any alteration.

LSL (25 to 33 wk.); 8 replicate/10 hen each

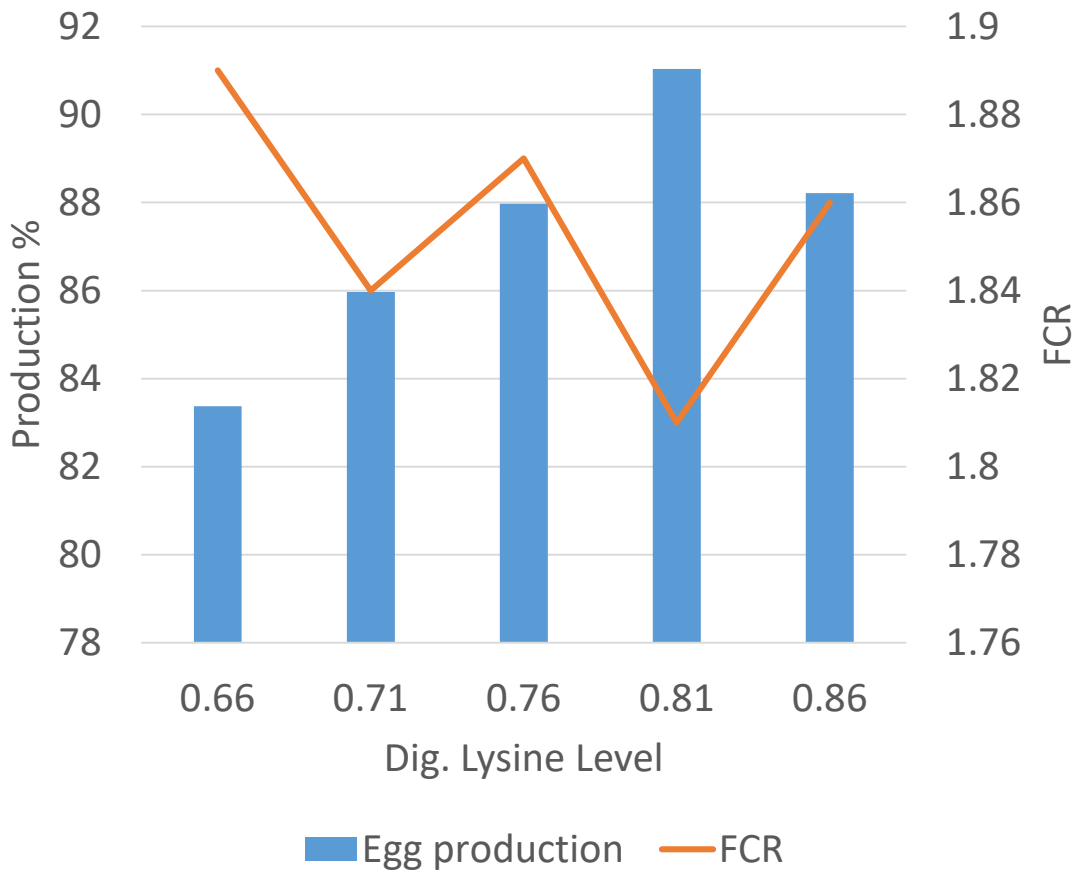
Effect of dietary digestible lysine concentration on performance, egg quality, and blood metabolites in laying hens

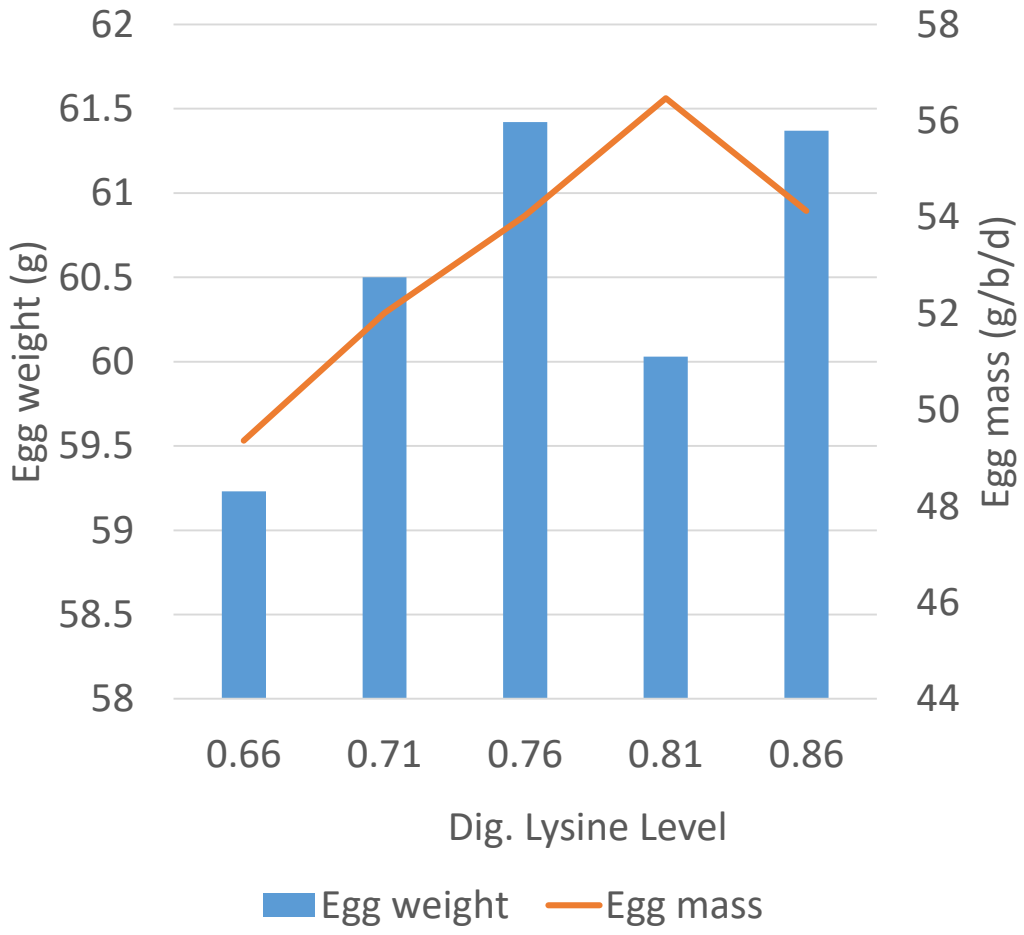
R. Akbari Moghaddam Kakhki, A. Golian,[1] and H. Zarghi

Department of Animal Science, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran, 91775-1163

2016 J. Appl. Poult. Res. 25:506–517
http://dx.doi.org/10.3382/japr/pfw032

Digestible lysine concentration (32-44wk)





W-36; 6 replicate/8 hen each

Kakhki et al. 2016; J. Appl. Poult. Res. 25:506-517

British Poultry Science

ISSN: 0007-1668 (Print) 1466-1799 (Online) Journal homepage: http://www.tandfonline.com/loi/cbps20

Effect of digestible methionine + cystine concentration on performance, egg quality and blood metabolites in laying hens

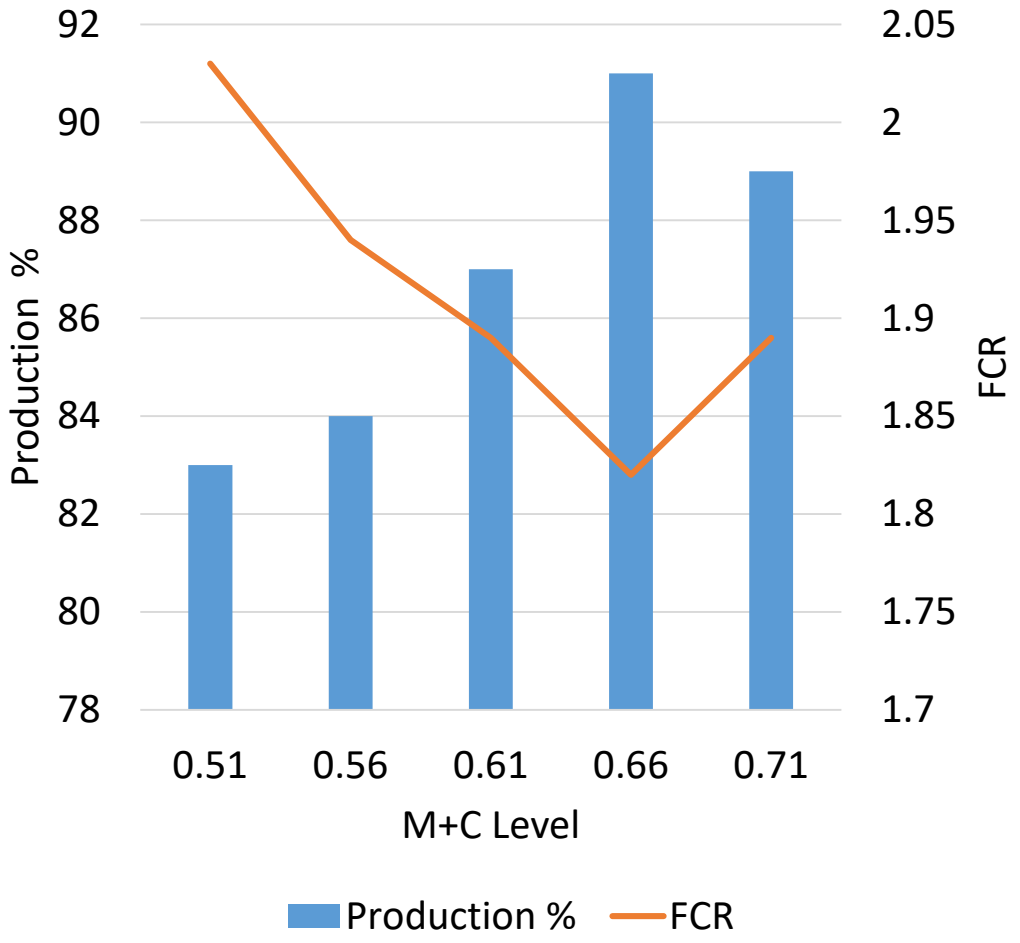
R. A. M. Kakhki, A. Golian & H. Zarghi

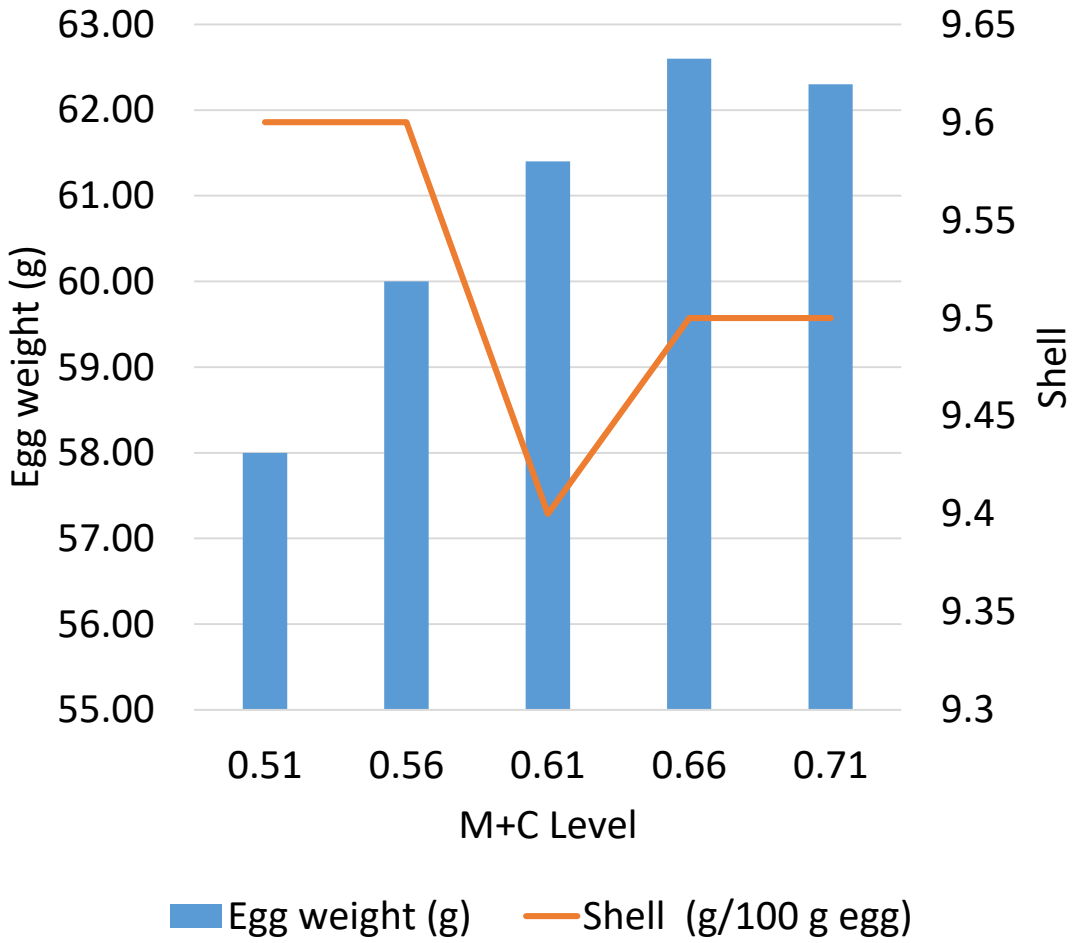
R. A. M. Kakhki, A. Golian & H. Zarghi

To cite this article: R. A. M. Kakhki, A. Golian & H. Zarghi (2016): Effect of digestible methionine + cystine concentration on performance, egg quality and blood metabolites in laying hens, British Poultry Science, DOI: 10.1080/00071668.2016.1173199

To link to this article: http://dx.doi.org/10.1080/00071668.2016.1173199

Effect of digestible methionine + cysteine concentration (32-44 weeks)





Egg production, egg mass, egg weight and FCR were significantly affected by an increase in DSAA intake.

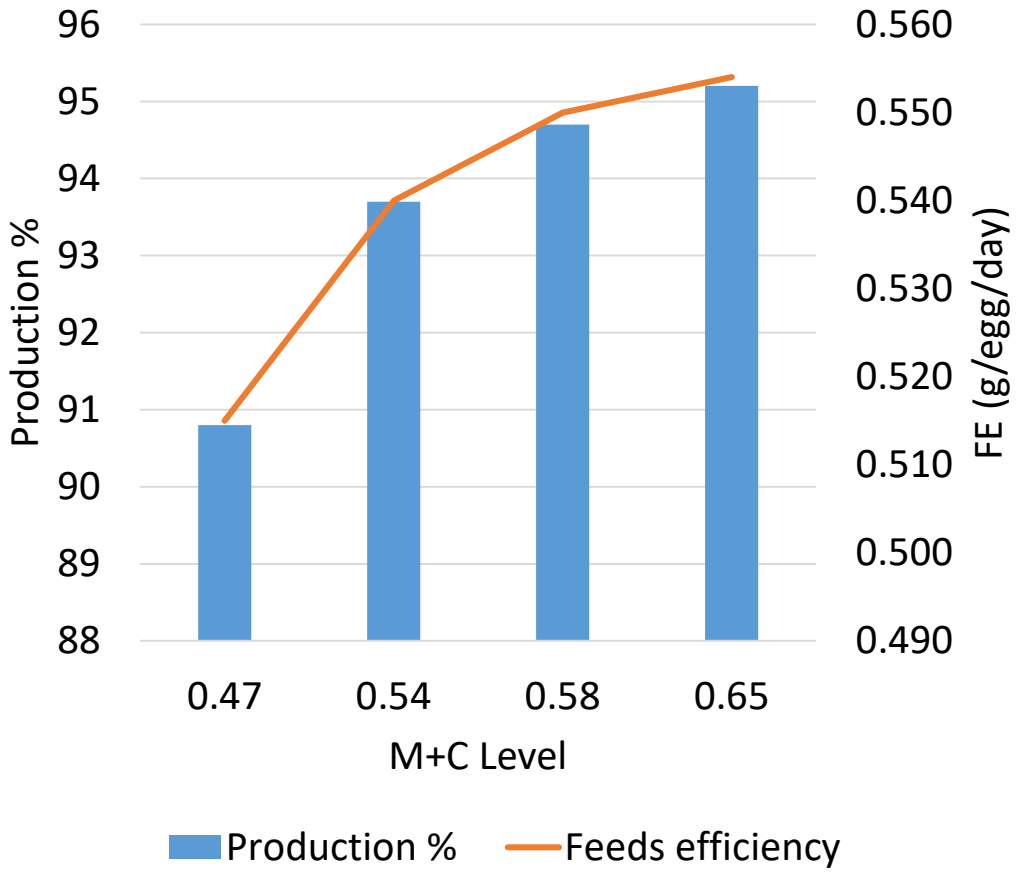
Digestible methionine+cysteine in the diet of commercial layers and its influence on the performance, quality, and amino acid profile of eggs and economic evaluation

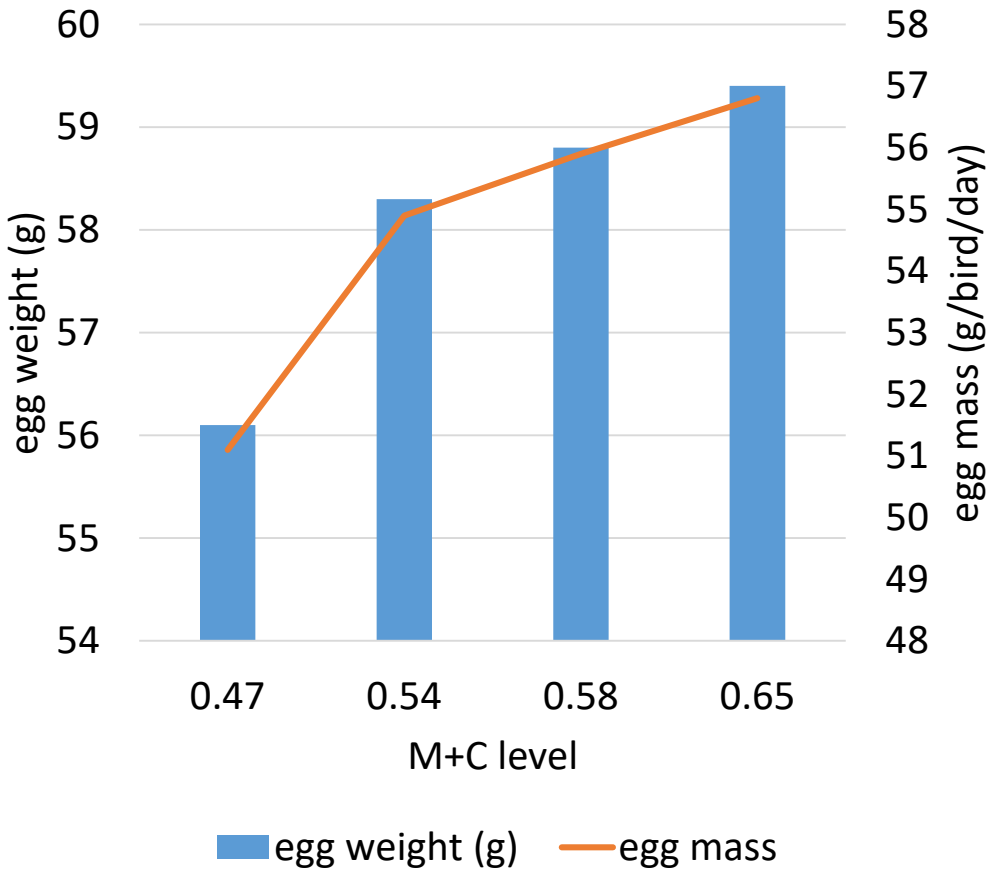
T. S. M. Carvalho, L. S. Sousa,[1] F. A. Nogueira, D. P. Vaz, M. M. Saldanha, M. V. Triginelli, M. F. V. S. Pinto, N. C. Baião, and L. J. C. Lara

Federal University of Minas Gerais- School of Veterinary, Department of Zootechny, Campus Pampulha, Avenida Antônio Carlos 6627- Pampulha- 31270-901- Belo Horizonte-MG-Brazil

2018 Poultry Science 97:2044–2052
http://dx.doi.org/10.3382/ps/pey036

Digestible methionine+cysteine in the diet of commercial layers



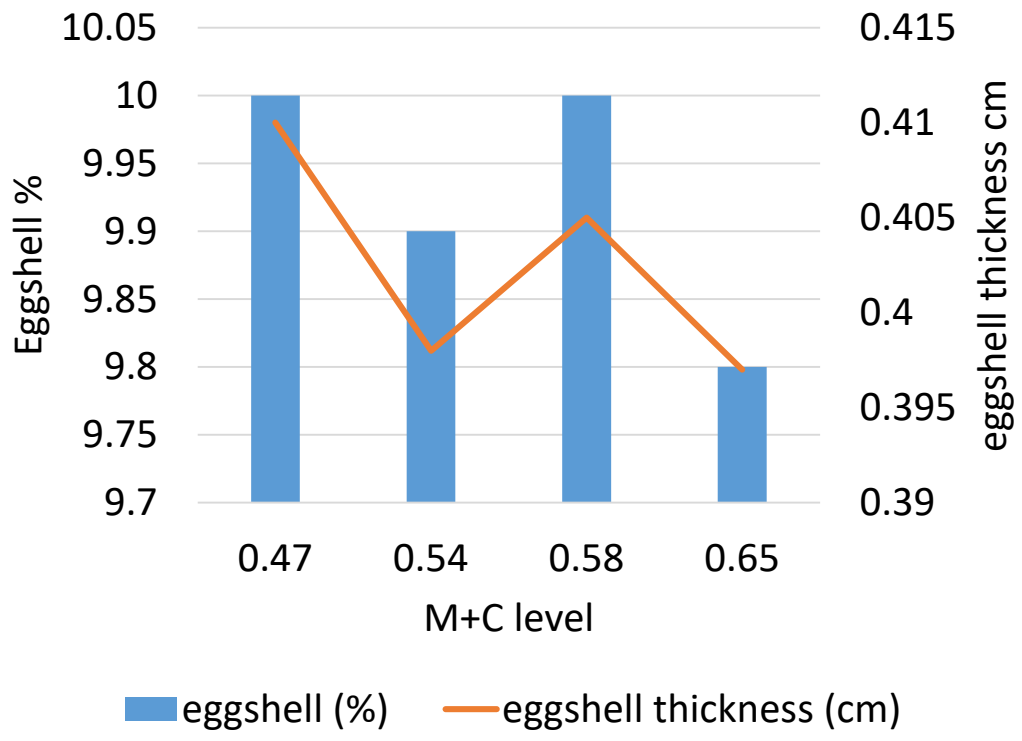


LSL-lite
6 replicate 24 hen each

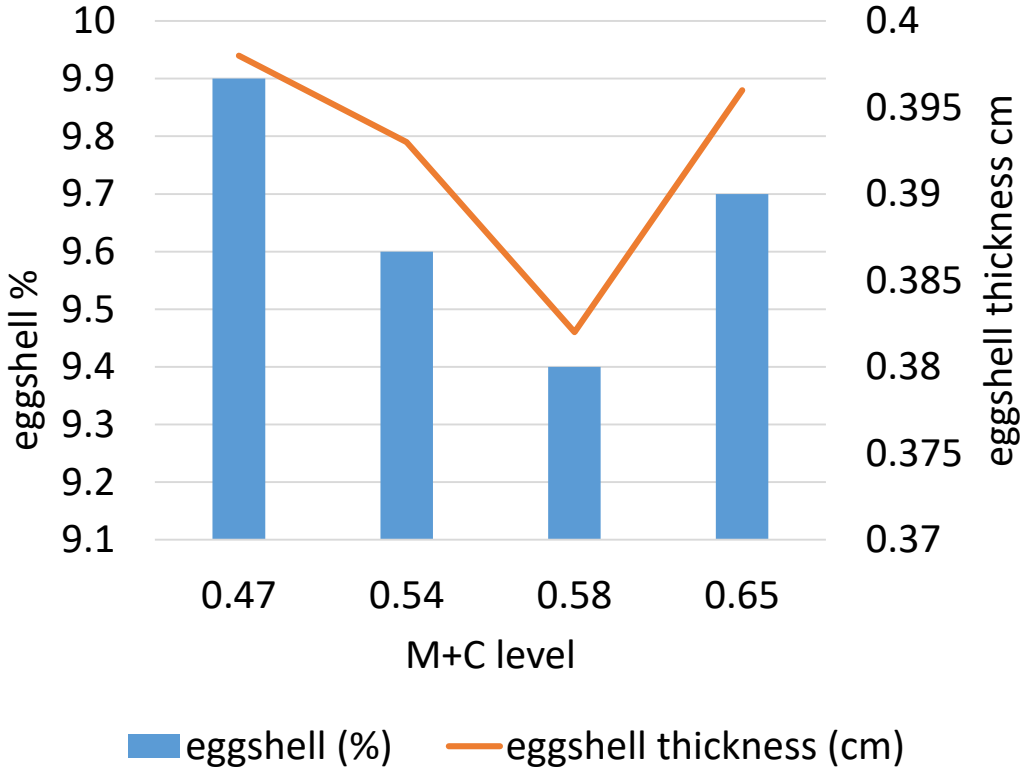
Carvalho, TMS et al. 2018; Poult. Sci. j. 97:2044-2052

Conti.

