
NC STATE UNIVERSITY
Prestage Department of Poultry Science
Oviedo's Lab
Developing Leadership *for the Global Marketplace*


NutriForum25
Modelaje matemático en nutrición aviar:
Estado actual, beneficios y limitaciones
Edgar O. Oviedo-Rondón
MVZ, MSc., PhD, Dipl. ACPV, MBA
Profesor / Extension Specialist, University Faculty Scholar

Agenda

- Principales metodologías para tomar decisiones nutricionales en avicultura.
- Evolución de los modelos
- Estructura y capacidad de modelos actuales
- Perspectivas futuras

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Toma de Decisiones en Nutrición

Rentabilidad del negocio

Lucro de la Empresa, Costo/Beneficio

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Niveles de nutrientes se deben determinar de acuerdo al Centro de Ingresos

Factores a considerar:

1. Respuesta biológica de las aves
2. Costos de alimento
3. Otros costos
4. Ingresos

Cálculo margen de beneficio:

- Granja
  - Alimento + Pollitos
- Carcasas evisceradas
  - Alimento + pollito + Procesamiento
- Cortes en porciones
  - Alimento + Pollito + Procesamiento completo.

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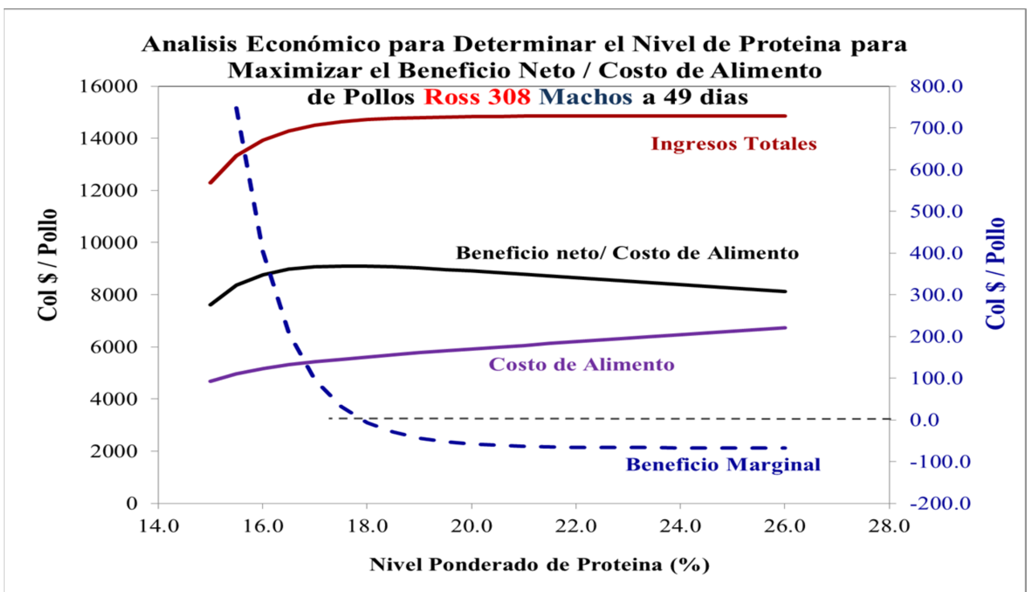