34 wk. old



50 wk. old



Higher digestible Met+Cys levels (>0.630%) led to a good performance of layers, while lower Met+Cys levels improved the eggshell quality of layers in peak production. Optimal Met+Cys levels may change according to the price of the synthetic amino acid

Ca: P Requirement (*Ref*: Hyline)

	Peaking Diet		Lay Diet #2		Lay Diet #3		Lay Diet #4	
	Hy-Line Brown	Hy-Line W-36	Hy-Line Brown	Hy-Line W-36	Hy-Line Brown	Hy-Line W-36	Hy-Line Brown	Hy-Line W-36
Calcium (g/day)	4.20	4.10	4.30	4.30	4.50	4.45	4.80	4.60
Available Phosphorus (mg/day)	460	485	420	470	380	450	360	400

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Nutrition for Good Eggshell Quality

	Growing	Pre-lay	First Egg to Peak	Peak to 90%	89% to 85%	Less than 85%
Calcium	1.0%	2.5 – 2.75%	4.0 – 4.2 grams/day	4.25 grams/day	4.40 grams/day	4.50 grams/day
Phosphorus, available	0.48%	0.5%	0.5 grams	0.48 grams	0.46 grams	0.40 grams
Vitamin D, I.U per day	3,300,000 I.U / ton of feed					
PARTICLE SIZE RATIOS OF CALCIUM CARBONATE						
Fine – <1 mm	100%	50%	45%	40%	35%	30%
Coarse – 2-4 mm	0%	50%	55%	60%	65%	70%

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Limestone particle size

- Limestone particle size is also important for optimum shell quality.
- Pullets should have fine particle calcium, ideally less than 1.1 mm (1100 micron) average.
- It is best to use limestone flour for pullets as the smaller particles are more easily absorbed.
- Layers should ideally receive a 50:50 ratio of large and fine particle limestone at the start of lay and transition to a 65:35 ratio (large: fine) by the end of lay.

Conti.

- The large particle fed during lay should be around 2–4 mm (2000–4000 micron) average size with an ideal 3 mm (3000 micron) size.
- When calcium particle size is above 3.5 mm (3500 micron), the solubility rapidly decreases.
- if the hen is not effectively absorbing the calcium in the diet, she can be deficient (even with an accurate “calculated value” of the ration).

Recommended ratio of fine and coarse limestone (LSL-lite)

Feeds type	Fine limestone (< 1.5 mm)	Coarse limestone (1.5 ,3.5 mm)
Layer phase 1	30 %	70 %
Layer phase 2	25 %	75 %
Layer phase 3	15 %	85 %

Measurement of true ileal calcium digestibility in meat and bone meal for broiler chickens using the direct method

M. N. Anwar,* V. Ravindran,*,[1] P. C. H. Morel,* G. Ravindran,† and A. J. Cowieson‡

*Institute of Veterinary, Animal and Biomedical Science, Massey University, Palmerston North 4442, New Zealand; †Institute of Food, Nutrition and Human Health, Massey University, Palmerston North 4442, New Zealand; and ‡Poultry Research Foundation, University of Sydney, Camden, NSW 2570, Australia

2015 Poultry Science 00:1–7
http://dx.doi.org/10.3382/ps/pev319

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MEASUREMENT OF TRUE ILEAL CALCIUM DIGESTIBILITY OF FEED INGREDIENTS FOR BROILER CHICKENS

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in

Animal Science

at Institute of Veterinary, Animal and Biomedical Science (IVABS)

Massey University, Palmerston North,

New Zealand

Studies on the measurement of ileal calcium digestibility of calcium sources in broiler chickens

L. S. David,* M. R. Abdollahi,* G. Ravindran,† C. L. Walk,‡ and V. Ravindran*,[1]

*Monogastric Research Centre, School of Agriculture and Environment, Massey University, Palmerston North 4442, New Zealand; †Institute of Food, Nutrition and Human Health, Massey University, Palmerston North 4442, New Zealand; and ‡AB Vista, Marlborough, Wiltshire SN8 4AN, UK

2019 Poultry Science 0:1–8
http://dx.doi.org/10.3382/ps/pez314

Calcium digestibility

Ing.	Ca digestibility
MBM	50 (range, 41-60)
Limestone	55 (range, 43-71)
DCP	35 (range, 25-45)
MCP	35 (range, 32-45)
Canola meal	30
Fish meal	25
Poultry by product meal	30

Sources: Naveed Anwar (2017), PhD Thesis; Laura David (unpublished PhD thesis

Factor for bone calcification and eggshell formation

- Vitamin D3 (cholecalciferol)
- Dietary electrolyte balance – (DEB)
- Vitamin K.
- Zinc, copper, iron, manganese.
- Some essential amino acids (valine and arginine)

which are often limiting in laying diets may be important due to their role in calcium transportation and formation of the bone matrix.

METABOLISM AND NUTRITION

Assessment of the minimal available phosphorus needs of laying hens: Implications for phosphorus management strategies

M. Jing,* S. Zhao,* A. Rogiewicz,† B. A. Slominski,† and J. D. House*,†,1

*Department of Food and Human Nutritional Sciences, University of Manitoba, Winnipeg, MB, R3T 2N2, Canada; and †Department of Animal Science, University of Manitoba, Winnipeg, MB, R3T 2N2, Canada

2018 Poultry Science 97:2400–2410
http://dx.doi.org/10.3382/ps/pey057

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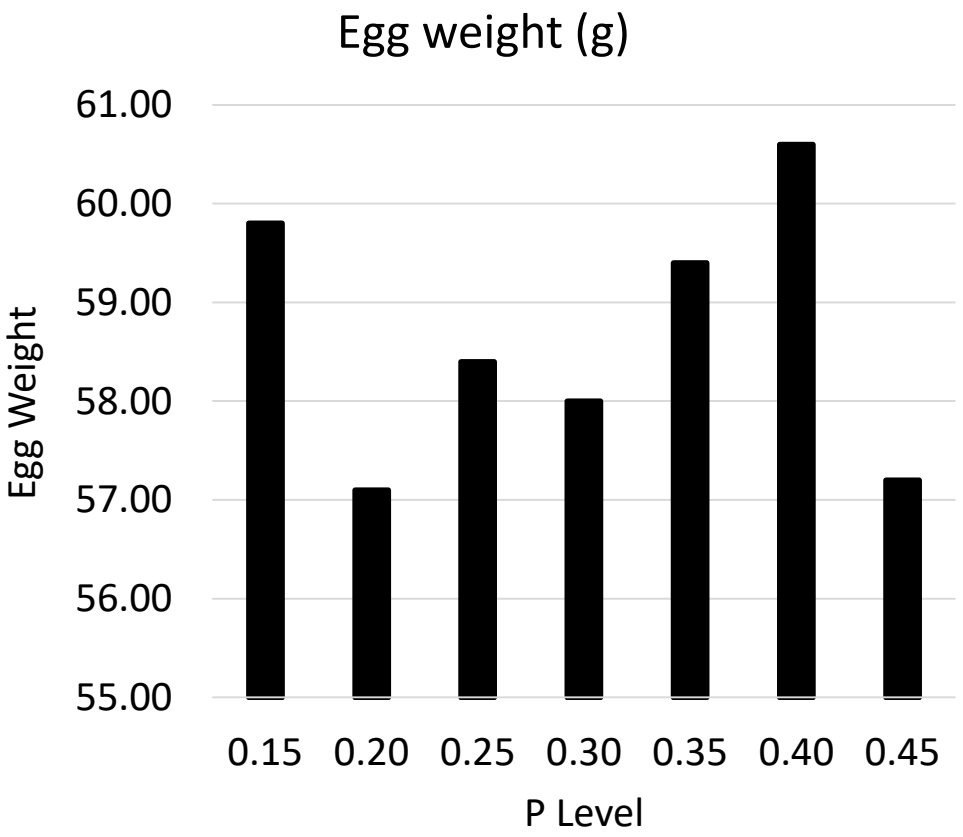
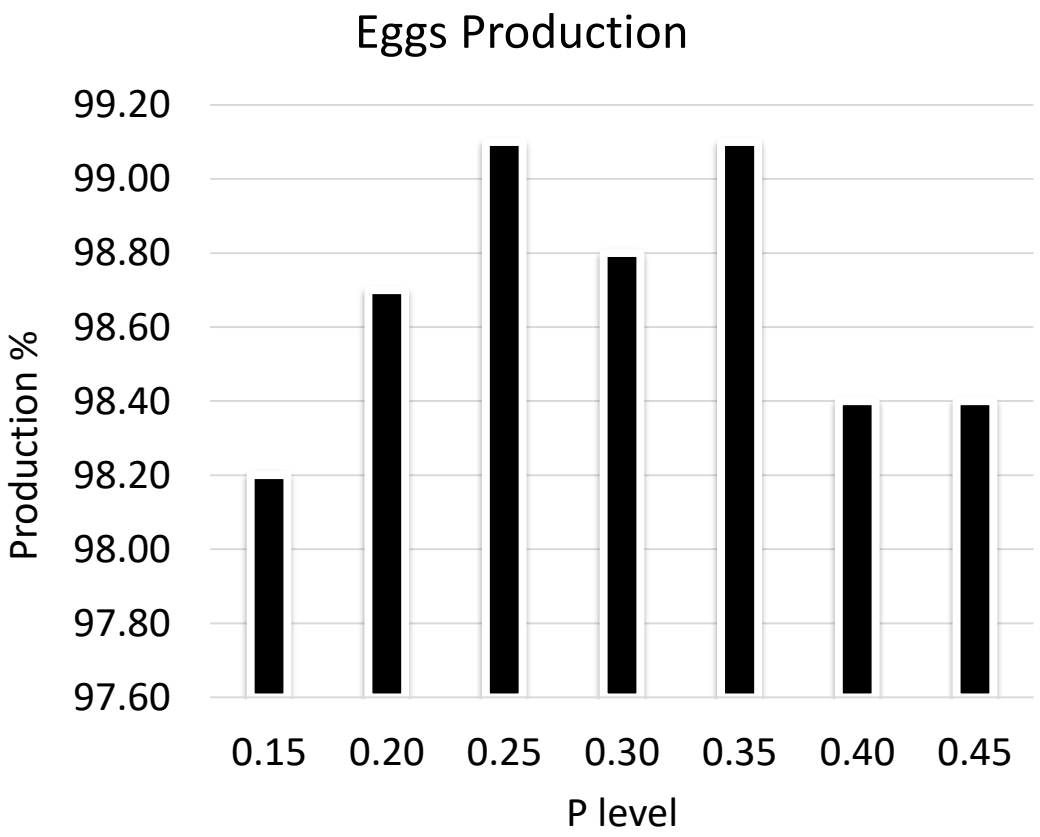
Assessment of the minimal available phosphorus needs of laying hens

- The experiment was conducted at the University of Manitoba (Winnipeg, Manitoba, Canada) poultry unit.
- birds: 56
- Age: 19 to 34 weeks (first 3 weeks adaptation period)
- 7 Available phosphorus level.

Conti.





NS: non significant

In conclusion, the results of the present study showed that reducing layer diet available P (up to 0.15%) did not adversely affect growth or production performance,

Measurement of true ileal calcium digestibility in meat and bone meal for broiler chickens using the direct method

M. N. Anwar,* V. Ravindran,*,[1] P. C. H. Morel,* G. Ravindran,† and A. J. Cowieson‡

*Institute of Veterinary, Animal and Biomedical Science, Massey University, Palmerston North 4442, New Zealand; †Institute of Food, Nutrition and Human Health, Massey University, Palmerston North 4442, New Zealand; and ‡Poultry Research Foundation, University of Sydney, Camden, NSW 2570, Australia

2016 Poultry Science 95:70–76
http://dx.doi.org/10.3382/ps/pev319

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Phytate P, non-phytate P and true digestible P contents of common feed ingredients (as a percentage of total P)

	% of total P		
Ingredient	Phytate P	Non-phytate P	Digestible P
Dicalcium phosphate	-	100	55
Monocalcium phosphate	-	100	85
Maize	71	29	68
Canola meal	71	29	47
Wheat	66	34	46
Sorghum	77	23	33
Soybean meal	67	33	80
Maize-DDGS	47	53	73
Meat and bonemeal			
MBM-1	-	100	69
MBM-2		100	61
MBM-3	-	100	42

Ruvini Mutucumarana, PhD thesis (2014)

Vitamin requirement (LSL-Lite)

NUTRITION

Table 7: Recommended Micro-Nutrient Specification

Supplements per kg Feed		Starter/Grower	Developer	Pre-Layer/Layer
Vitamin A*	I.U.	10000	10000	10000
Vitamin D_3	I.U.	2000	2000	2500
Vitamin E	mg	20–30***	20–30***	15–30***
Vitamin K_3	mg	3****	3****	3****
Vitamin B_1	mg	1	1	1
Vitamin B_2	mg	6	6	4
Vitamin B_6	mg	3	3	3
Vitamin B_{12}	mcg	20	20	25
Pantothenic Acid	mg	8	8	10
Nicotinic Acid	mg	30	30	30
Folic Acid	mg	1.0	1.0	0.5
Biotin	mcg	50	50	50
Cholin	mg	300	300	400
Antioxydant	mg	100–150***	100–150***	100–150***
Coccidiostat		as required	as required	–
Manganese**	mg	100	100	100
Zinc**	mg	60	60	60
Iron	mg	25	25	25
Copper**	mg	5	5	5
Iodine	mg	0.5	0.5	0.5
Selenium**	mg	0.2	0.2	0.2

* *Higher level might be possible according to local state and national regulations.*
** *So called "organic sources" should be considered with higher bioavailability.*
*** *according to fat addition* **** *double in case of heat treated feed*

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Geng et al. Nutrition & Metabolism (2018) 15:58
https://doi.org/10.1186/s12986-018-0293-8

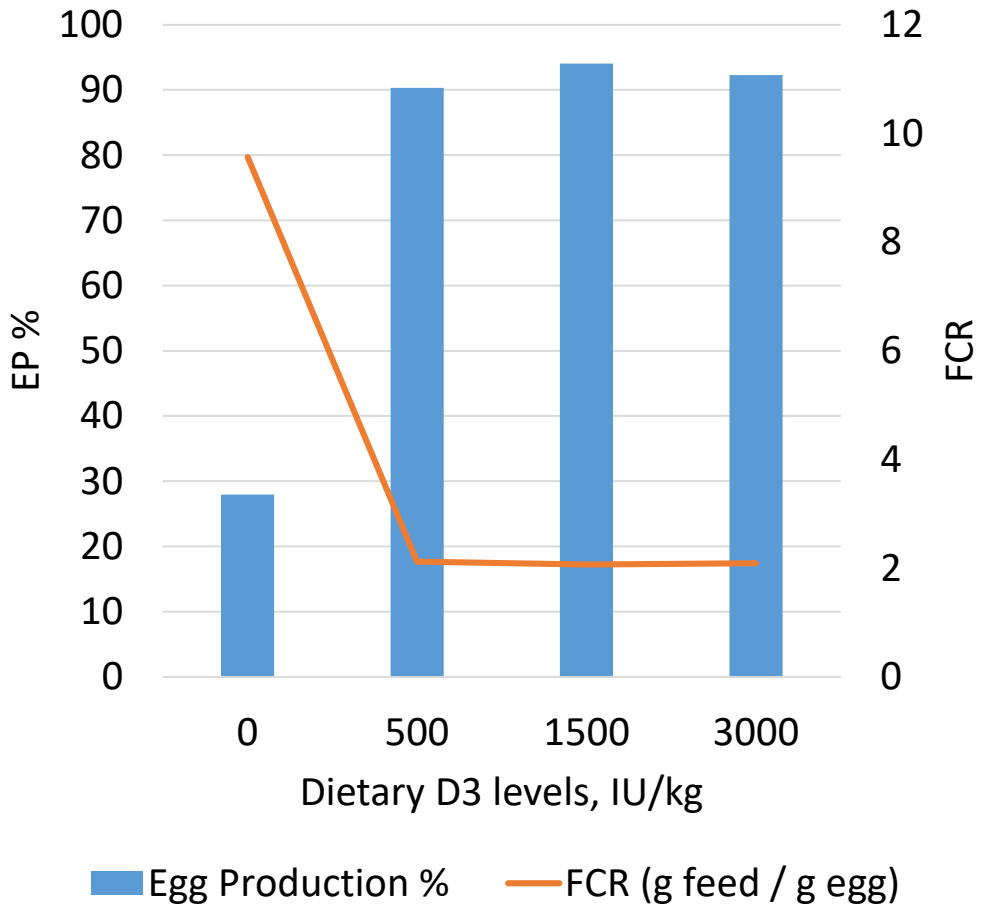
Nutrition & Metabolism

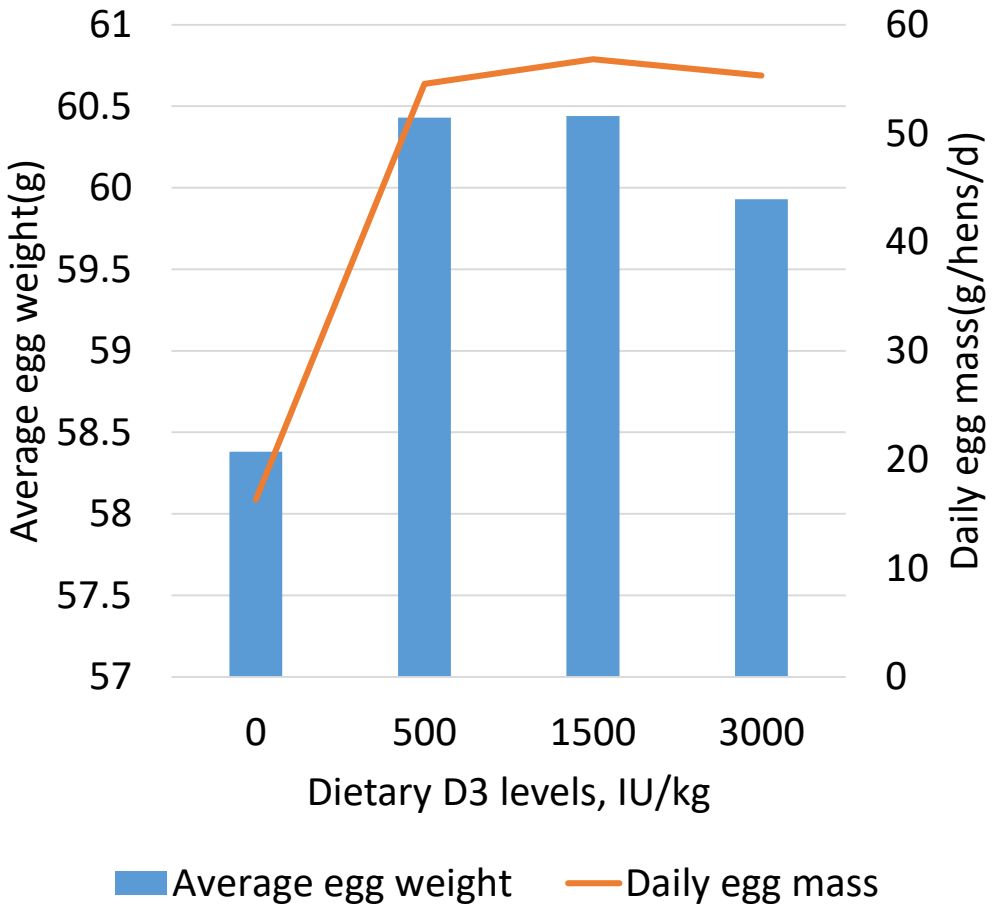
RESEARCH Open Access

Dietary vitamin D_3 supplementation protects laying hens against lipopolysaccharide-induced immunological stress

Yanqiang Geng, Qiugang Ma, Zhong Wang* and Yuming Guo

Effect of different levels of vitamin D3 on laying performance of laying hens





Geng et al. Nutrition & Metabolism (2018) 15:58

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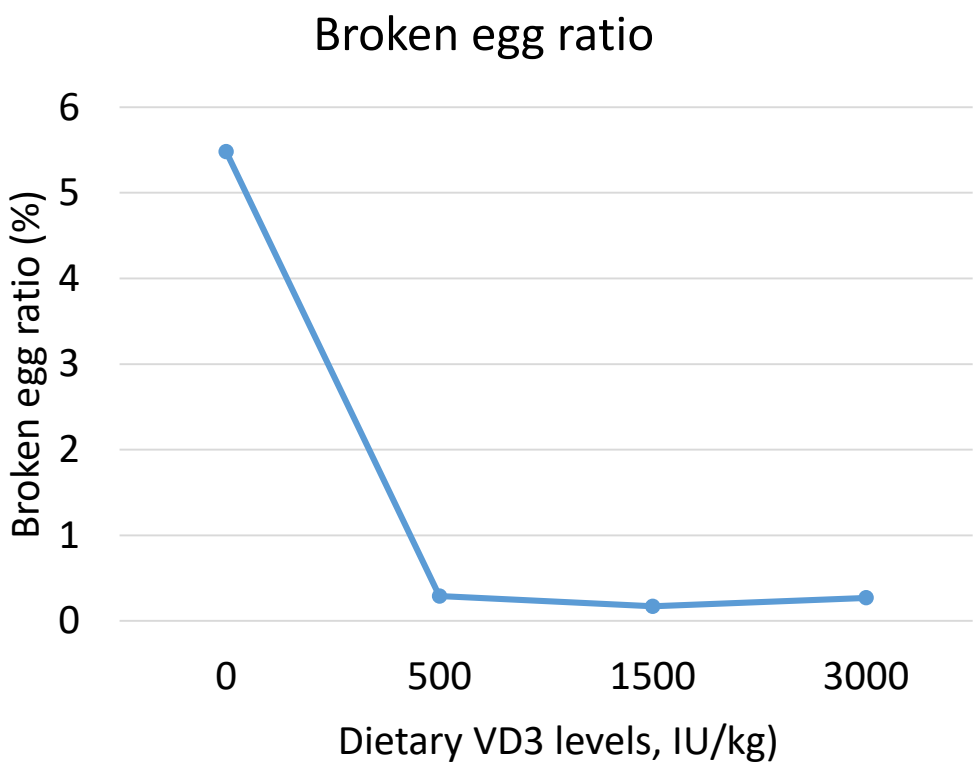

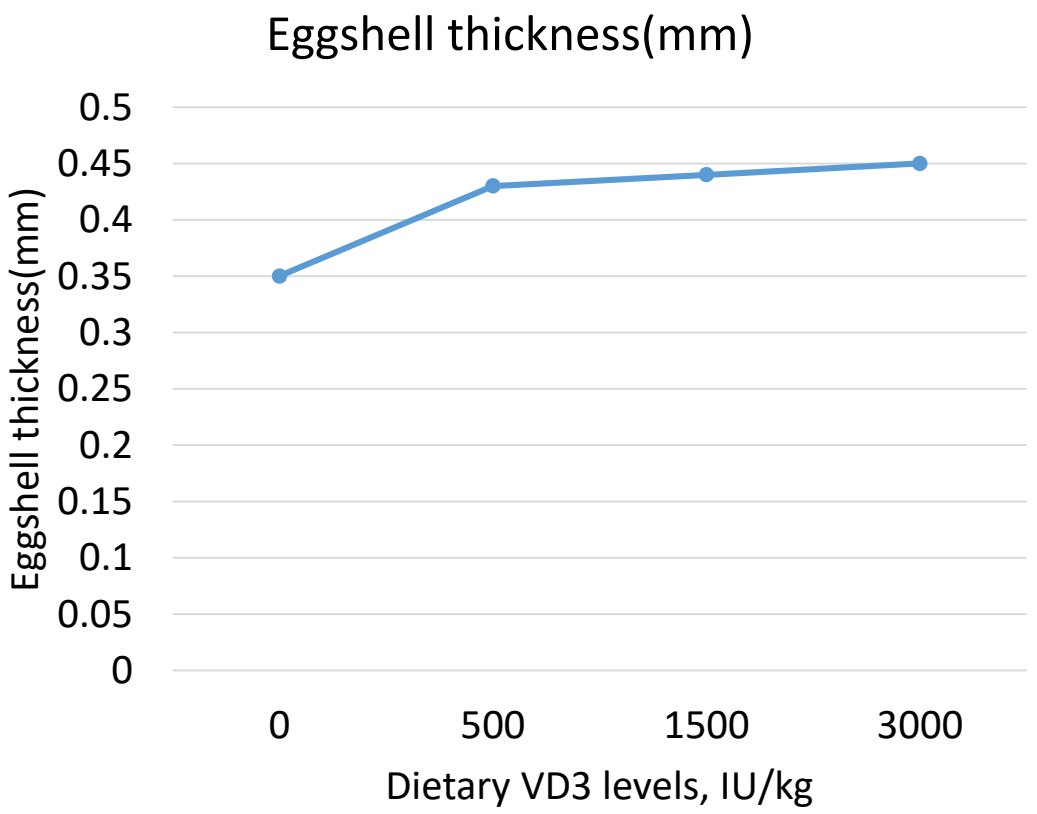

Geng et al. Nutrition & Metabolism (2018) 15:58

Optimum vitamin nutrition for poultry

by Lee R. McDowell, Department of Animal Sciences, University of Florida, Gainesville, Florida 32611, USA
and Nelson E. Ward, DSM Nutritional Products Inc, 45 Waterview Boulevard, Parsippany, NJ 07054, USA.

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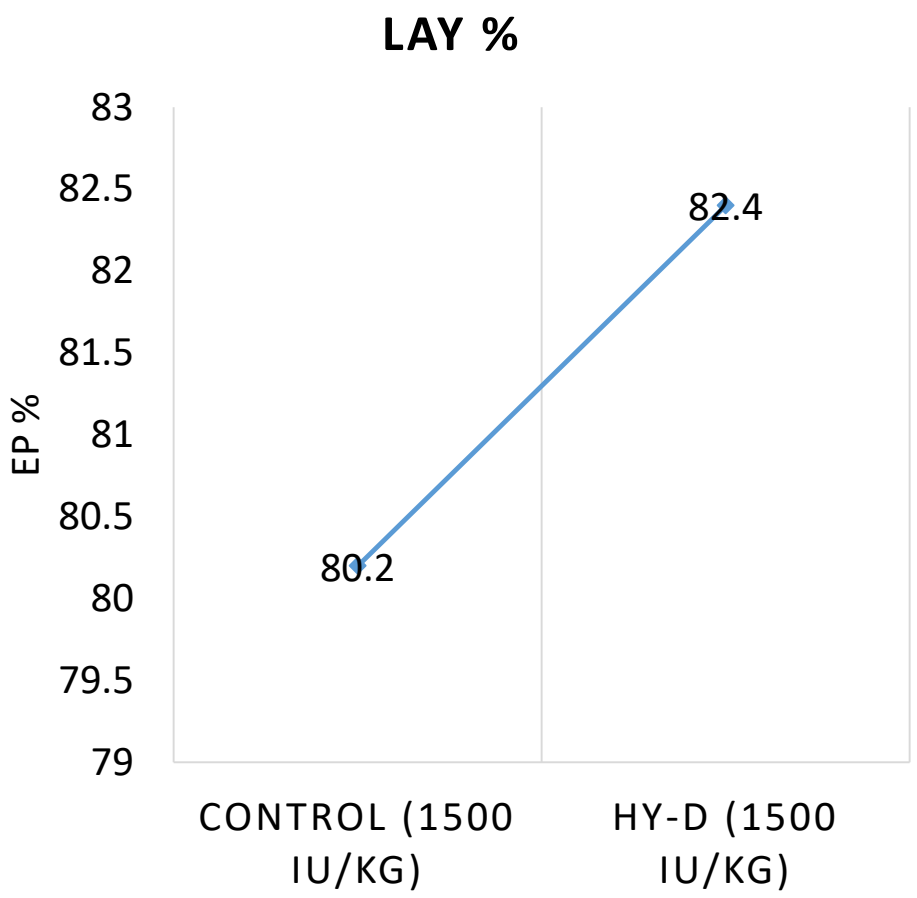
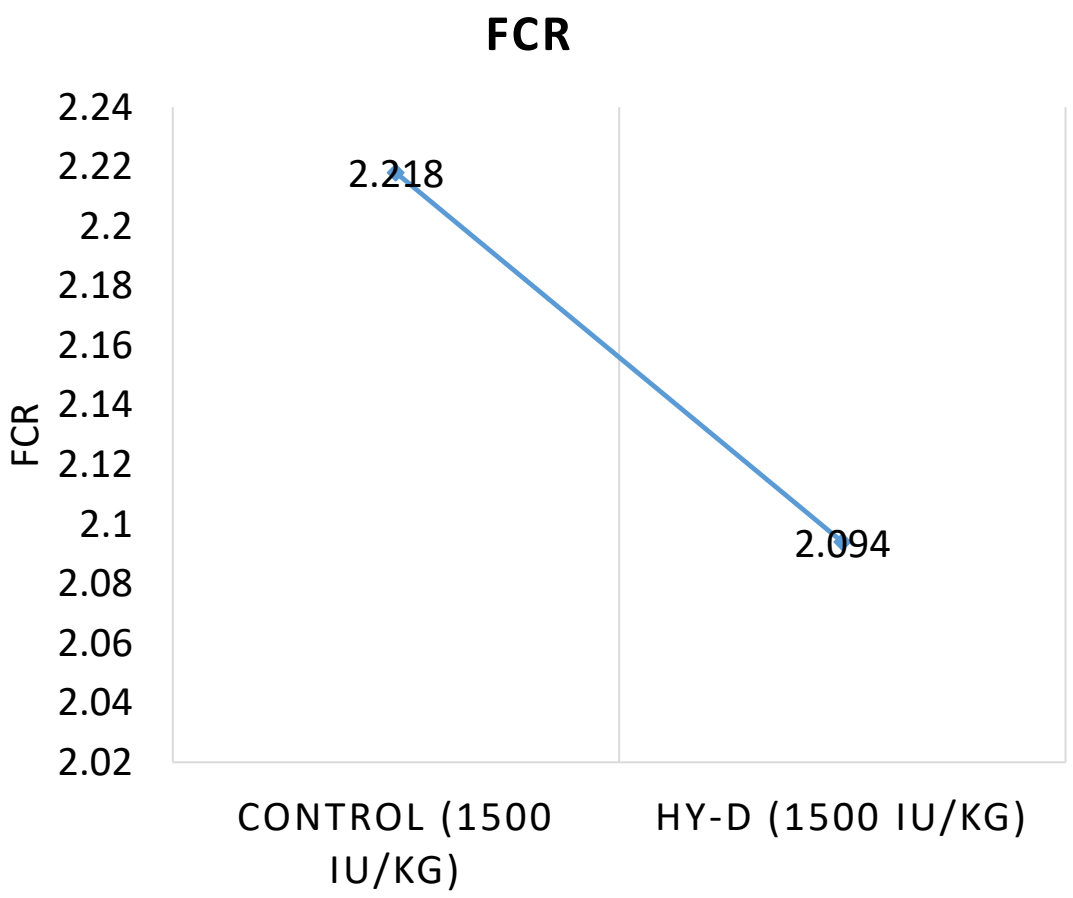
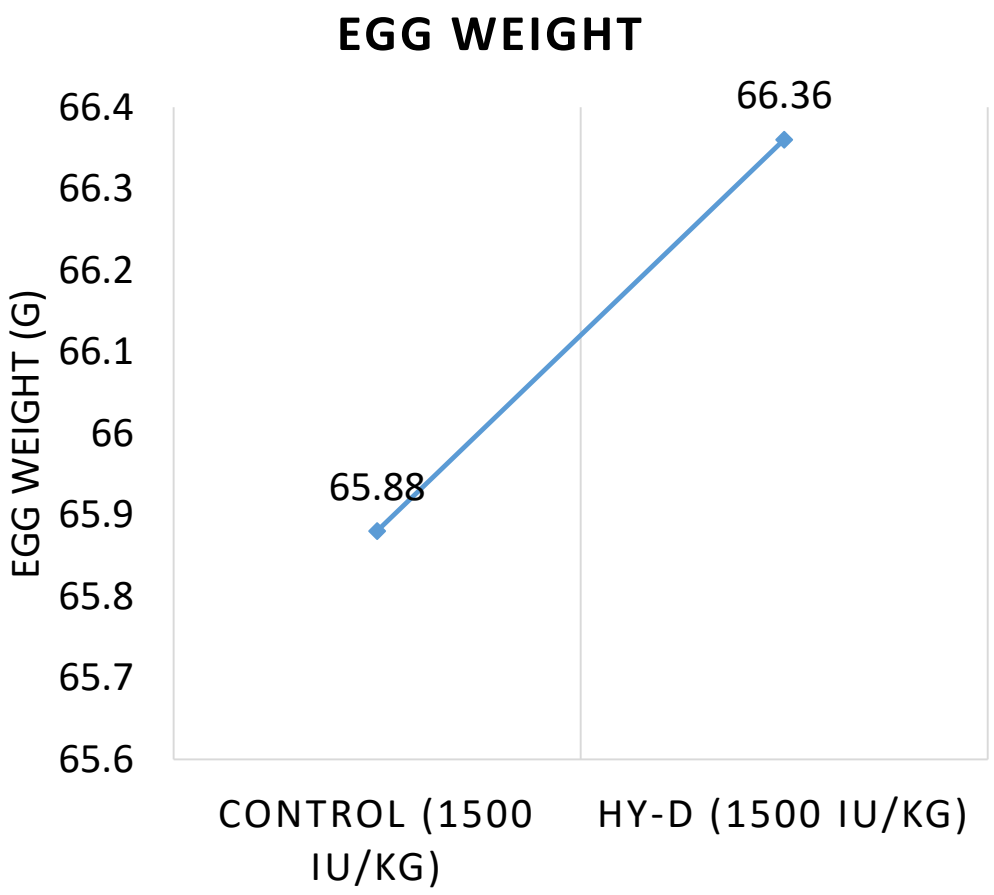
(41 -67 weeks of age)

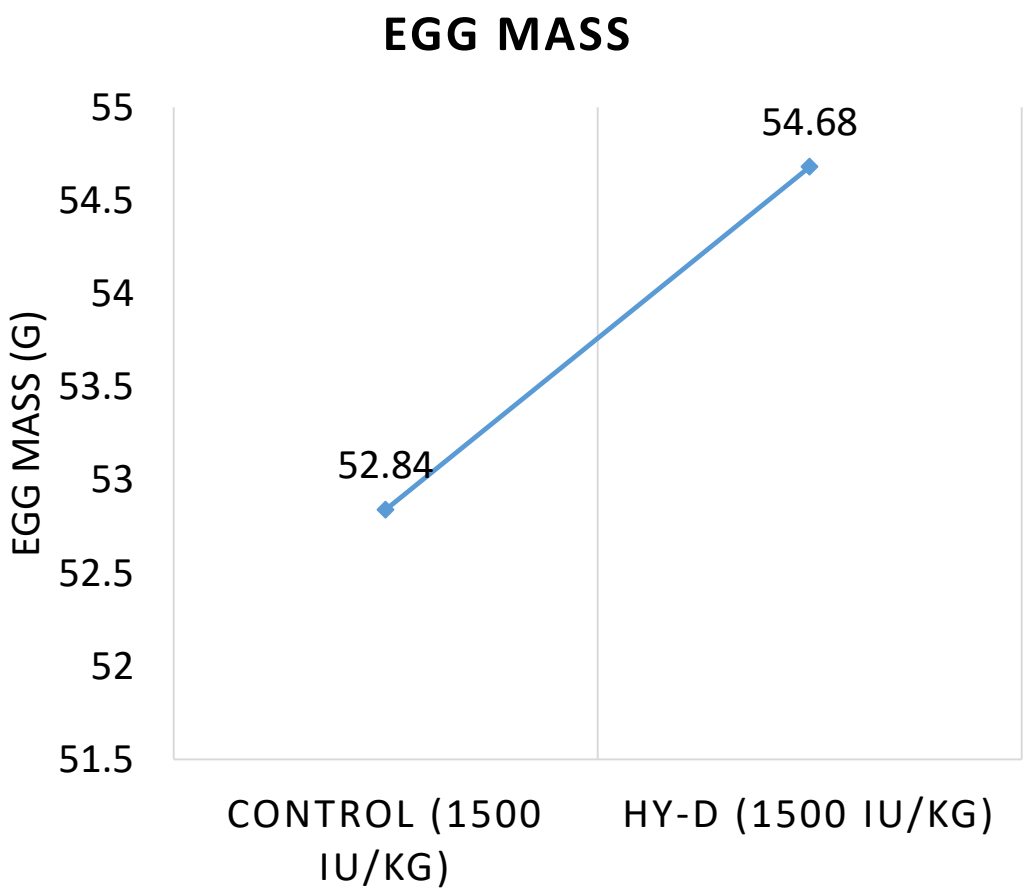




Lee R. McDowell, Department of Animal Sciences, University of Florida, Gainesville, Florida 32611, USA

Conti.





Lee R. McDowell, Department of Animal Sciences, University of Florida, Gainesville, Florida 32611, USA

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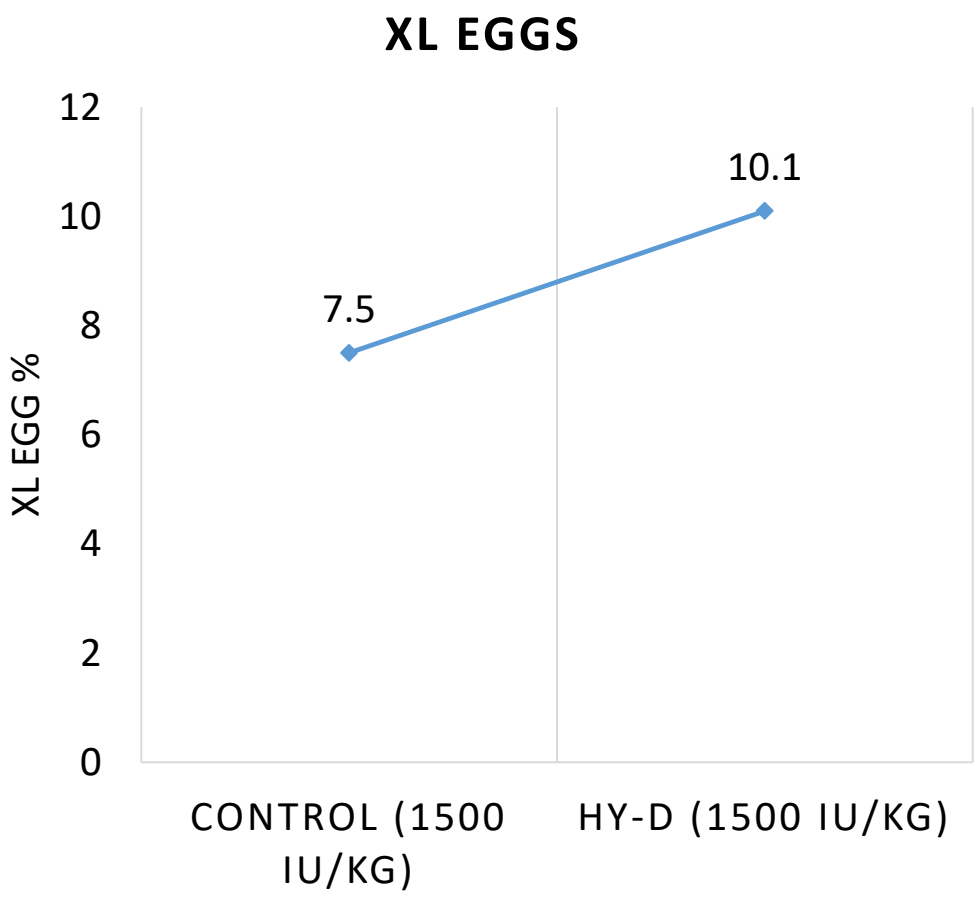
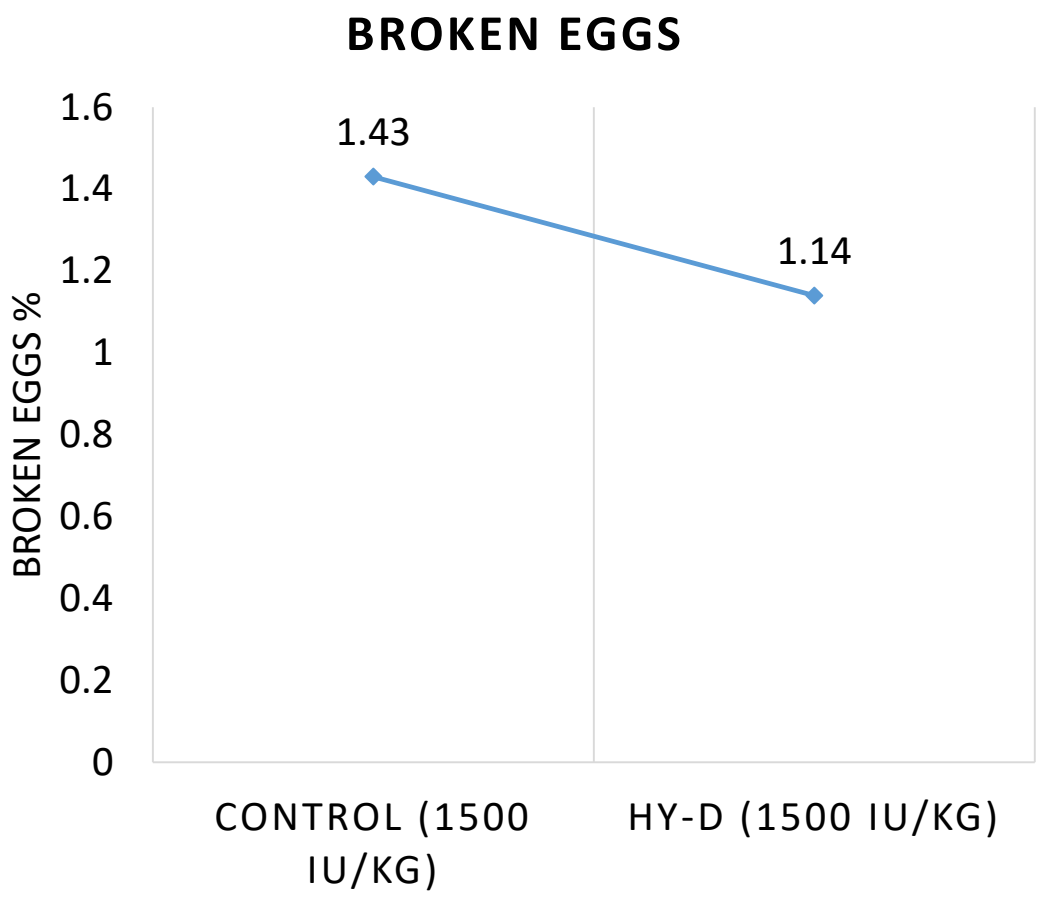

XL EGGS
XL EGG %
12
10
8
6
4
2
0
7.5
10.1
CONTROL (1500 IU/KG)
HY-D (1500 IU/KG)


BROKEN EGGS
BROKEN EGGS %
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1.43
1.14
CONTROL (1500 IU/KG)
HY-D (1500 IU/KG)

Italian Journal of Animal Science

ISSN: (Print) 1828-051X (Online) Journal homepage: https://www.tandfonline.com/loi/tjas20

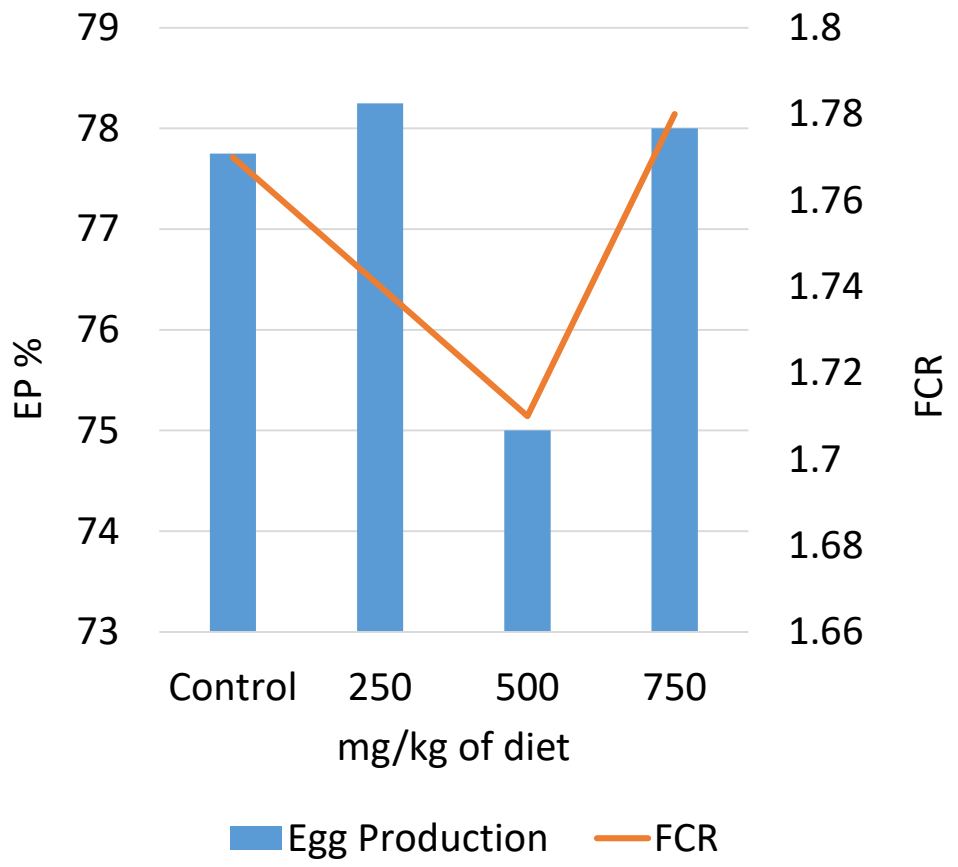
Can Vitamin C Elevate Laying Hen Performance, Egg and Plasma Characteristics Under Normal Environmental Temperature?

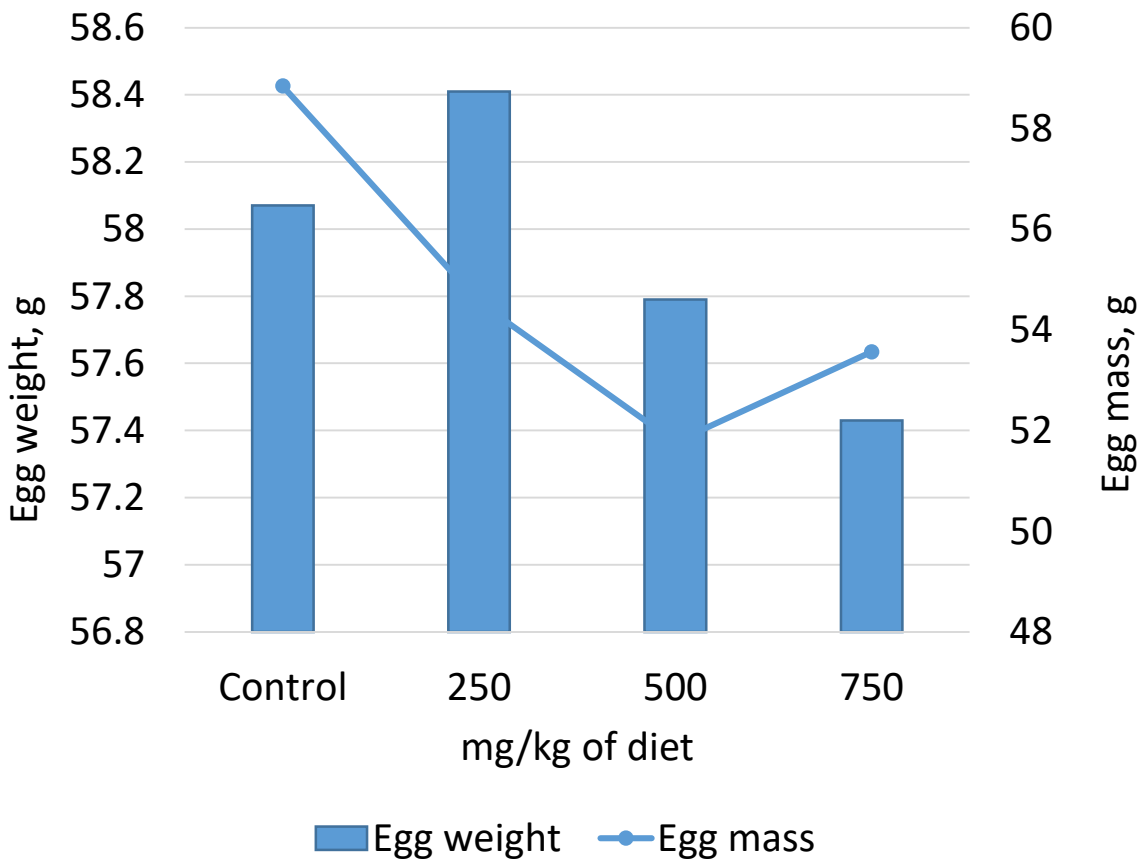
Ali A. Saki, Masud M.H. Rahmati, Pouya Zamani, Khalil Zaboli & Hamid R.H. Matin

To cite this article: Ali A. Saki, Masud M.H. Rahmati, Pouya Zamani, Khalil Zaboli & Hamid R.H. Matin (2010) Can Vitamin C Elevate Laying Hen Performance, Egg and Plasma Characteristics Under Normal Environmental Temperature?, Italian Journal of Animal Science, 9:3, e60

To link to this article: https://doi.org/10.4081/ijas.2010.e60

Vitamin C Elevate Laying Hen Performance





192 (20-week-old) White Leghorn Hens/4 replications and 12 birds for each treatment.

The results of the current study have shown that diets supplemented with vitamin C 250 mg/kg can improve some egg characteristics

The efficacy of a phytase enzyme fed to Hy-Line W-36 laying hens from 32 to 62 weeks of age

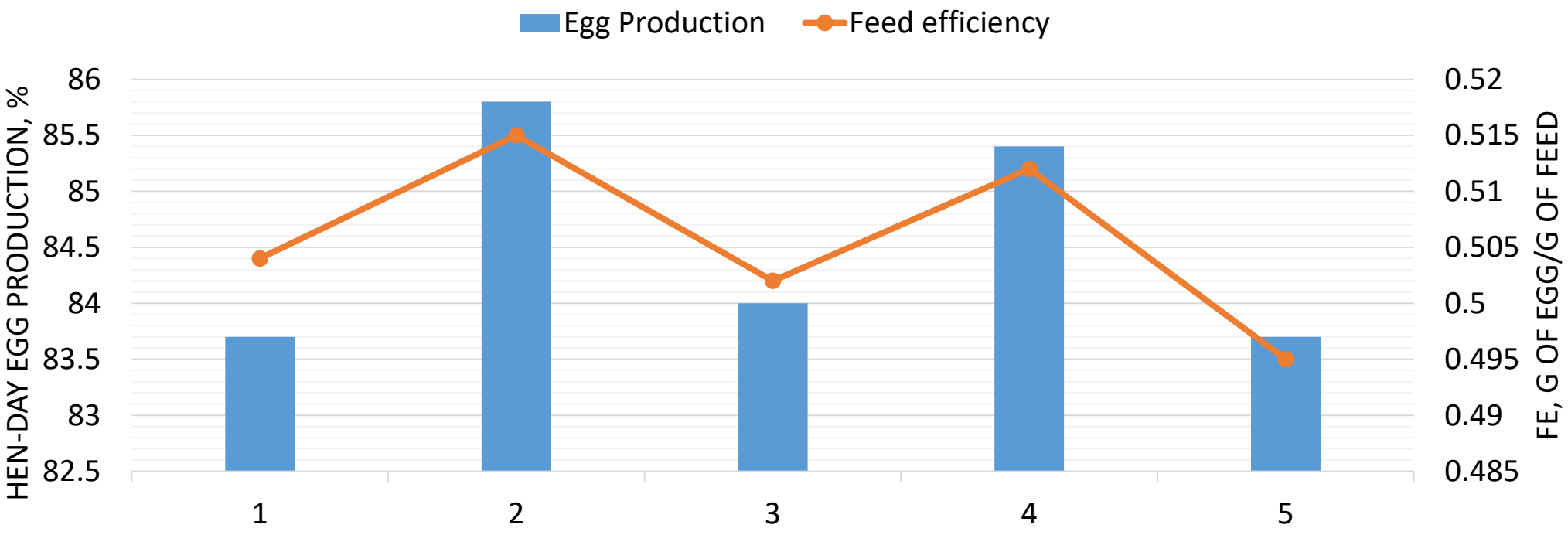
E. Meyer and C. Parsons[1]

Department of Animal Sciences, 132 Animal Sciences Laboratory, 1207 W. Gregory Dr., University of Illinois, Urbana 61801

Primary Audience: Feed Manufacturers, Nutritionists, Laying Hen Producers

2011 J. Appl. Poult. Res. 20:136–142
doi:10.3382/japr.2010-00212

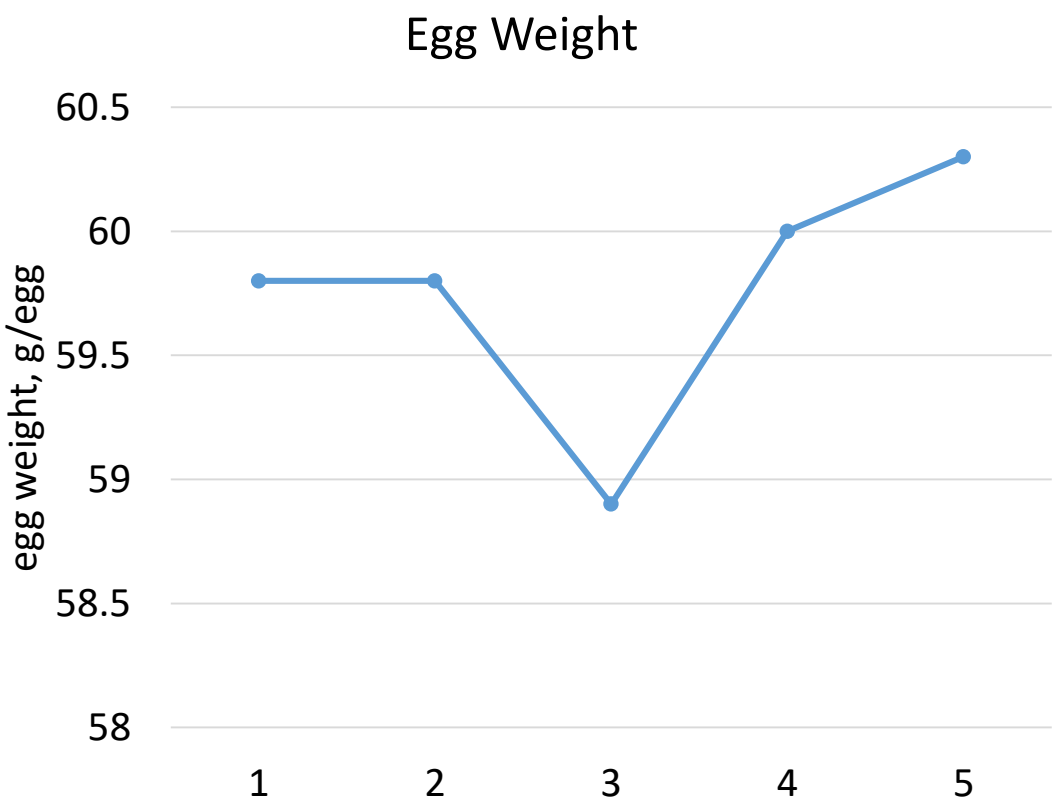
Phytase superposing



Diet 1 = 0.105% NPP + 150 phytase units (FTU)/kg; diet 2 = 0.105% NPP + 250 FTU/kg; diet 3 = 0.105% NPP + 15,000 FTU/
kg; diet 4 = 0.20% NPP; diet 5 = 0.45% NPP.

E. Meyer and C. Parsons. 2011; J. appl. Poult. res. 20 :136–142

Conti.



Feeding a diet containing 0.105% calculated NPP and supplemented with as little as 150 FTU/kg of the phytase enzyme was as efficacious as feeding a diet containing 0.45% calculated NPP for long-term (32 to 62 wk) laying hen performance.

Original Paper

Czech J. Anim. Sci., 63, 2018 (5): 182–187

https://doi.org/10.17221/113/2017-CJAS

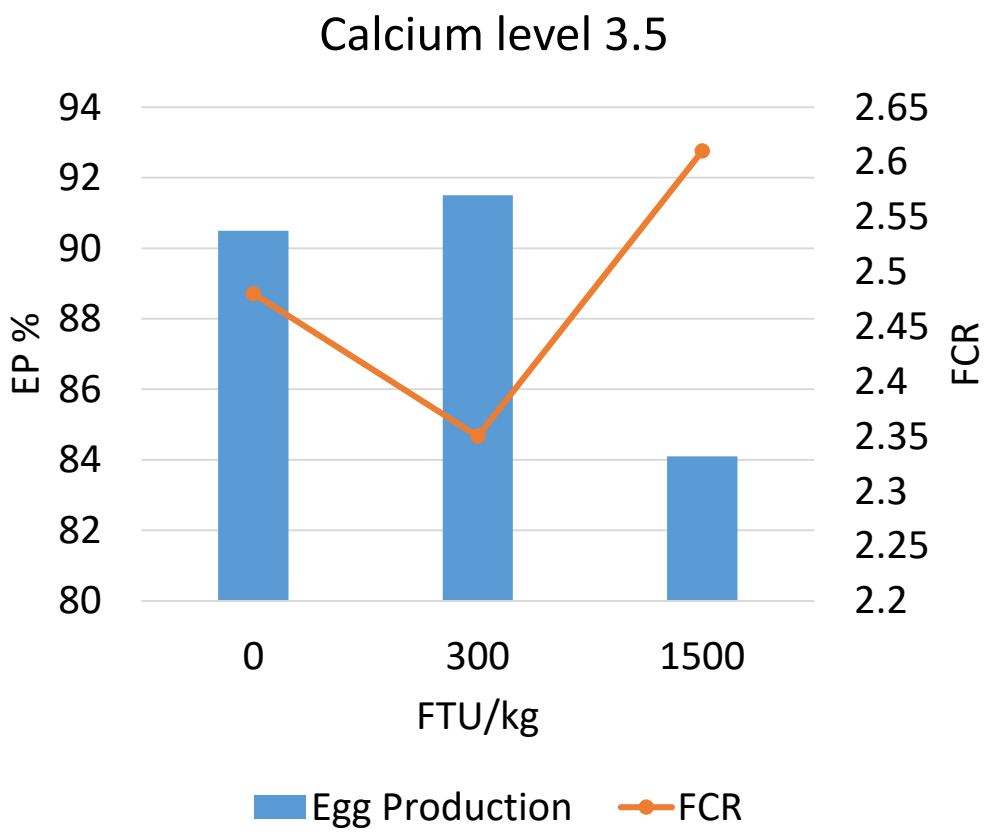
Negative Effect of Phytase Superdosing in Laying Hens

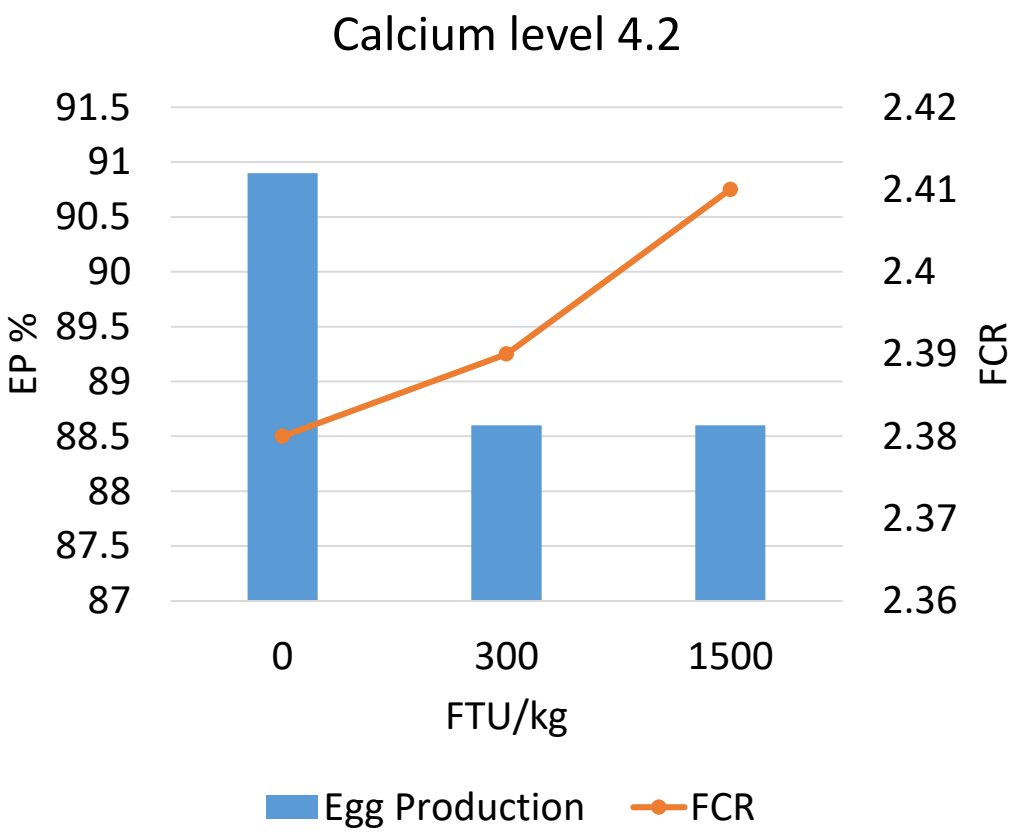
MILOŠ SKŘIVAN*, MICHAELA ENGLMAIEROVÁ, VĚRA SKŘIVANOVÁ

Department of Nutrition Physiology and Animal Product Quality, Institute of Animal Science, Prague-Uhříněves, Czech Republic

*Corresponding author: skrivan.milos@vuzv.cz

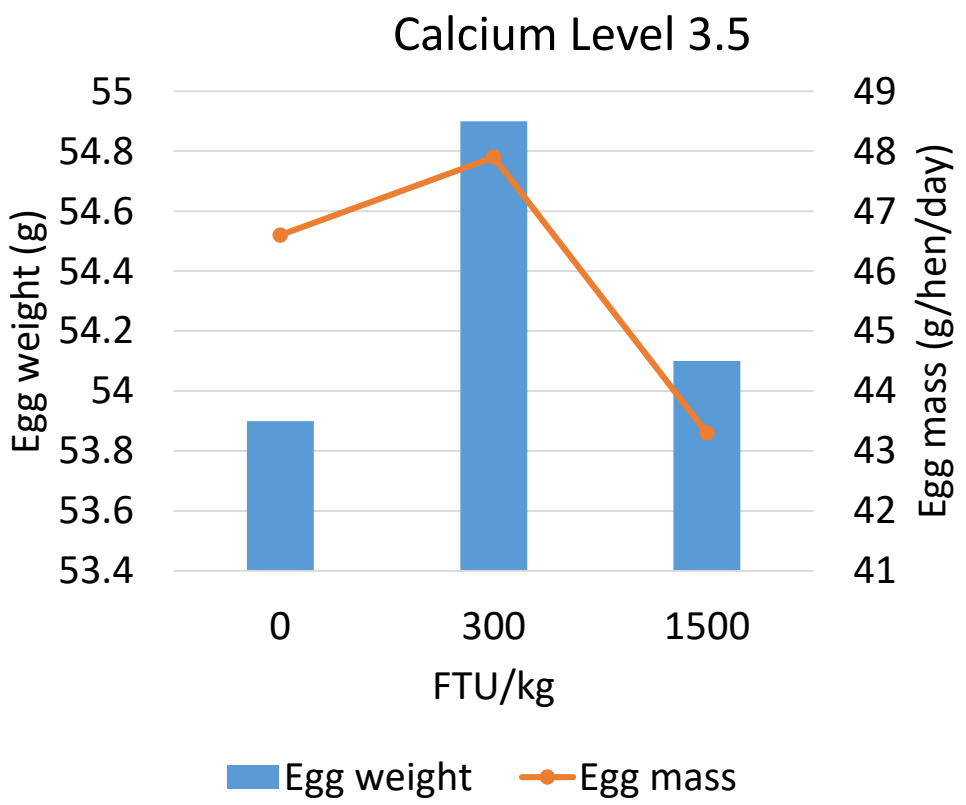
Phytase superposing

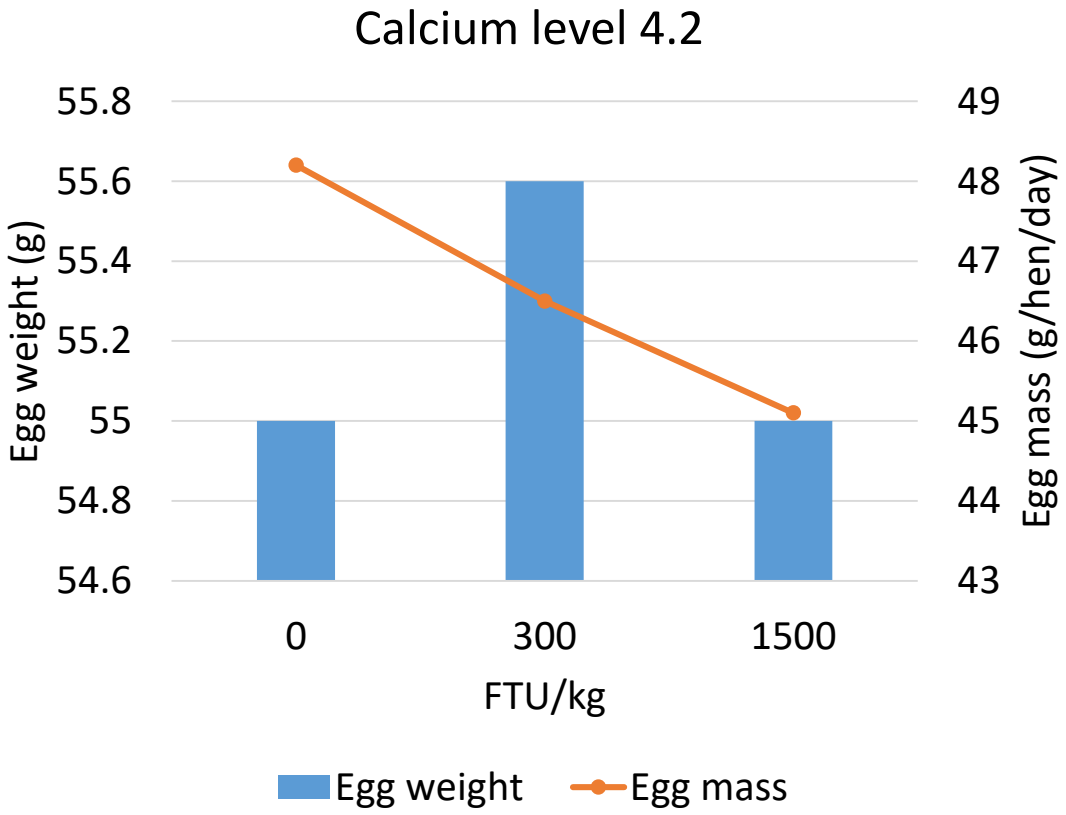




24-week-old Hisex Brown hens
4 replicate cages at 10 hens per cage

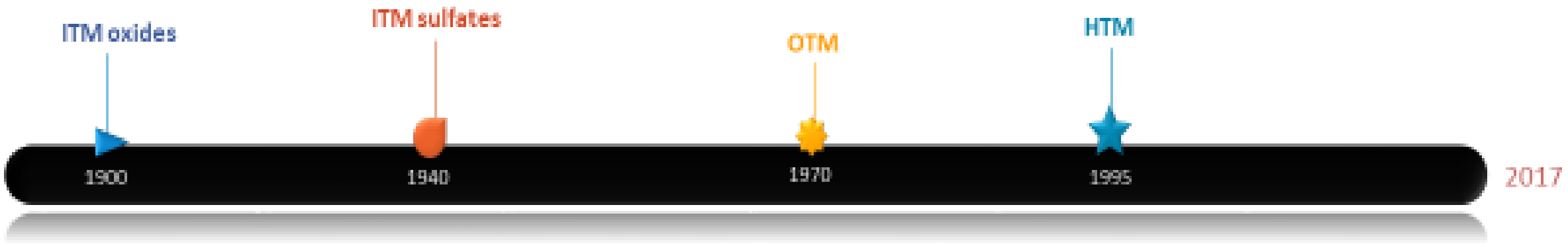
Conti.





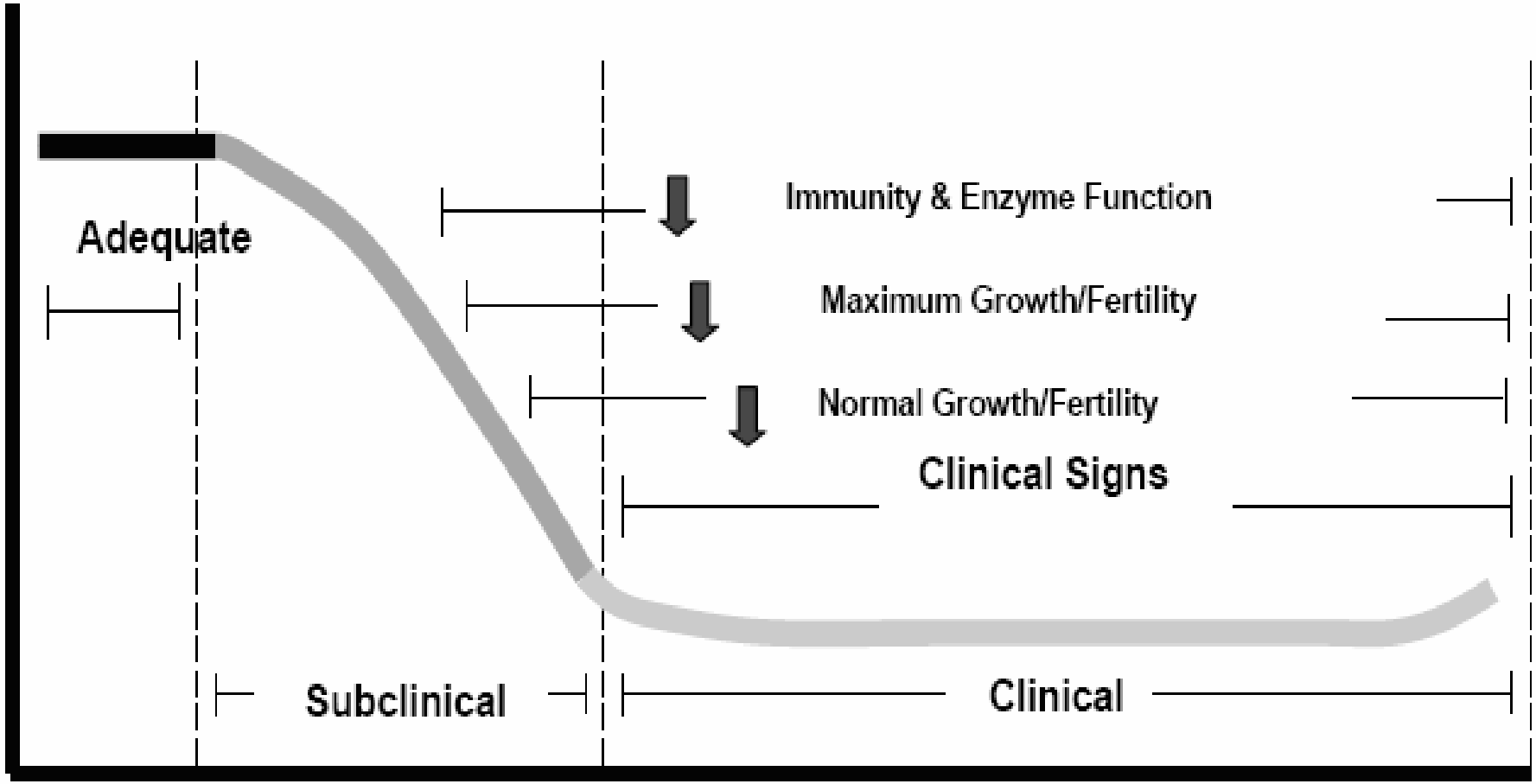
Based on the results of this work, the authors conclude that at dietary Ca concentrations of 35 g/kg, a dietary superdose of Phytase at 1500 FTU/kg is a factor that can reduce the performance of laying hens

Trace mineral history



- Development of organic trace minerals (OTM's): improvements on bioavailability, reactivity and homogeneity compared to inorganic trace minerals (ITM's)
- Development of hydroxy trace minerals (HTM's): new technology to improve essential **nutrient stability** in feeds and optimise **animal production**, requiring additional trace mineral **absorption**.
- EFSA: reduction tolerable upper uptake levels copper and zinc

Trace minerals status on animal performance



Biological value

Mineral sources and RBV%

Source	Type	Class	Density	Bond type	Reactivity	RBV* (%)	Cost/unit of metal
$ZnSO_4$	Inorganic	Salt	35.5%	Ionic	High	100	$Lower
ZnO	Inorganic	Oxide	72%	Covalent / ionic	Low	37-74	$Lowest
AvailaZn	Organic	Non-specific AA complex	12%	Covalent	Lower	142-164	$High
IntelliBond Z	Hydroxy	Hydroxy	55%	Covalent	Lowest	122-204	$Low

*Wedekind et al., 1992; Rodhell et al., 2013, Star et al., 2012; Batal et al., 2001; Edwards and Baker, 1999.

Types of organic minerals

- Metal amino acid complex
- Metal proteinates
- Metal polysaccharides
- Metal glycine

Productive performance, eggshell quality, and eggshell ultrastructure of laying hens fed diets supplemented with organic trace minerals

C. Stefanello, T. C. Santos,[1] A. E. Murakami, E. N. Martins, and T. C. Carneiro

Department of Animal Science, State University of Maringá, Av. Colombo 5790, Maringá, PR 87020-900, Paraná, Brazil

2014 Poultry Science 93:104–113
http://dx.doi.org/10.3382/ps.2013-03190

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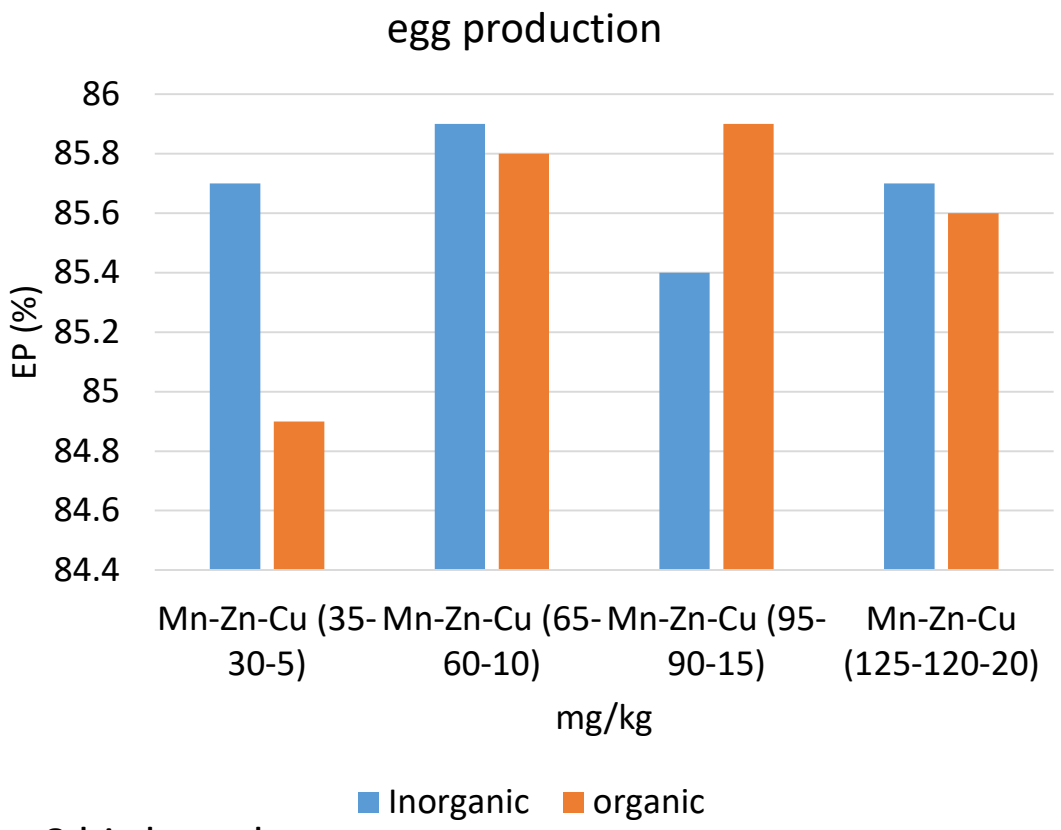
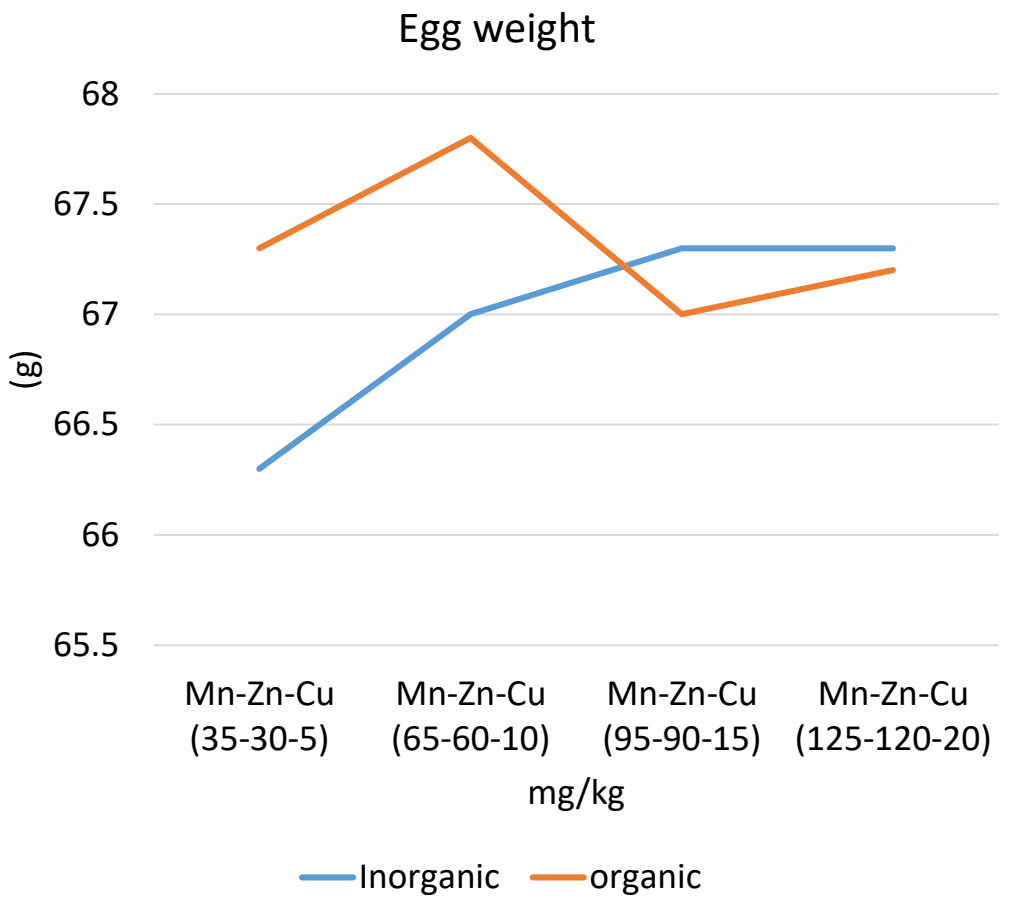
Inorganic vs organic mineral (W-36) (47 to 65 weeks)





5 replicate 8 birds each

Stefanello et al. 2014: Poult. Sci. J. 93:104-113

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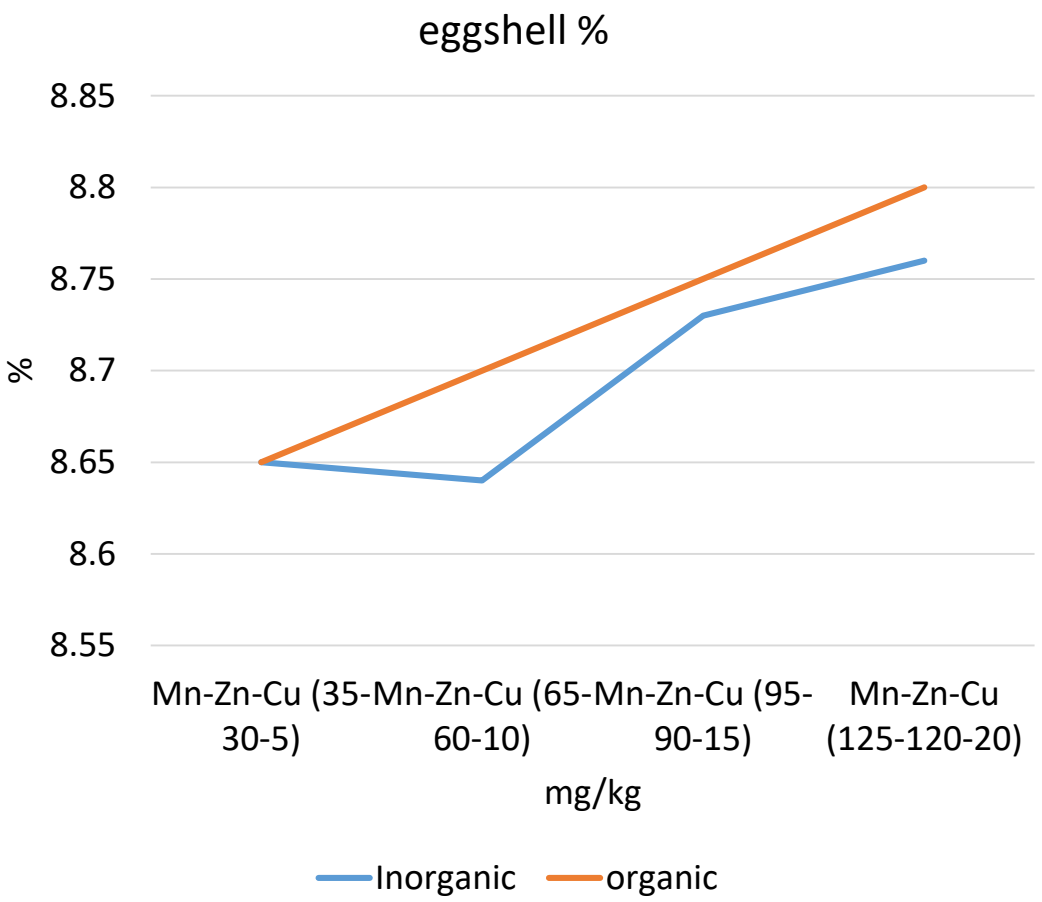

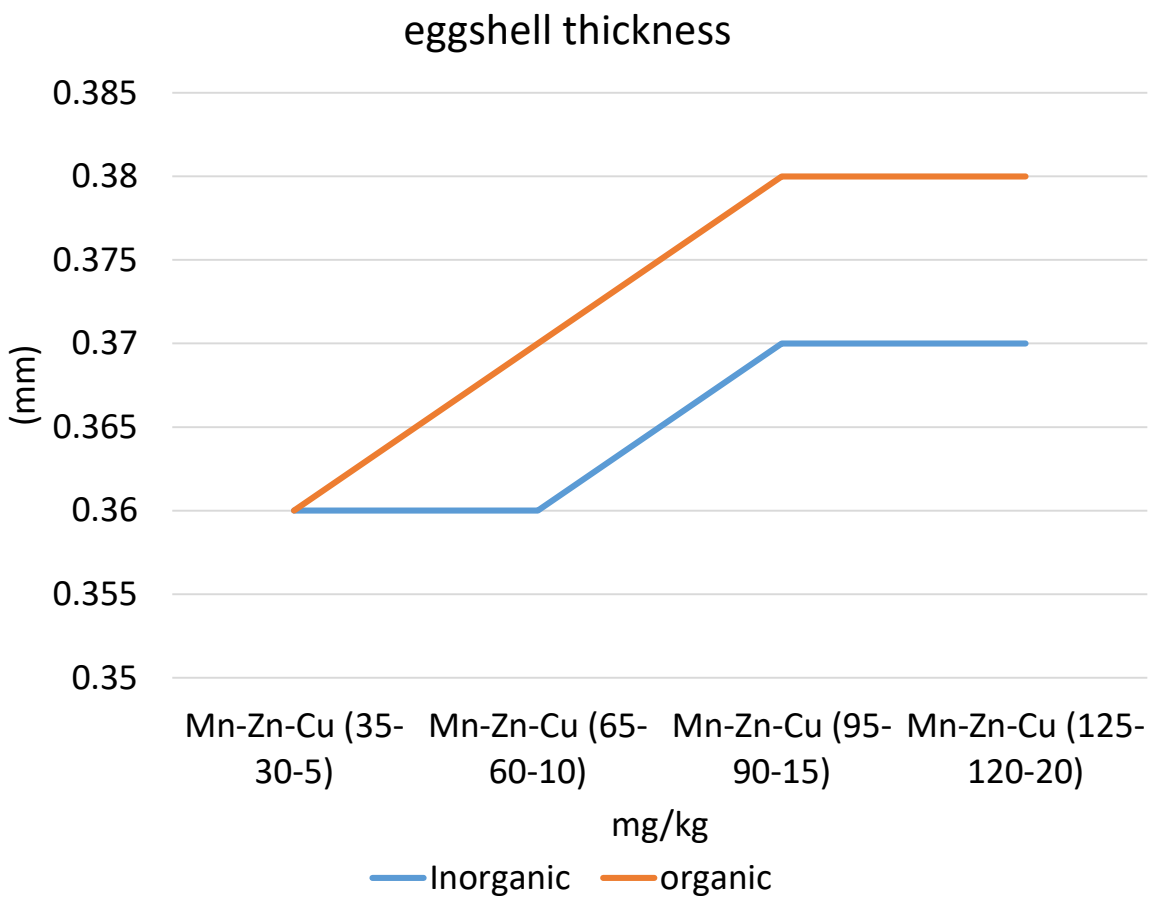

However, supplementation of Mn, Zn, and Cu did improve quality characteristics and ultrastructure of eggshells. Levels equal to or above 65-60-10 mg/kg, for Mn, Zn, and Cu, respectively, resulted in less egg loss and increased strength of shell.

Effect of dietary supplementation of organic or inorganic manganese on eggshell quality, ultrastructure, and components in laying hens

Y. N. Zhang, J. Wang, H. J. Zhang, S. G. Wu, and G. H. Qi[1]

Key Laboratory of Feed Biotechnology of Ministry of Agriculture, Feed Research Institute, Chinese Academy of Agricultural Sciences, Beijing 100081, China

2017 Poultry Science 96:2184–2193
http://dx.doi.org/10.3382/ps/pew495

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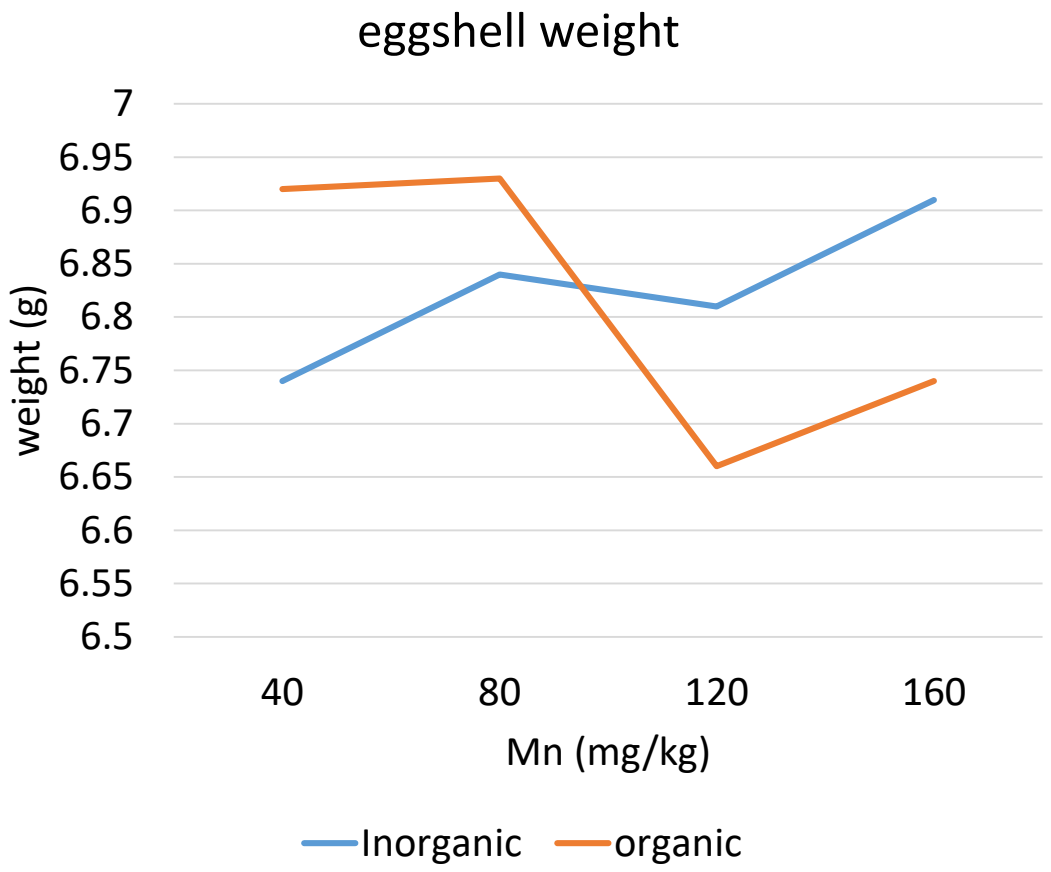
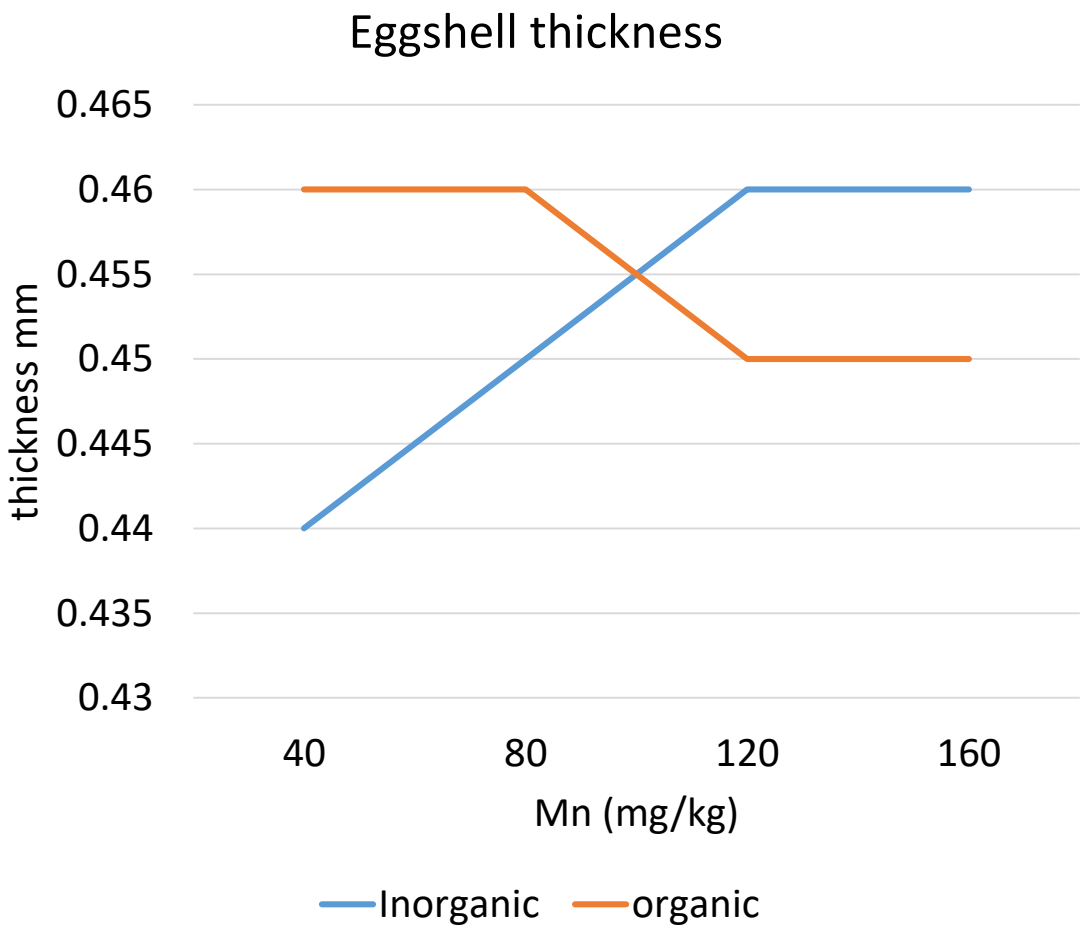




In conclusion, dietary Mn supplementation, regardless of the source, could increase breaking strength and thickness by improving the ultrastructure.

Received: 16 October 2018 | Revised: 28 November 2018 | Accepted: 4 January 2019

DOI: 10.1111/jpn.13061

Check for updates

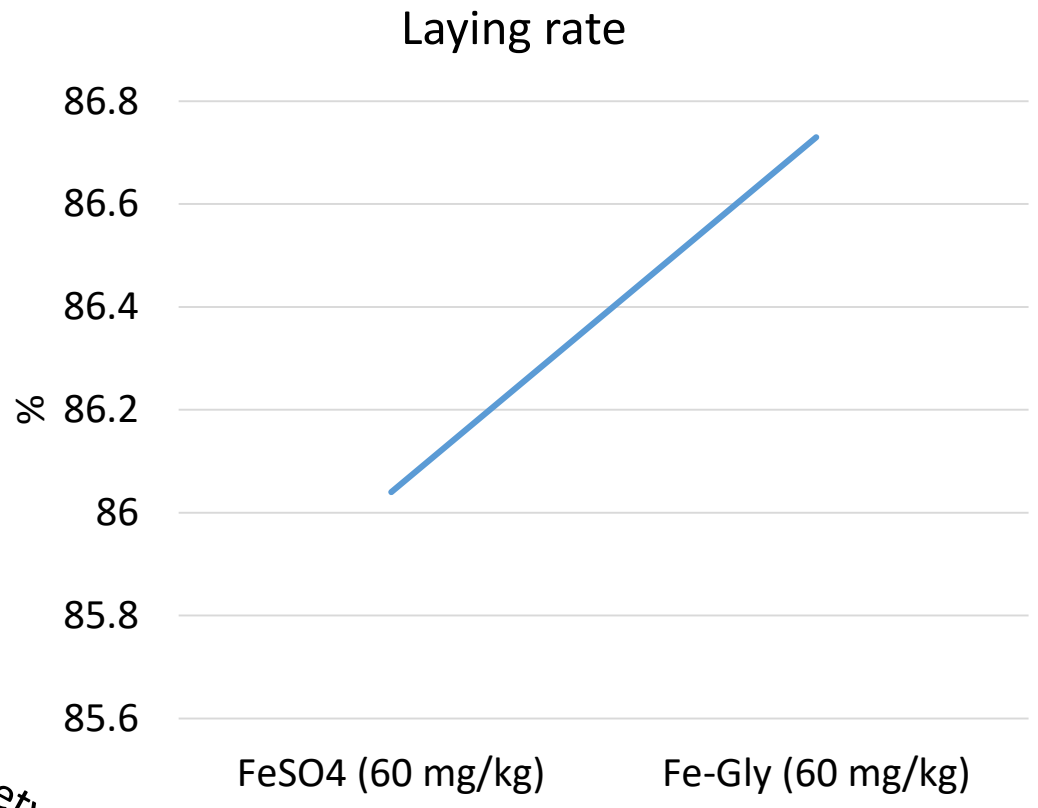
ORIGINAL ARTICLE

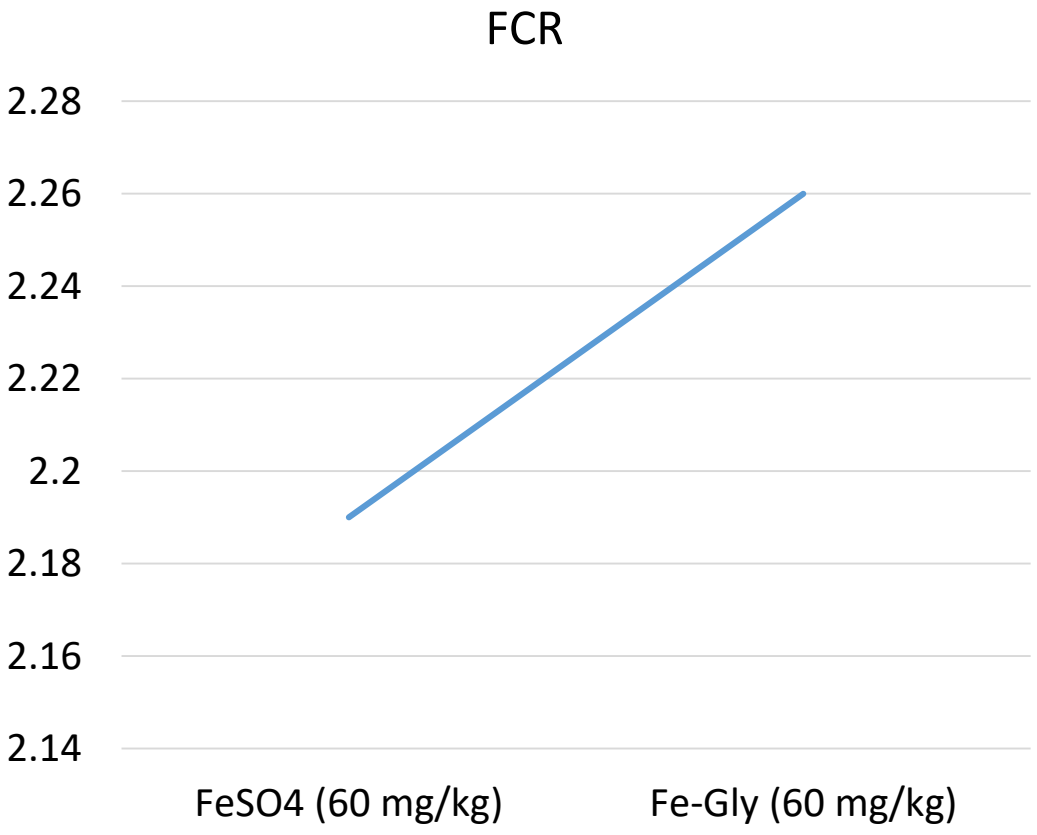
WILEY Journal of Animal Physiology and Animal Nutrition

Effects of iron glycine chelate on laying performance, antioxidant activities, serum biochemical indices, iron concentrations and transferrin mRNA expression in laying hens

Chao Xie[1] | Hamada A. M. Elwan[1,2] | Shaaban S. Elnesr[1,3] | Xinyang Dong[1] | Jie Feng[1] | Xiao-ting Zou[1]

Inorganic-Fe vs Fe- glycine chelate





(Hy-Line Variety White, 26 weeks old) five replications (n = 27 laying hens)

conclusion, the present study indicated that dietary Fe-Gly supplementation could increase the laying rate, egg weight, antioxidant ability and iron accumulation and promote protein synthesis in laying hens, compared with dietary FeSO4 supplementation

Effect of sodium selenite and selenium yeast on performance, egg quality, antioxidant capacity, and selenium deposition of laying hens

X. J. Han,[1] P. Qin,[1] W. X. Li, Q. G. Ma,[2] C. Ji, J. Y. Zhang, and L. H. Zhao

State Key Laboratory of Animal Nutrition, College of Animal Science and Technology, China Agricultural University, Beijing 100193, P. R. China

2017 Poultry Science 96:3973–3980
http://dx.doi.org/10.3382/ps/pex216

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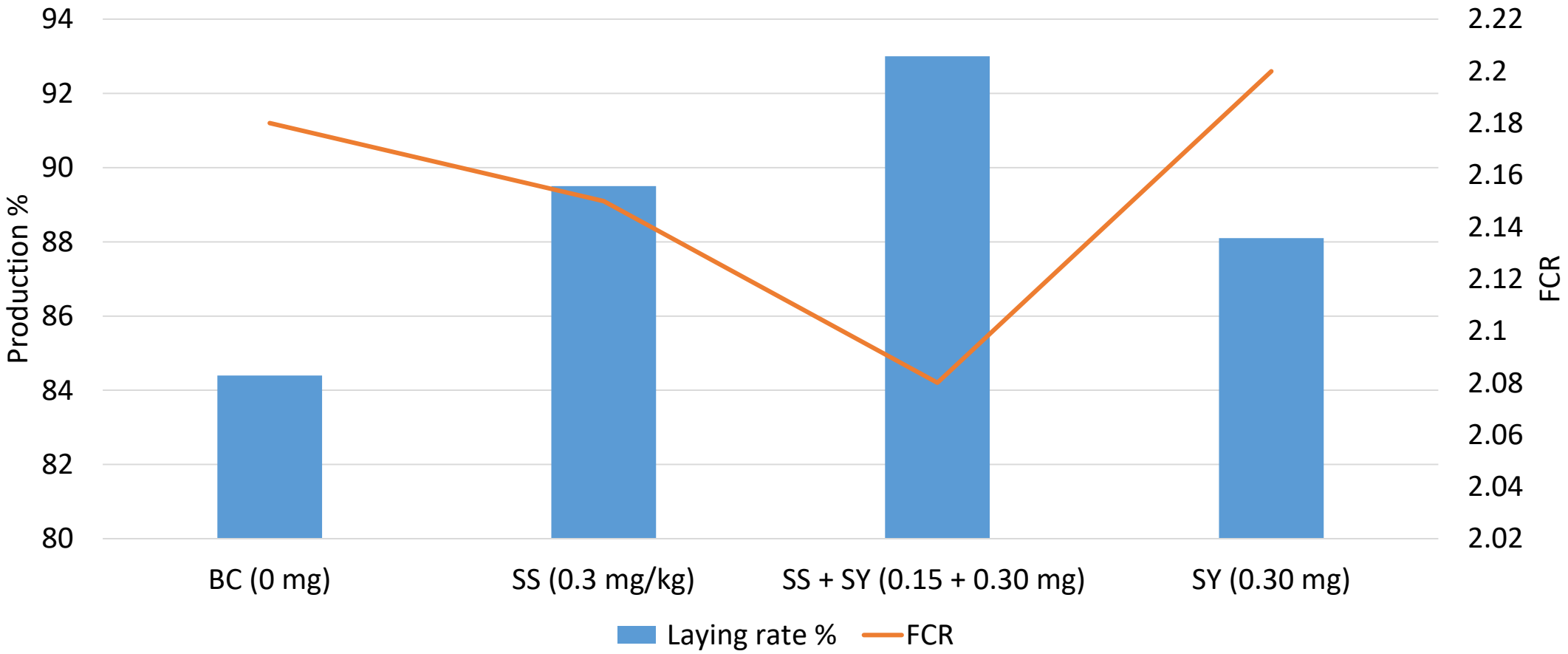
Inorganic and organic selenium



Hen et al. 2017; Poult. Sci. J. 96:3973-3980

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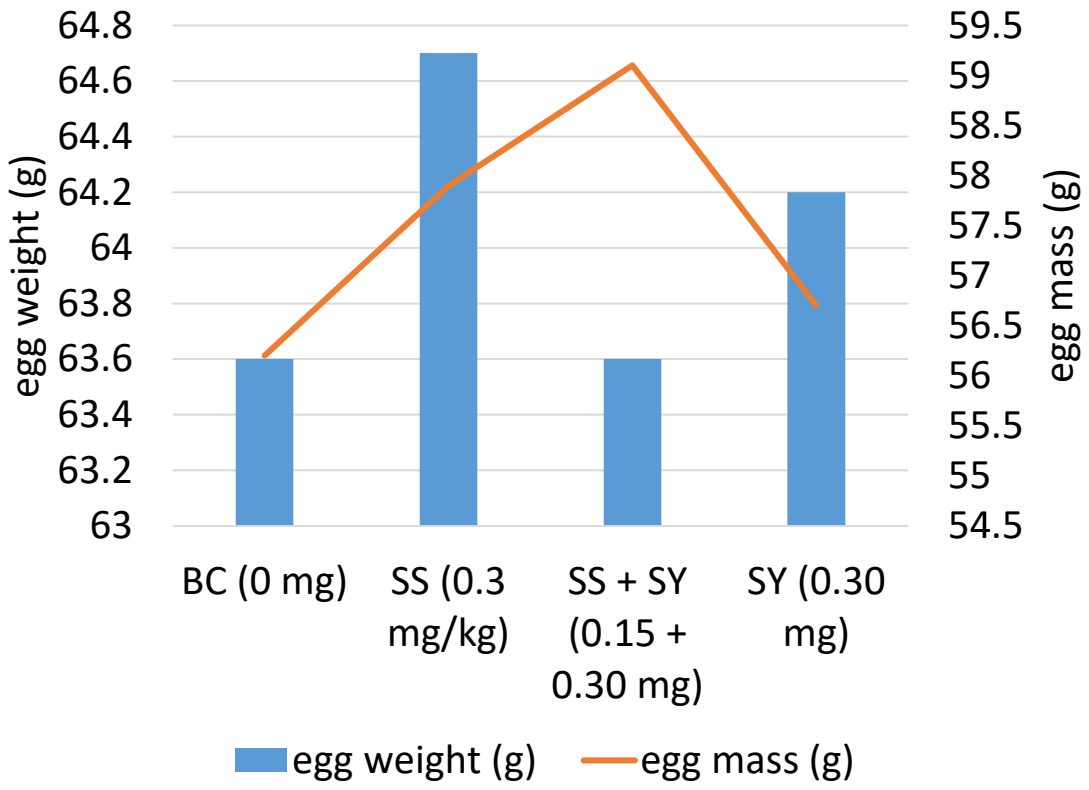

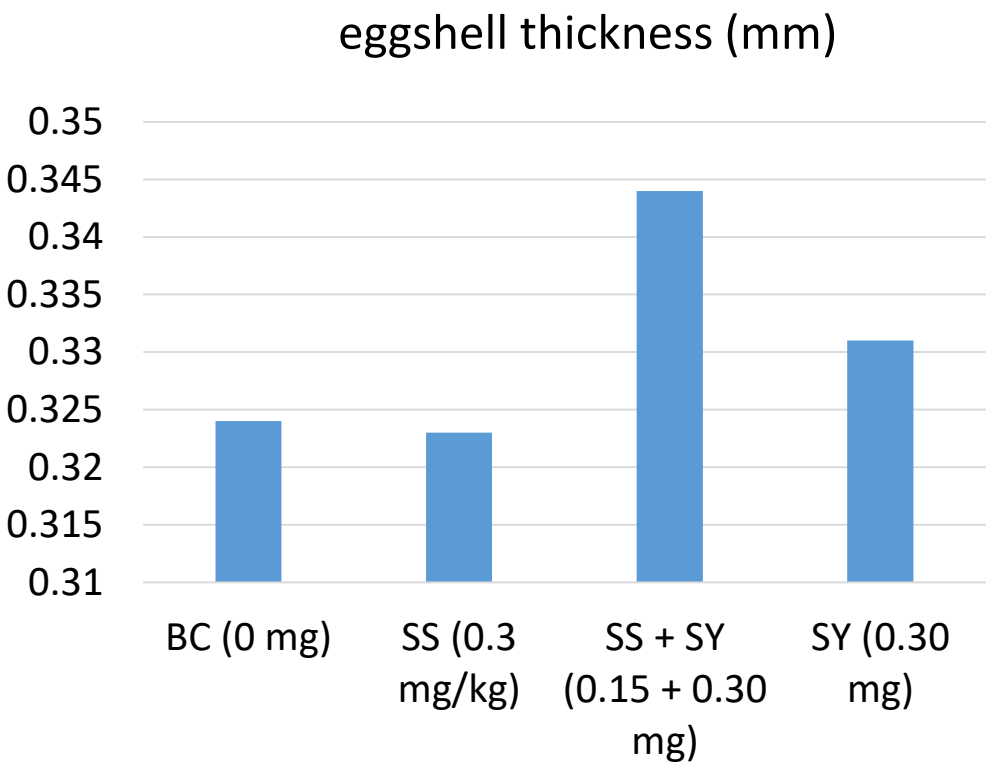

In conclusion, the effects of SS and Se yeast were approximately equal in promoting laying percentage and antioxidant capacity of laying hens, while Se yeast is easier to deposit into eggs and tissues

Sulfate and hydroxychloride trace minerals in poultry diets – comparative effects on egg production and quality in laying hens, and growth performance and oxidative stress response in broilers

Oluyinka A. Olukosi,[*,†,1] Sandra J. A. van Kuijk,[‡] and Yanming Han[‡]

[*]*Department of Poultry Science, University of Georgia, Athens, GA 30602, USA;* [†]*Monogastric Science Research Centre, SRUC, Edinburgh, EH9 3JG, UK; and* [‡]*Trouw Nutrition R&D, Amersfoort, 3800 AG, the Netherlands*

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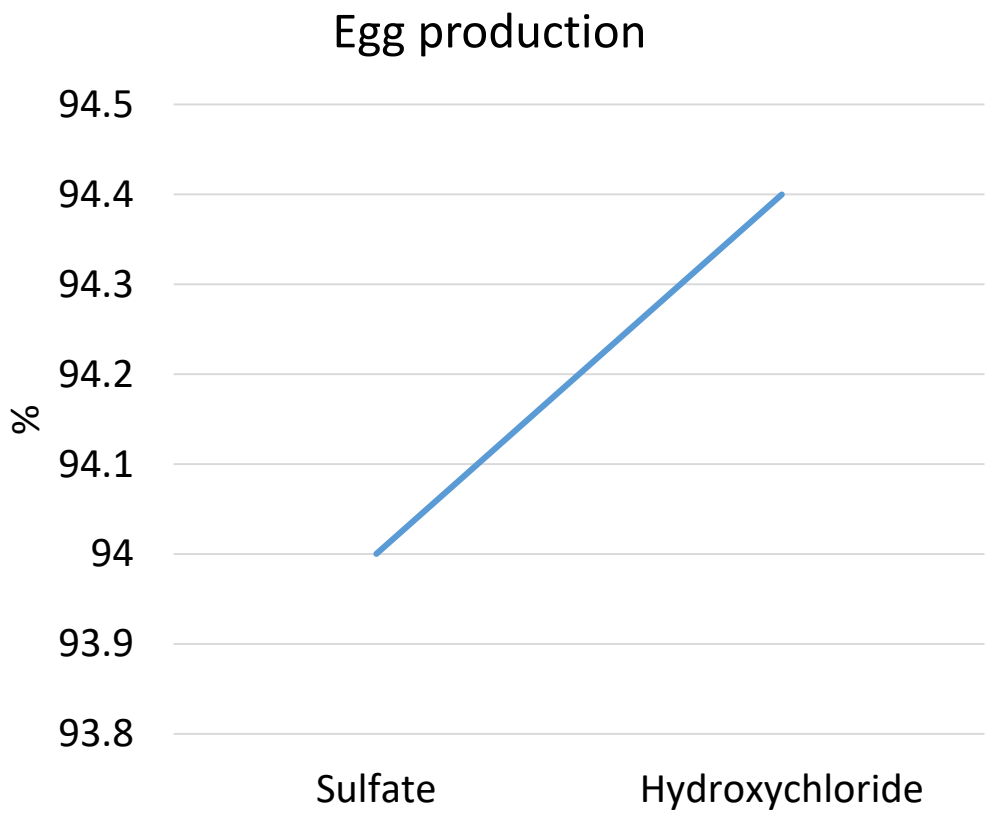
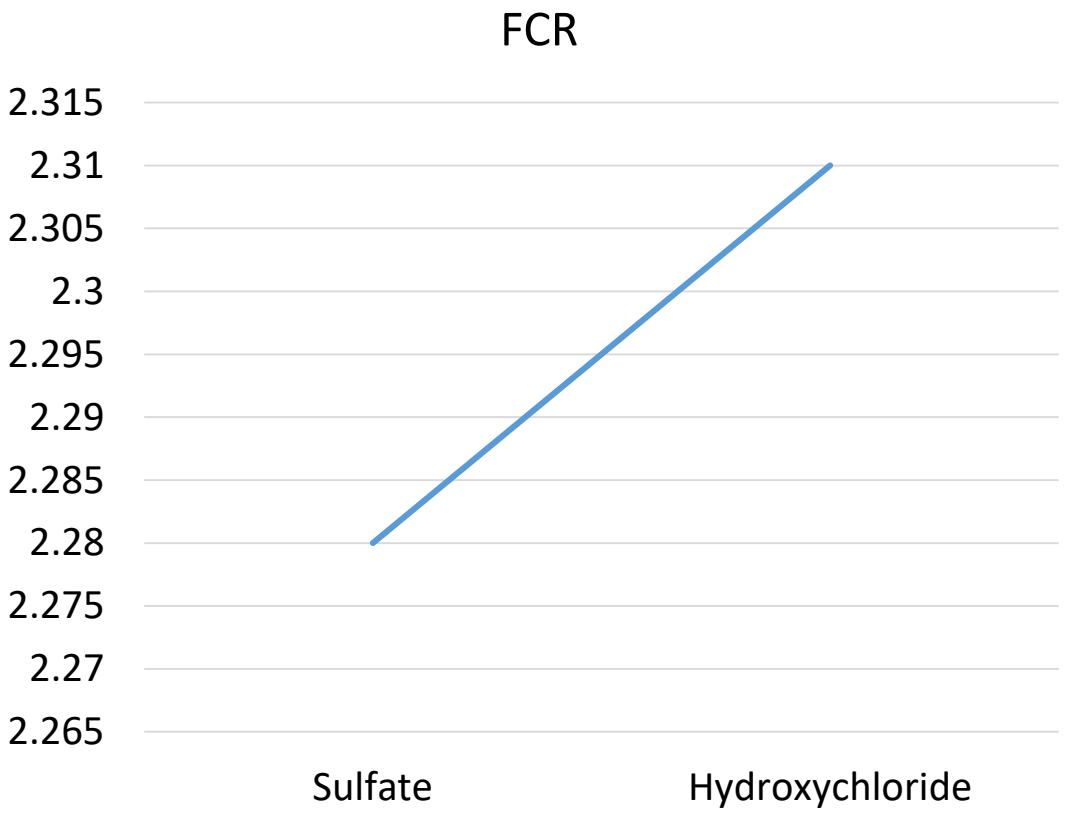
Sulfate and hydrochloride trace minerals in Layer diet





Olukosi et al. 2019; Poult. Sci. J. 98:4961-4971

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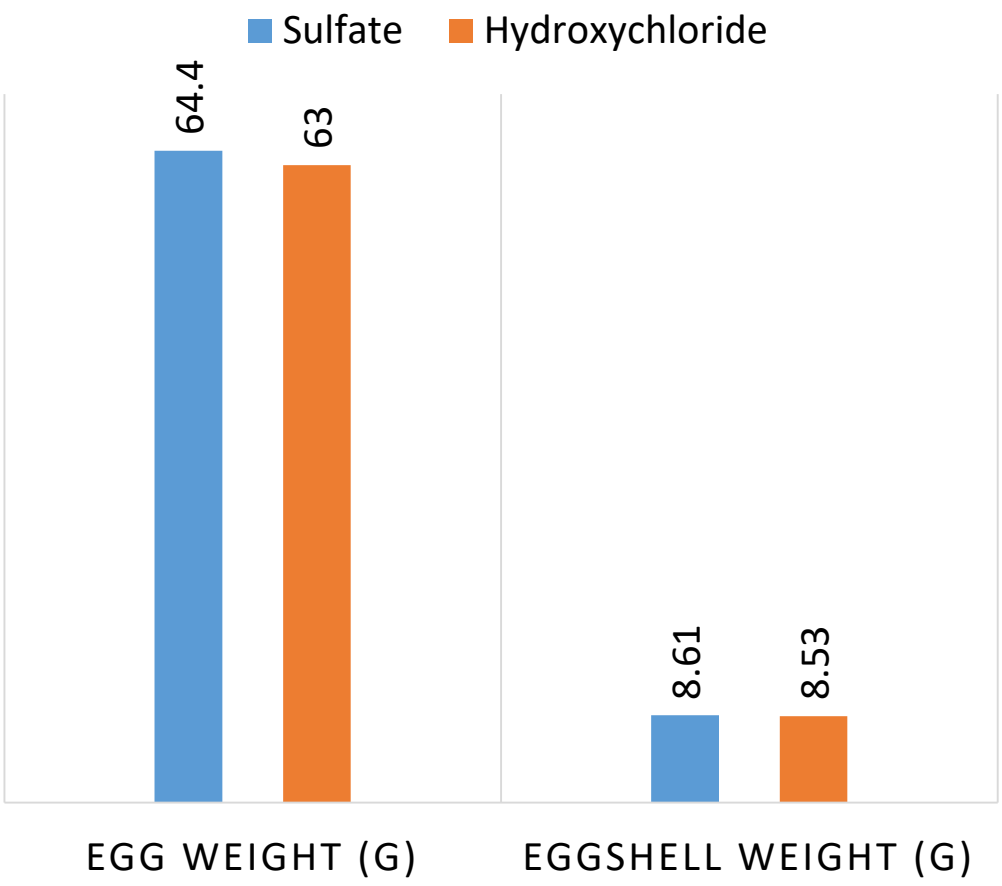

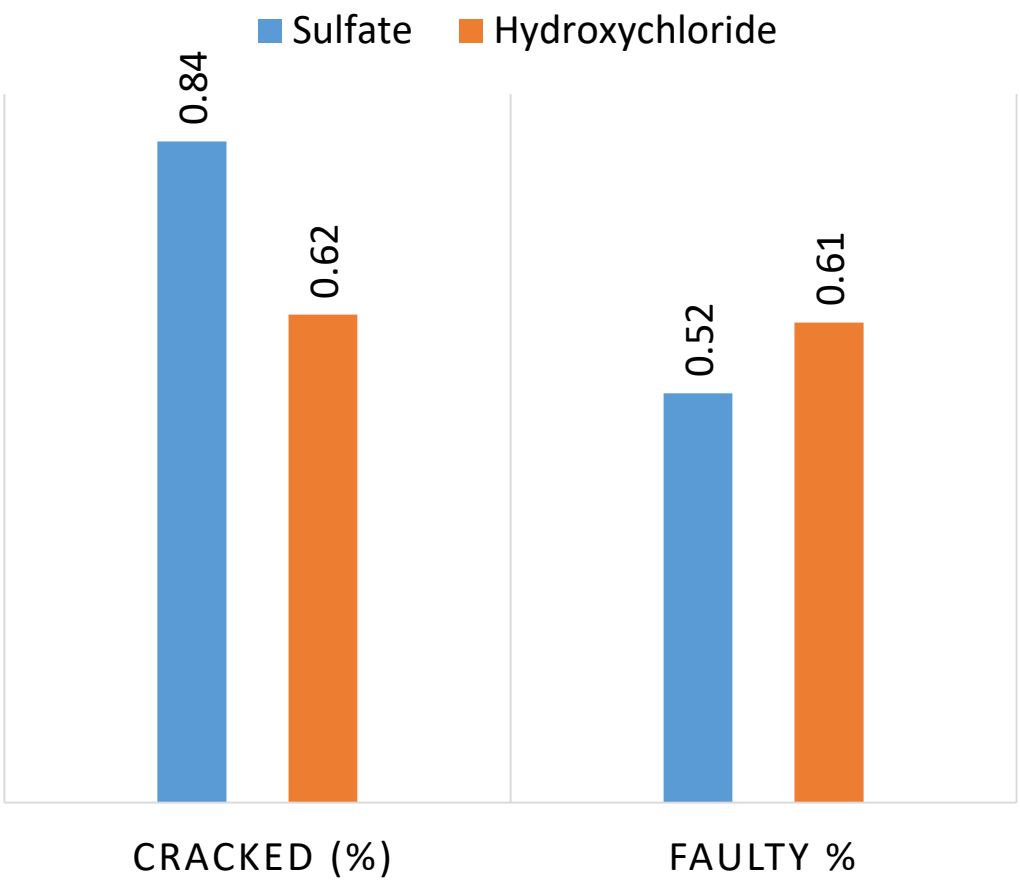

The observations from the current experiments indicate that hydrochloride Mn, Zn, and Cu reduced egg loss by reducing the proportion of cracked eggs, even though its effect on egg production was minimal in hens at peak production.

Egg enrichment (microalgae)

- Eggs can be enriched with long-chain n-3 polyunsaturated fatty acids (**PUFA**) such as docosahexaenoic acid (**DHA**, 22:6 n-3) by supplementing the hen's diet with microalgae.

(Lemahieu et al., 2015; Long et al., 2018)

- The benefits of microalgae in layer hen feeding include its production sustainability, egg sensory qualities, improvement in antioxidant status.

Choline supplementation alters egg production performance and hepatic oxidative status of laying hens fed high-docosahexaenoic acid microalgae

Joseph A. Yonke and Gita Cherian[1]

Department of Animal and Rangeland Sciences, Oregon State University, Corvallis, OR 97331

2019 Poultry Science 0:1–8
http://dx.doi.org/10.3382/ps/pez339

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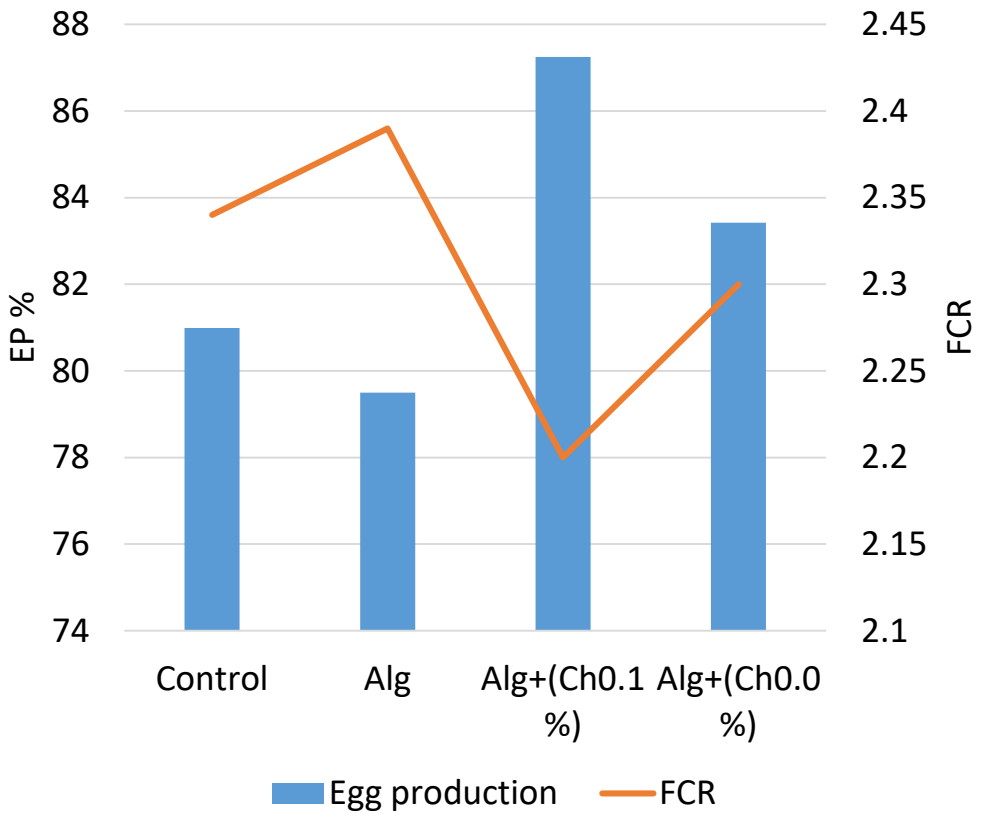
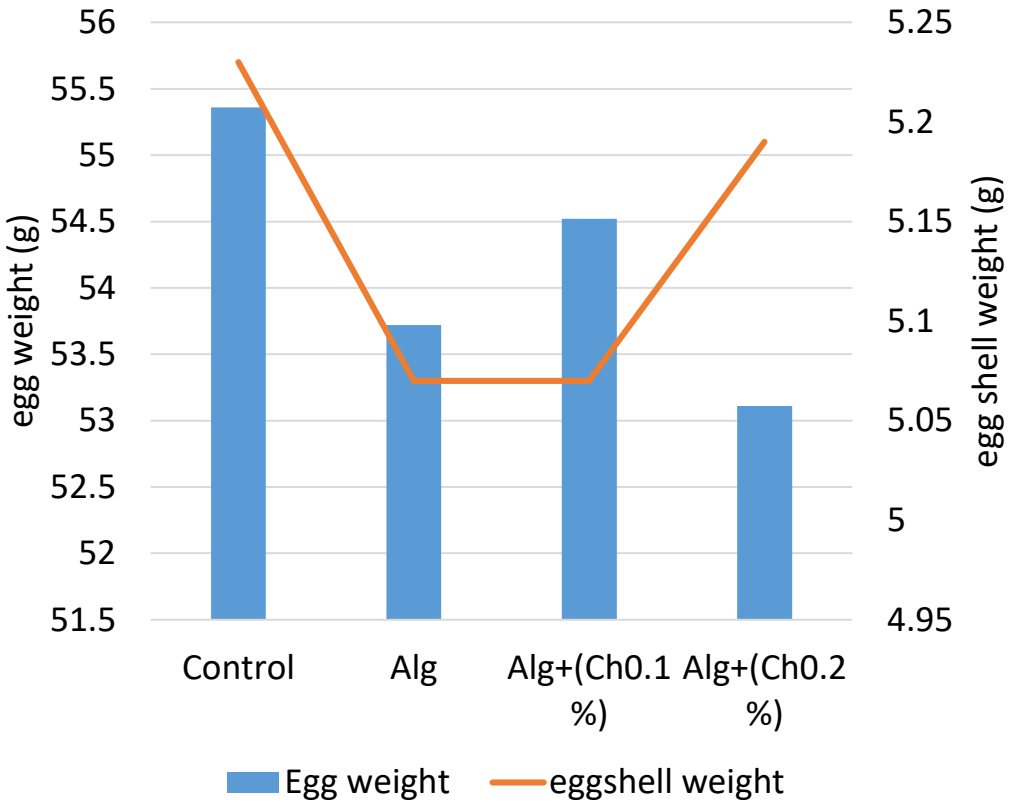
CHOLINE AND MICROALGAE IN LAYER DIETS





24-wk-old, White Leghorn hens
14 hens kept in 7 replicate groups

Yonke and Gita Cherian. 2019; Poult. Sci. j. 0:1-8

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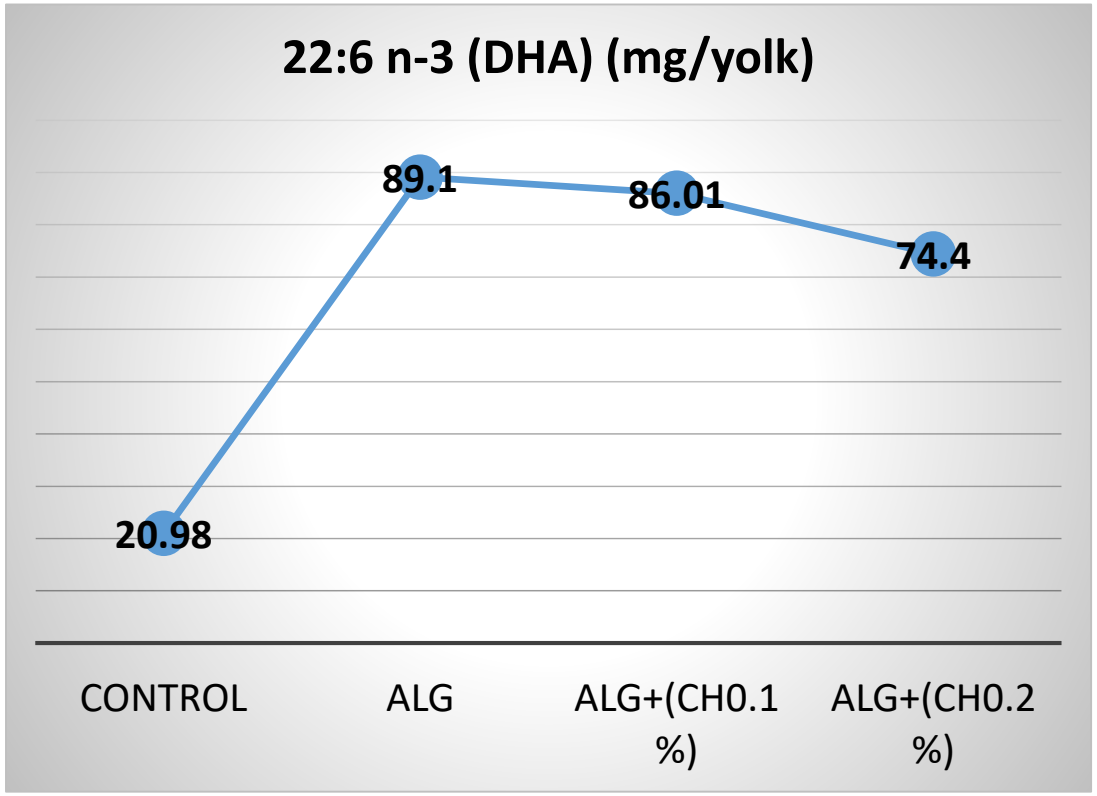
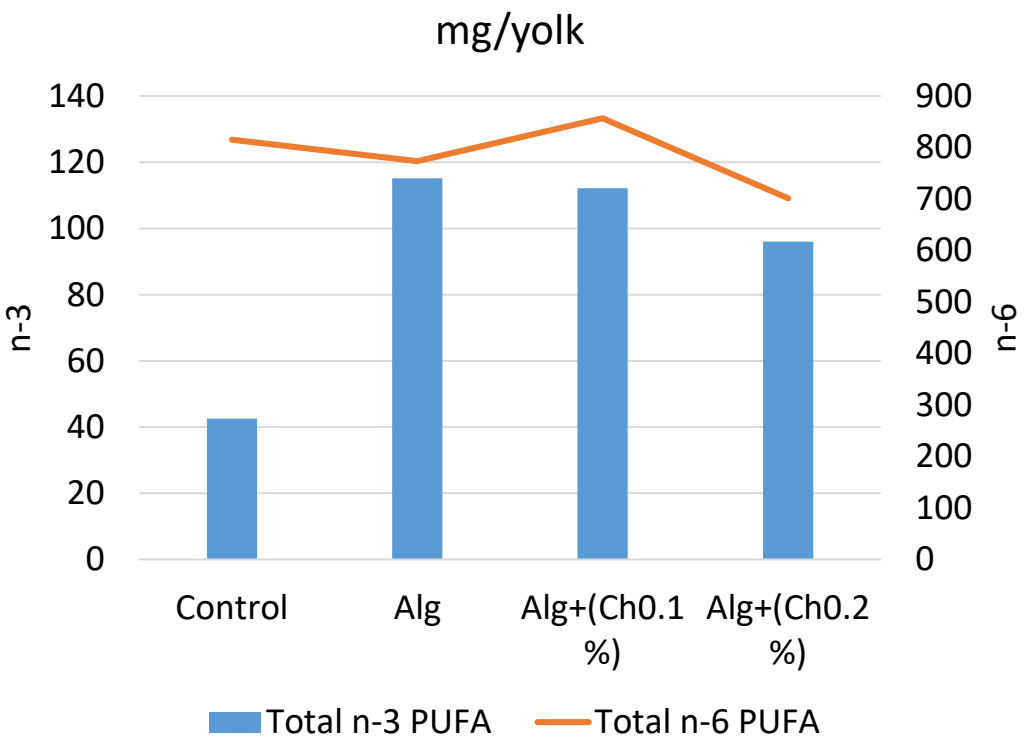




The results from the current study suggest that supplemental choline chloride in hen diets containing microalgae can improve production performance and egg quality, and protect the liver from oxidative stress.

British Poultry Science

ISSN: 0007-1668 (Print) 1466-1799 (Online) Journal homepage: http://www.tandfonline.com/loi/cbps20

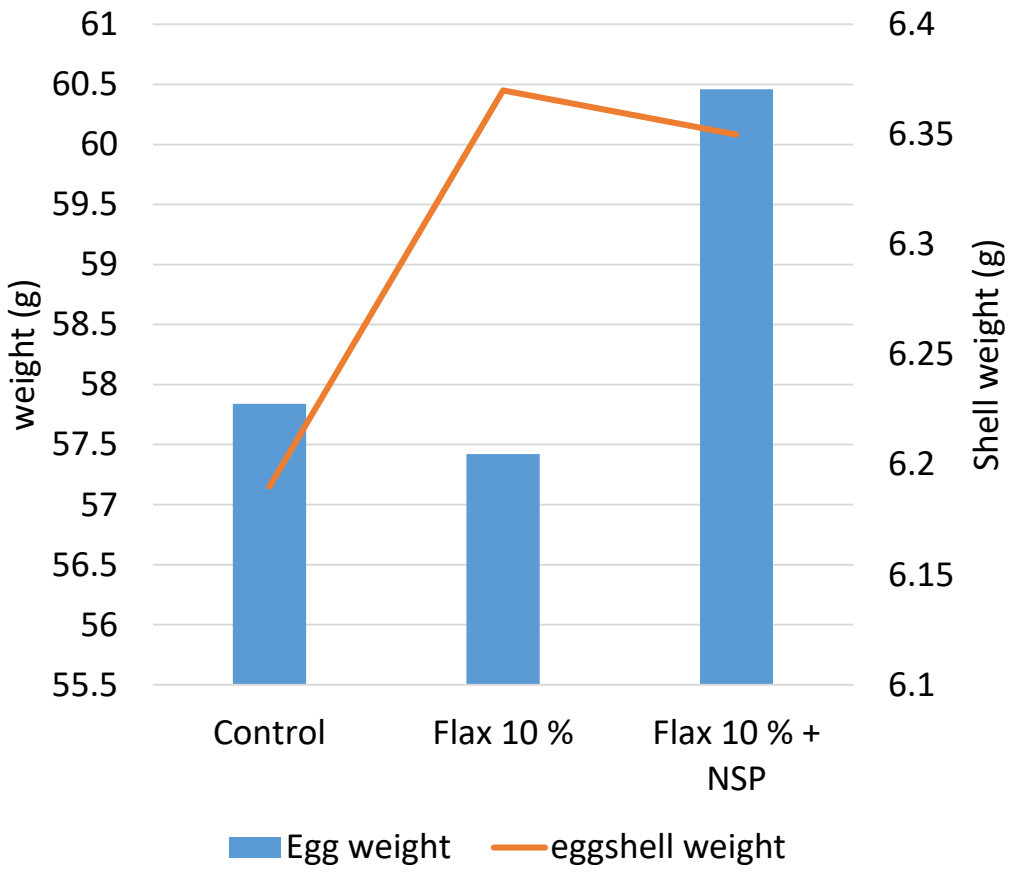
Egg quality, fatty acid composition and gastrointestinal morphology of layer hens fed whole flaxseed with enzyme supplementation

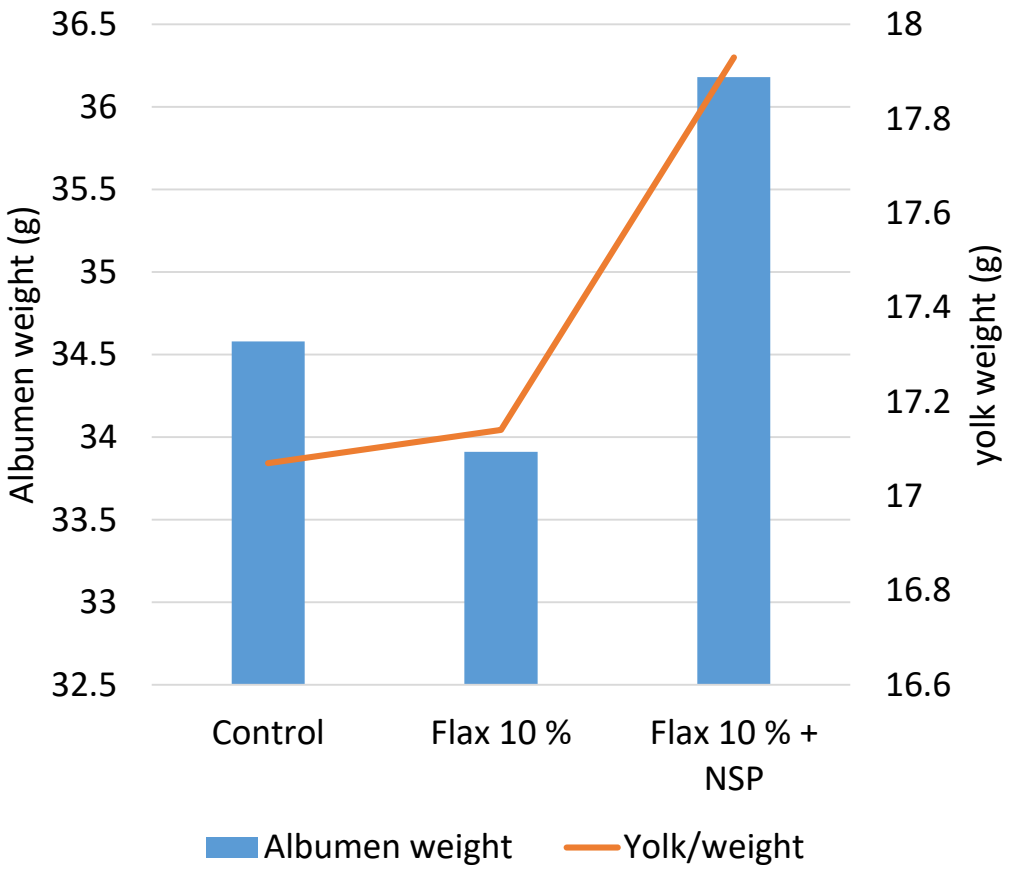
L. A. Westbrook & G. Cherian

To cite this article: L. A. Westbrook & G. Cherian (2018): Egg quality, fatty acid composition and gastrointestinal morphology of layer hens fed whole flaxseed with enzyme supplementation, British Poultry Science, DOI: 10.1080/00071668.2018.1556783

To link to this article: https://doi.org/10.1080/00071668.2018.1556783

Whole flaxseed with enzyme supplementation





51-week-old brown layer hens
six replicates/12 hen each

L. A. Westbrook & G. Cherian (2019) British Poultry Science, 60:2, 146-153

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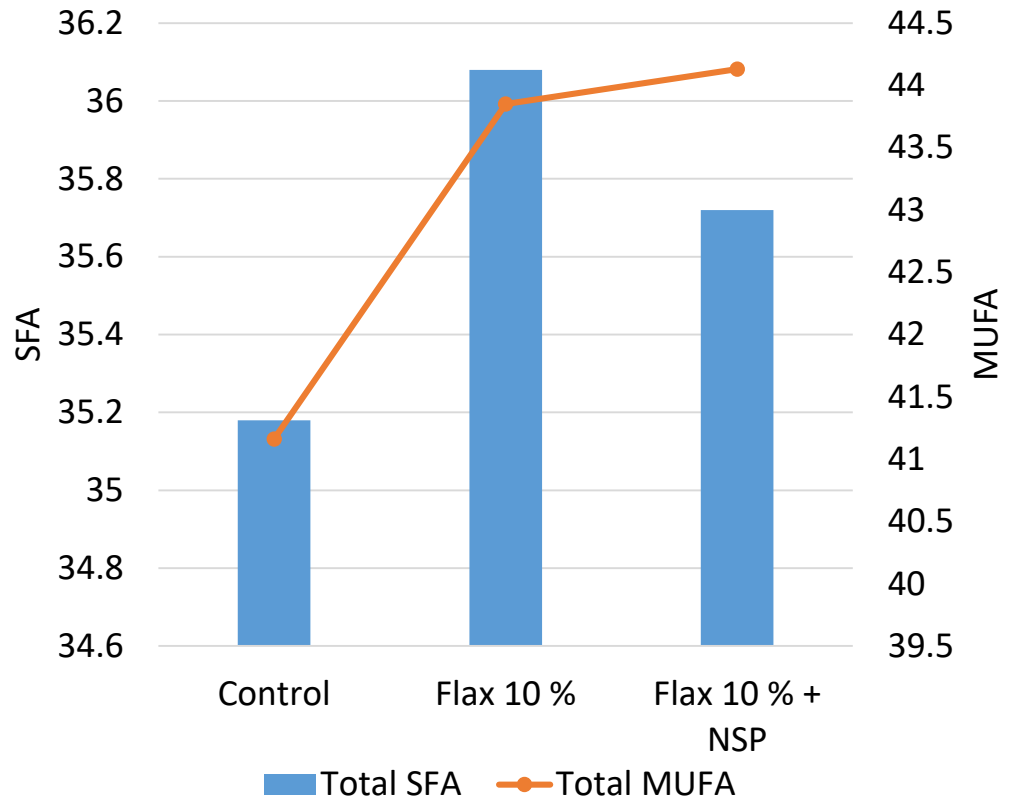

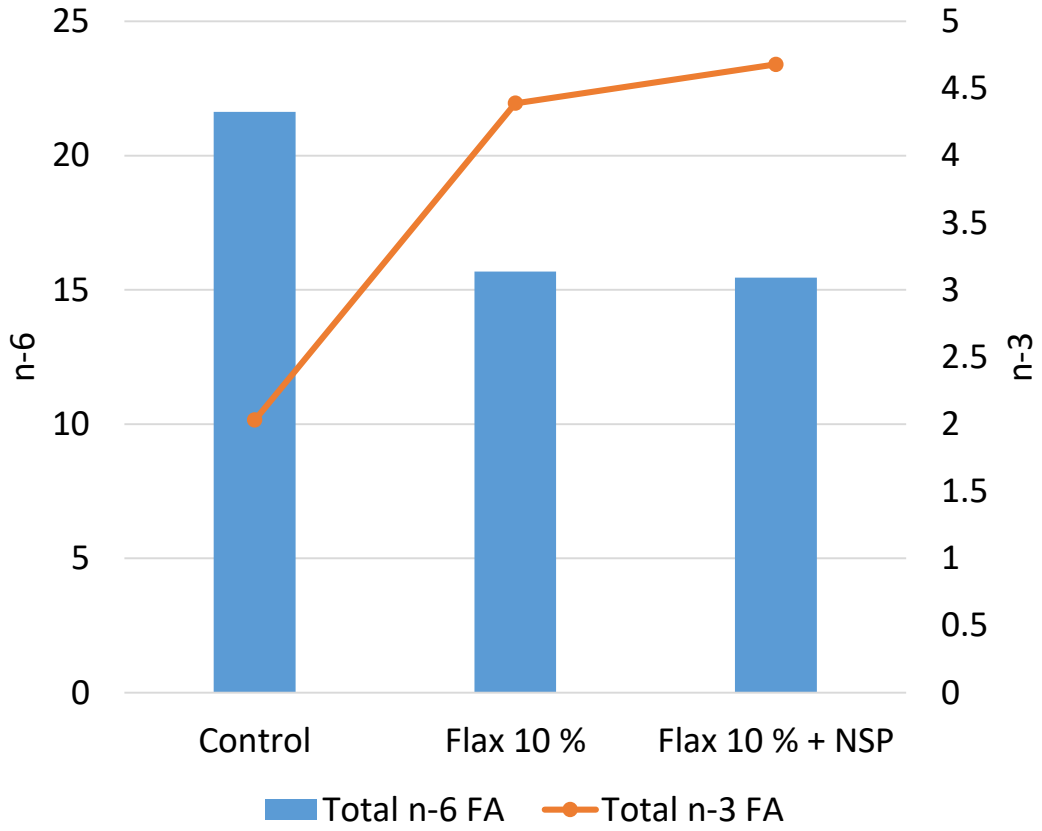

It was concluded that enzyme supplementation enhanced total n-3 FA deposition in eggs and liver and influence gastrointestinal morphology in layer hens fed flaxseed

Omega-3 Enriched Eggs

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SB Omega Gold Eggs

SB
OMEGA GOLD®
DHA OMEGA 3 - RICH EGGS

Docosahexaenoic Acid (DHA)

Docosahexaenoic acid (DHA) is an omega 3 fatty acid that is a primary structural component of the human brain and is essential for the growth and functional developlement of the brain in infants and for maintenance of normal brain fucntion in adults. SB DHA Omega 3 eggs are enriched in natural way with Selenium, Vitamin D and Vitamin E.

SB Omega Gold Eggs promote your health by adding folowing vital nutrients to your meal

DHA	• May help reduce risk of Heart disease. • Supports a healthy pregnancy
Vitamin D	• Regulate insulin levels and aid Diabetes management. • Maintain the health of bones and teeth. • Reduced risk of flu.
Vitamin E	• Improve Skin health and thickness of Hair. • Protects tissues against damage.
Selenium	• Selenium supplementation helps in reduction arthritis, cancer and diabetes.

Good for

- Preschoolers
- Growing Children
- Pregnant Women
- Adults
- Lactating Mothers

Nutritional Advantage:

Nutrient	In Regular Egg	DHA Omega 3 Rich Eggs
DHA	20-30 mg	110 mg
Vitamin E	0.5-1 mg	8 mg
Vitamin D	1-1.5 mg	3 mg
Selenium	10-12 mg	25-30 mg

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Nutritional advantage

Nutrient	In regular egg	In SB Omega Gold Egg	RDA %
DHA	20-30 mg	110 mg	> 50 %
Vitamin E	0.5-1 mg	8 mg	> 50 %
Vitamin D	1-1.5 mcg	3 mcg	> 50 %
Selenium	10-12 mcg	25-30 mcg	> 50 %

SB: The protein king

SB Eggs are Certified for

- ISO:22000:2005 FSMS
- HACCP Codex Alimentarius
- HACCP-Dutch
- Halal-PS-3733

SB Eggs in Market

- Packs of 30 Eggs Trays
- Pack of 6 Eggs Boxes
- Pack of 12 Eggs Boxes
- Omega-3 Fortified Eggs

- SB Eggs are being exported to:

  - Kingdom of Bahrain
  - Kingdom of Qatar
  - Muscat
  - Moroni Comoros East Africa

Managing gut health

- AGP
- Probiotic
- Prebiotic
- Organic acids
- Enzyme (NSPs, proteases, etc.)
- Fiber source

Insoluble fiber an “essential nutrient

Mateos et al. (2012):

- *“Moderate amounts of fiber might improve the development of organs, enzyme production, and nutrient digestibility in poultry.*

Feeding guidelines
Lohman, Ross recommend to use fiber for a certain purpose

- Effect on the gut flora through `feeding for gut health´
- Stabilization of digestion with a positive effect on litter condition and house climate
- Reduced percentage of dirty eggs due to sticky droppings
- Favorable impact on behavioral characteristics, such as aggressive pecking and cannibalism

British Poultry Science
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/cbps20

Effects of increasing the fibre content of a layer diet

O. G. Longe [a]

[a] Department of Animal Science , University of Ibadan , Ibadan, Nigeria

Published online: 24 Jun 2008.

Lohmann Information

Fibre in Layer Diets

Vol. 43 (2), Oct. 2008, Page 22

Fibre in Layer Diets

Robert Pottgüter, Lohmann Tierzucht GmbH, Cuxhaven, Germany

Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och husdjursvetenskap

Swedish University of Agricultural Sciences
Faculty of Veterinary Medicine and Animal Science

Effect of Insoluble Fibre Enrichment on Egg Quality in Laying Hens

Soluble versus insoluble fibers

- ***Soluble fibers***

➢ Lowers intestinal passage rate

➢ Reduces digestion of fat, protein and starch

➢ Constitutes an energy source for monogastric animals

➢ Affects the viscosity of the digesta

➢ Is mainly made of fermentable parts

➢ Reduces faecal dry matter contents

➢ Binds nutrients (pectin)

- ***Insoluble fibers***

➢ is a structuring fiber

➢ Accumulates in the gizzard. Regulates the passage of feed through the digestive tract

➢ Improves starch digestibility

➢ Increases intestinal passage rate

➢ Can only be poorly fermented

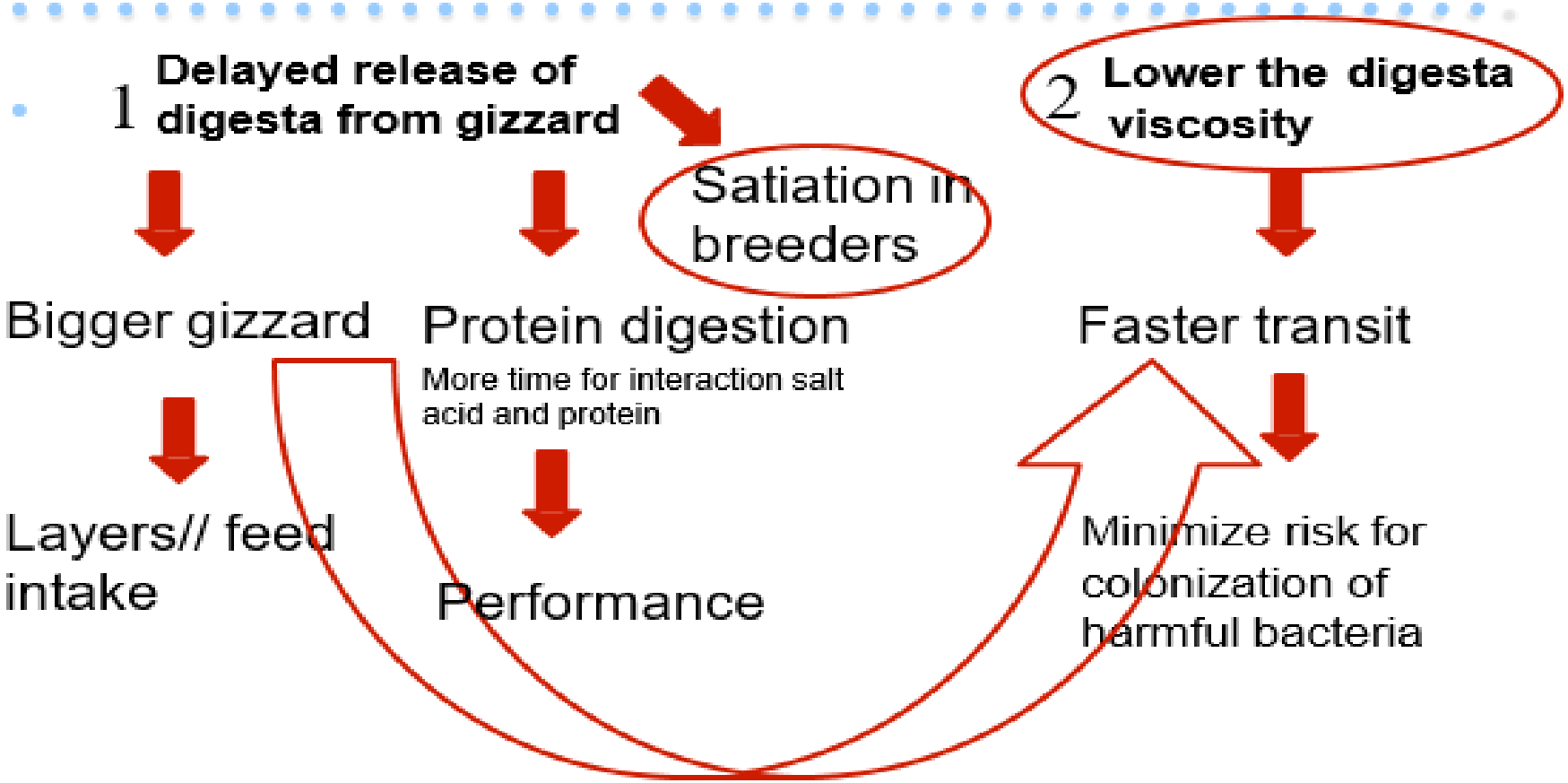
➢ Stimulates intestinal villi growth

➢ Does not constitute an energy source for young monogastric animals

➢ Increases faecal dry matter contents

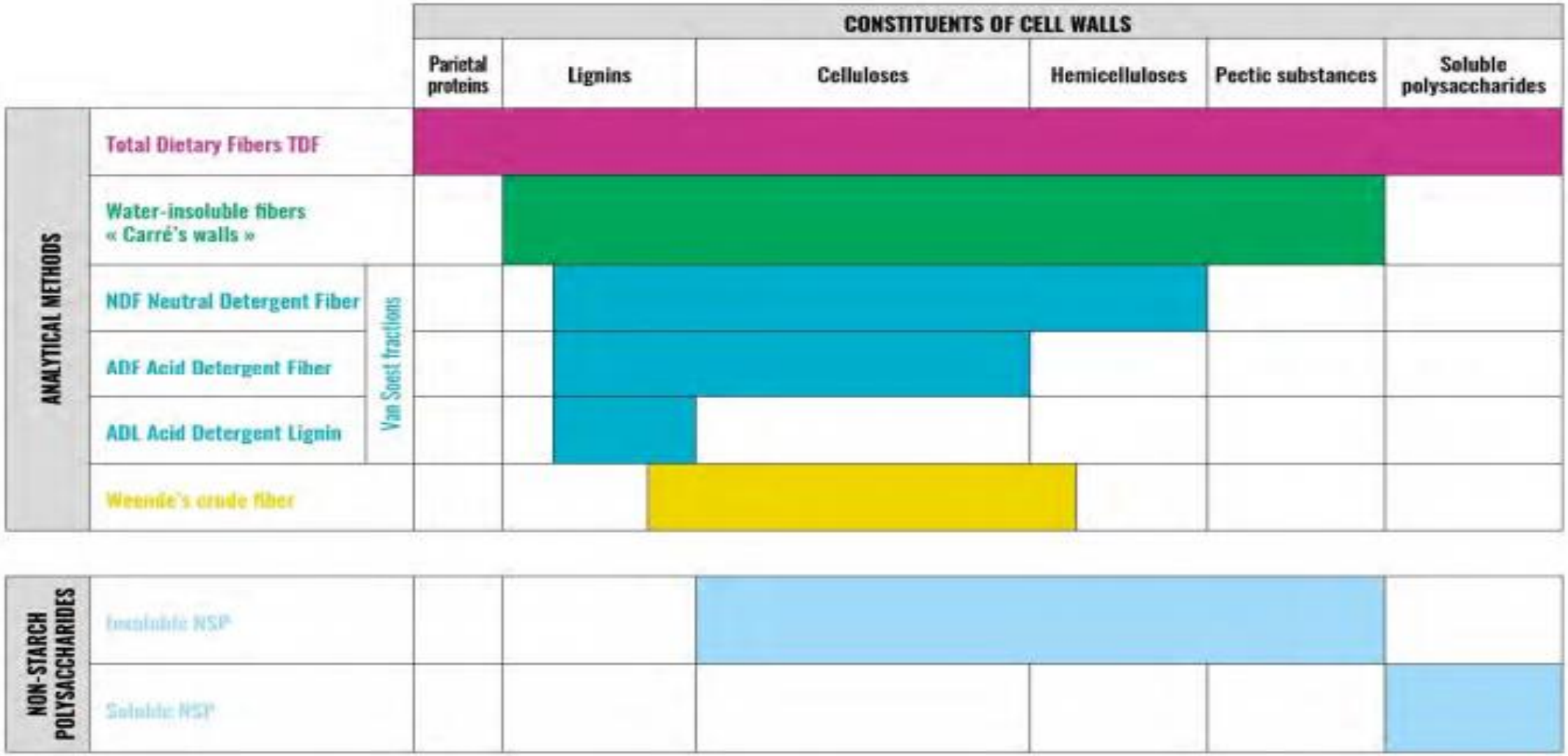
➢ Orientation and development of the microbiota

Insoluble fibers – main effects

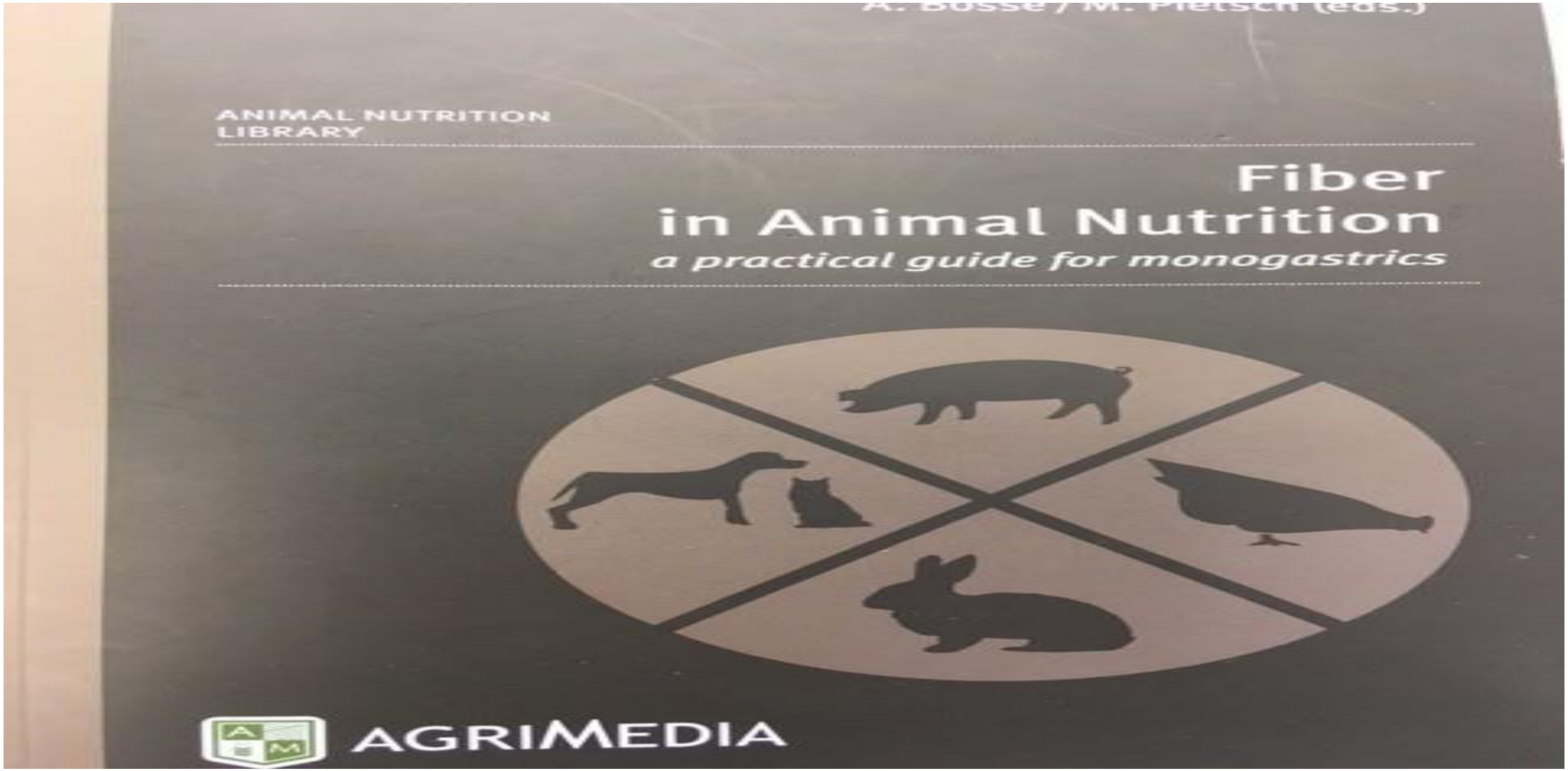


Soluble fibers have adverse effects: faster gizzard emptying, higher viscosity

Analysis methods and components of the vegetable walls



Fiber booklet for more and detailed information With chapters from some well known Professors



Prebiotic

- **Prebiotic** is any food component that escapes digestion in the small intestine enters the lower gut, where it may serve a growth substrate for intestinal bacteria (Gibson and Roberfroid, 1995**).**

Or

- A nondigestible food ingredient that beneficially that affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon and thus improves host health.

- Prebiotic that promote the growth of clostridia

Prebiotic

FOS = fructo-oligosaccharide

- Encourage growth of *lactobacillus*, *bifidobacterium*, suppress growth of *salmonella*

MOS = mannan-oligosaccharide

- Poorly fermentable sugar. Absorb enteric pathogens. Immunomodulation

GOS = galacto-oligosaccharide

XOS = xylo-oligosaccharide

Prebiotic

Mode of action

1. Directly target the colon .

2. Preferably by being utilized by promoting species and increased pathogen by feaces.

3. Selective fermentation
Maintaining balanced microflora .

4. Nutritional effects:
   - Absorption of fermentation product into the bloodstreem.

Probiotic

- *Live microorganisms which when administered in adequate amounts confer a health benefit on the host"*

  - *FAO/WHO, 2002*

- The most frequently used organisms for probiotic preparations are:
  - *Bacillus*
  - Lactic acid bacteria (LAB)
  - Live yeast

Effect of dietary supplementation of *Bacillus subtilis* DSM29784 on hen performance, egg quality indices, and apparent retention of dietary components in laying hens from 19 to 48 weeks of age

M. Neijat,* R. B. Shirley,† J. Barton,† P. Thiery,‡ A. Welsher,† and E. Kiarie*,1

*Department of Animal Biosciences, University of Guelph, Guelph, ON N1G 2W1, Canada; †Adisseo USA Inc., Alpharetta, GA 30022; and ‡Adisseo France, SAS, 92160 Antony, France

2019 Poultry Science 0:1–14
http://dx.doi.org/10.3382/ps/pez324

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Effect of probiotics on fecal excretion, colonization in internal organs and immune gene expression in the ileum of laying hens challenged with *Salmonella* Enteritidis

P. Adhikari,* C. H. Lee,† D. E. Cosby,‡ N. A. Cox,‡ and W. K. Kim§,1

*Department of Poultry Science, Mississippi State University, Starkville, MS 39762, United States of America; †Genebiotech Co., Ltd., Seoul, Republic of Korea; ‡USDA, ARS, The U.S. National Poultry Research Center, Athens, Georgia 30605, United States of America; and §Department of Poultry Science, University of Georgia, Athens, Georgia 30602, United States of America

2018 Poultry Science 0:1–8
http://dx.doi.org/10.3382/ps/pey443

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Microorganism (Probiotics)

- *Bacillus cereus var. Toyoi Enterococus faecium*
- *Pediococcus acidilactici*
- *Bacillus amyloliquefaciens*
- *Bacillus subtillis*
- *Saccharomyces cerevisiae*
- *Lactobacillus rhamnosus*
- *Lactobacillus fraciminis*

Probiotic

Mode of action

1. Competitive exclusion of pathogens

2. Improved immune status: production of antibacterial defensins and mucin

3. Maintain epithelial integrity and barrier function

4. Nutritional effects:
   - Production of enzymes
   - Production of vitamin B_{12} and K

O'Toole and Cooney (2008)

FEED-BORN MICROBIAL CONTAMINATION : SALMONELLA

it is estimated that about 15% of the Salmonella contaminations in poultry products are caused by feed.

Breeder feeds must be safe, it must therefore be treated systematically either by heat treatment, additives (acids, formaldehyde, etc...).

- Heat treatment particularly via pelleting
- Short chain fatty acids (formic, acetic, propionic and butyric acids)
- Formaldehyde
- medium chain fatty acids (C6 to C12; caproic, caprylic, capric and lauric acid).
- essential oils.
- probiotics, prebiotics and glycans .

MOULDS AND MYCOTOXINS

- Reduced weight gain and decrease of uniformity in rearing.
- Decrease serum proteins. Increased liver and kidney weights. Liver and kidney lesions.
- Induced immune-suppression/depression.
- Altered feathering.
- Reduced egg production, fertility and hatchability. Smaller day-old chicks.
- Low quality of day old chicks

Estimated minimum level of main mycotoxins to affect performances

Mycotoxin (ppm)	Pullets	Layers
Aflatoxin (B1)	50	20
Fumonisin (B1+B2)	1000	800
Ochratoxin	25	10
T2 Toxin	100	50
Vomitoxin (DON)	500	400
Zearalenone	75	50

Source: NOVOGEN Commercial & Parental Layer Nutrition Guide

Water Quality

Parameter	Poultry	
	Good quality	Do not use
pH	5 – 8,5	<4 and >9
Ammonium mg/l	<2,0	>10
Nitrite mg/l	<0,1	>1,0
Nitrate mg/l	<100	>200
Chloride mg/l	<250	>2000
Sodium mg/l	<800	>1500
Sulfate mg/l	<150	>250
Iron mg/l	<0,5	>2,5
Mangane mg/l	<1,0	>2,0
Lime/chulk content	<20	>25
Oxidizable organic matter mg/l	<50	>200
H_2S	non detectable	non detectable
Coliform bacteria's cfu/ml	<100	>100
Total bacteria count cfu/ml	<100.000	>100.000

Acidification of water improves gut health

- There are two key aspects to clean and healthy water on-farm:

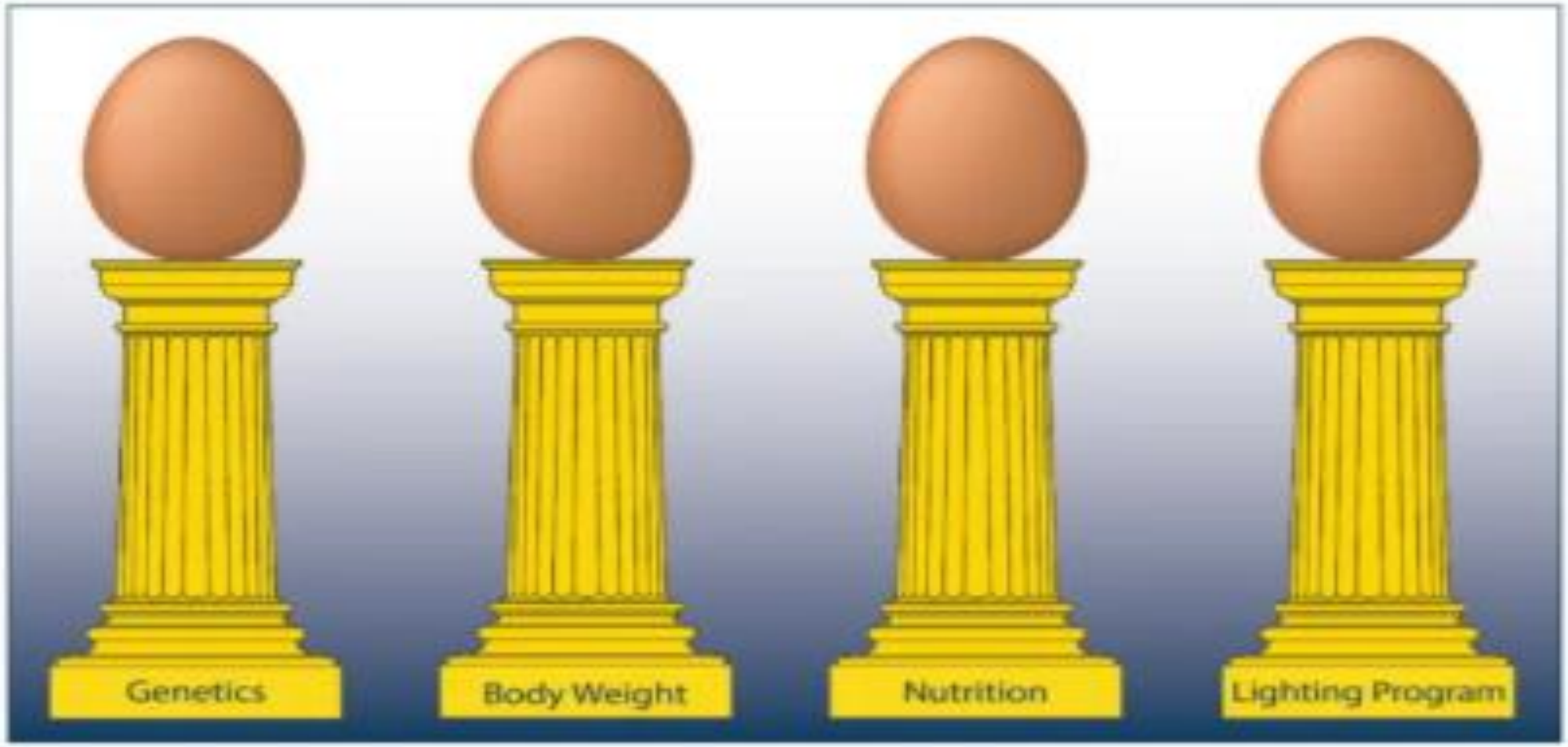
1. Terminal hygiene at turnaround
2. Ongoing water treatments like organic acids.

Testing the water	
Optimum pH level	The optimum pH is between 5 and 6.
Water softening equipment	Typically, water softening equipment uses ion exchange to remove the calcium and magnesium ions and replace them with sodium ions

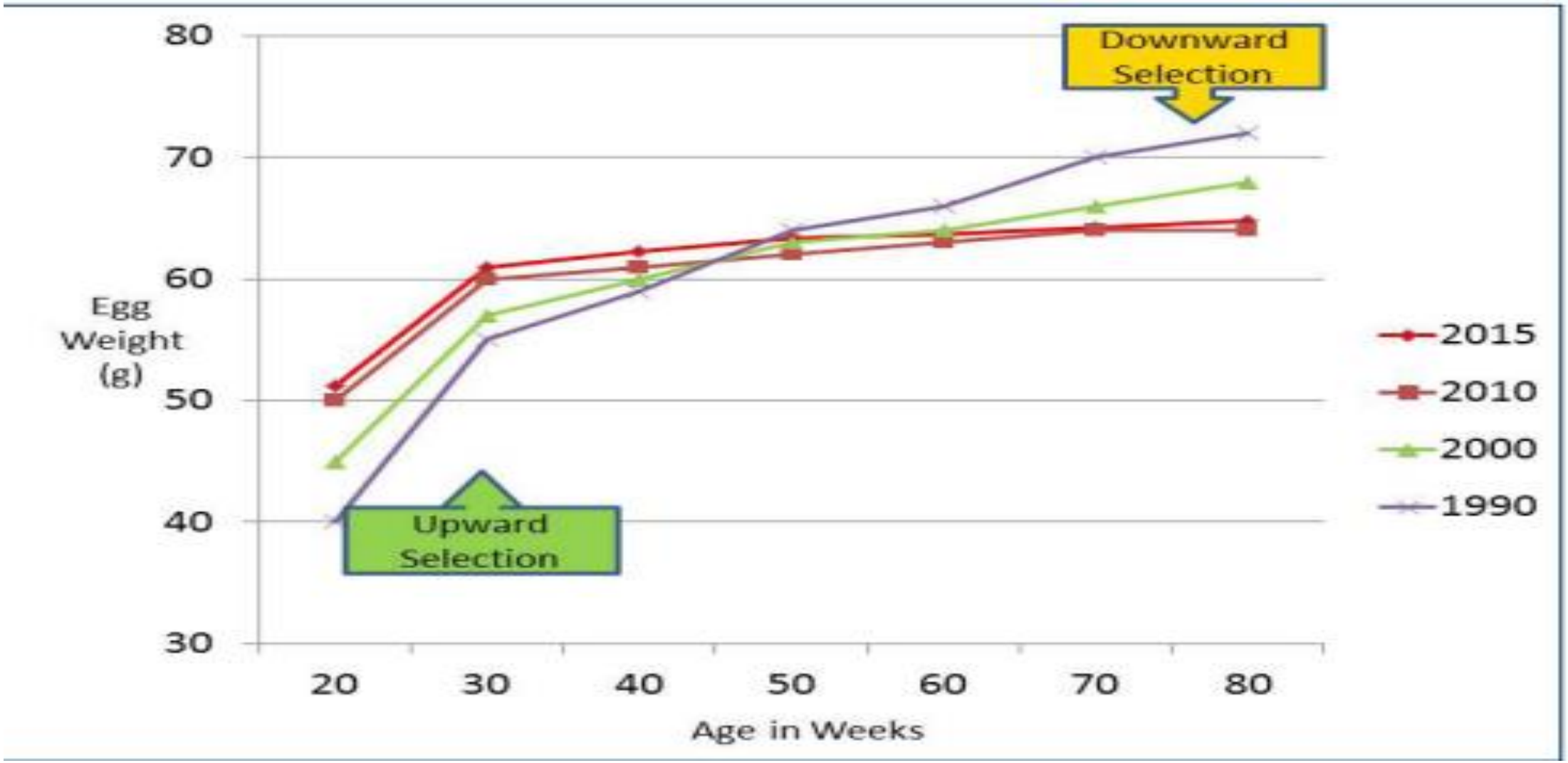
Conti.

Continual sanitation	Water treatment options include ultraviolet filters, electrolyzed water, chlorine dioxide, and chlorine tablets and hydrogen peroxide
Organic acids	they help sanities the water break down lime scale promote gut health
Reducing pH with organic acids	Organic acids available: Formic acid and propionic acid are particularly effective at controlling E.coli and Salmonella, whereas lactic acid and butyric acid are important in promoting beneficial lactobacilli in the gut microflora.
Automated dosing system to ensure safety	Automated dosing system which alleviates the need for manual handling and measuring

OPTIMIZING EGG SIZE IN COMMERCIAL LAYERS



Eggs weight change of Hy-line



Nutrition

- Nutrition during the rearing and laying period has a critically important role in egg weight.

- Proper rearing nutrition allows the hen to achieve or exceed the standard body weights.

- Changing the rearing diets based on attaining body weight standards (and not bird age) will best match the diet to the actual nutritional needs of the pullet.

www.hyline.com.

During the laying period

- Energy, methionine/cystine, other digestible amino acids, linoleic acid, and total fat can directly affect the egg size.
- These components can be specified in layer diets to influence egg size downwards or upwards.
- To avoid excessively large egg size and weak egg shells later in the laying period, these nutrients are gradually reduced after peak egg production (30 weeks of age).

Management for larger egg size

- Provides 10–15% higher digestible amino acid intake (mg of digestible amino acid per bird per day) than recommended in the guide.
- Increase the ratio of methionine + cystine to lysine to be >90%.
- Use 1.5 g linoleic acid per bird per day.
- Keep an optimal energy intake.

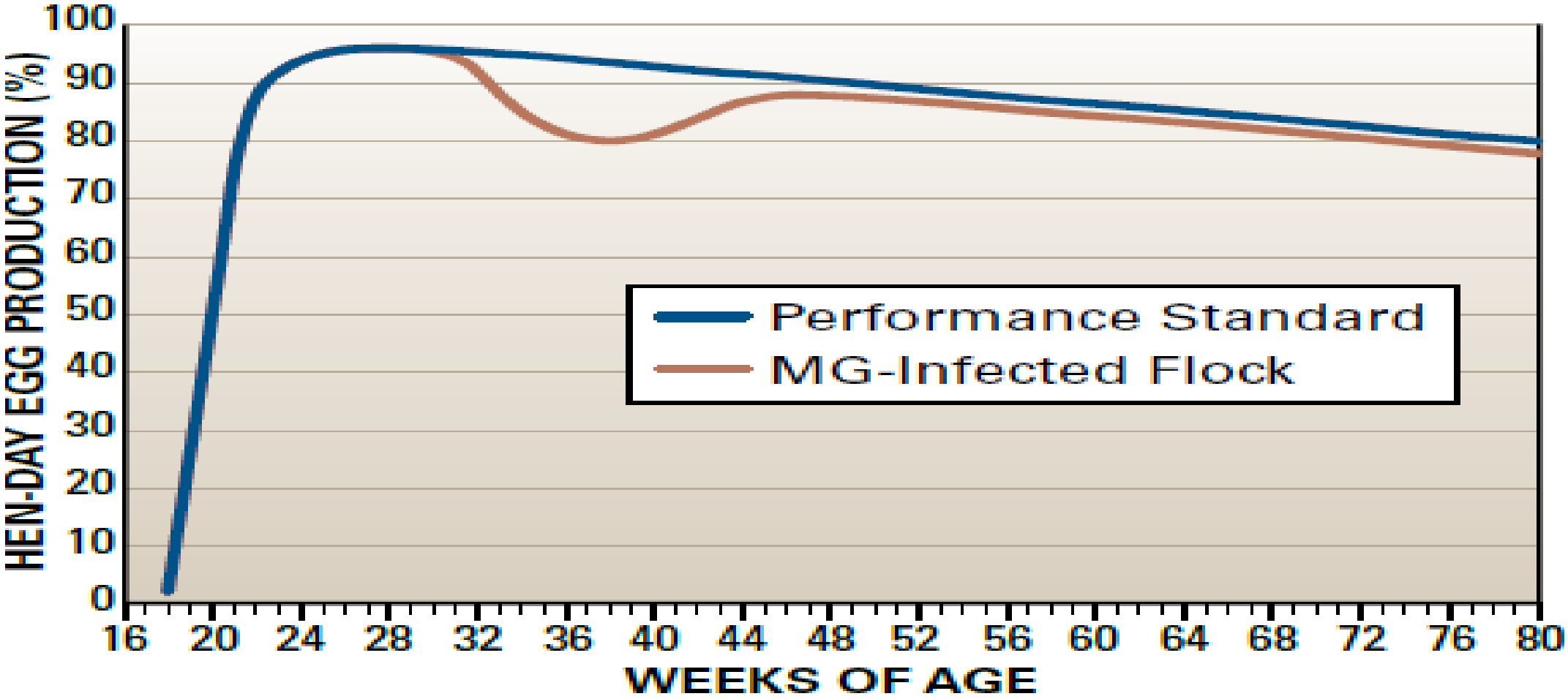
Management for smaller egg size

- Make larger gradual reductions in energy, methionine/cystine, and total digestible amino acids during the phase feeding program.
- Reduce methionine + cystine to lysine ratio (<84%).
- Control total digestible amino acid intake.
- Limit linoleic acid intake to 0.9 g/day per bird.

MG CONTROL IN COMMERCIAL LAYERS

- *Mycoplasma gallisepticum* (MG) is a common respiratory disease in commercial layers around the world.
- MG can be transmitted vertically from infected breeders through the hatching egg to the chicks, horizontally from bird-to-bird, from contaminated surfaces.
- Serology testing utilizing the plate agglutination, hemagglutination-inhibition (HI), or ELISA methods will detect antibodies specific to MG.
- Other laboratory methods, such as culture or PCR, are a direct indication of the presence of the MG organism.

Production Results in MG Infected Flock (Ref: Hyline)



TREATMENT

- Since MG is a bacterium, acutely affected flocks can be treated with antibiotics.

- treatment options include tylosin, tetracyclines, tiamulin, fluoroquinolones and possibly others.

Fatty liver hemorrhagic syndrome

- Fatty liver hemorrhagic syndrome (FLHS) is a noninfectious disease.
- Accumulation of fat in the liver and abdominal cavity, causing liver rupture, hemorrhage and sudden death of hens.
- Factors related to nutrition, genetics, environment, and hormonal influences have been proposed.
- It is suspected that a combination of these factors is needed to cause FLHS

Conti.

- Layer diets should contain adequate levels of Vitamin E (50-100IU/kg) and selenium (0.3ppm) to ensure adequate levels of antioxidants to prevent tissue rancidity.

- Supplementation with lipotropic agents such as choline (500mg/kg), methionine (0.1%), and Vitamin B12 help to mobilize fat from the liver, and support recovery in affected hens

Lipotropic Nutrients

- Methionine, choline, inositol, Vitamin B12, biotin, L-trytophan, carnitine, and selenium are essential for proper liver function and fat metabolism.
- Supplementation of these nutrients in the diet or in birds' drinking water has been used as a treatment for FLHS with variable success.

Examples of some biotechnological applications

Application	Aim(s) of developing the technology
New ingredients	Production of microbial proteins as new feed sources in animal feeding (e.g. single cell protein, yeast protein).
Designer ingredients	Nutritional enhancement (e.g. high-oil maize, high-methionine lupins) or reduction in the level of anti-nutritive components in common feed ingredients (e.g. low-phytate maize)
Crystalline amino acids	To increase dietary supply of specific amino acid and improve protein balance in diet formulations

Velmurugu Ravindran. : An Overview

Conti.

Gut ecosystem enhancers Probiotics Prebiotics	To promote the establishment of a desirable gut ecosystem through the proliferation of beneficial species (e.g. direct-fed microbials). To competitively exclude harmful organisms and promote the establishment of a desirable gut ecosystem (e.g. mannan oligosaccharides).
Antimicrobials	To suppress the growth of harmful bacteria and promote the establishment of a desirable gut flora balance (e.g. antibiotics)
Feed enzymes	To improve availability of nutrients (energy, amino acids, phosphorus etc) in feed ingredients by reducing the negative effects of anti-nutritive components (e.g. microbial phytases acting on phytate, xylanases acting on arabinoxylans in wheat).

Biotechnological applications with future potential in animal nutrition

Application	Aim(s) of developing the technology
Introduction of new gut microbes	To introduce new species or strains of microorganisms into the gut.
Bioactive peptides	Improved growth and efficiency (e.g. growth hormone-releasing peptides), improved gut function, immunomodulation, antibacterial properties
Modification of gut microbes	To genetically modify microorganisms naturally present in the gut to enhance their capacity for defined functions or add new functions (e.g. rumen microbes to improve cellulose digestion).

Conti..

Antimicrobial replacers	**Antimicrobial enzymes (e.g. lysozyme), delivery of specific antibodies via spray-dried plasma and egg products**
Transgenesis	To modify nutrient metabolism and improve growth efficiency by transfer of genes

THANK YOU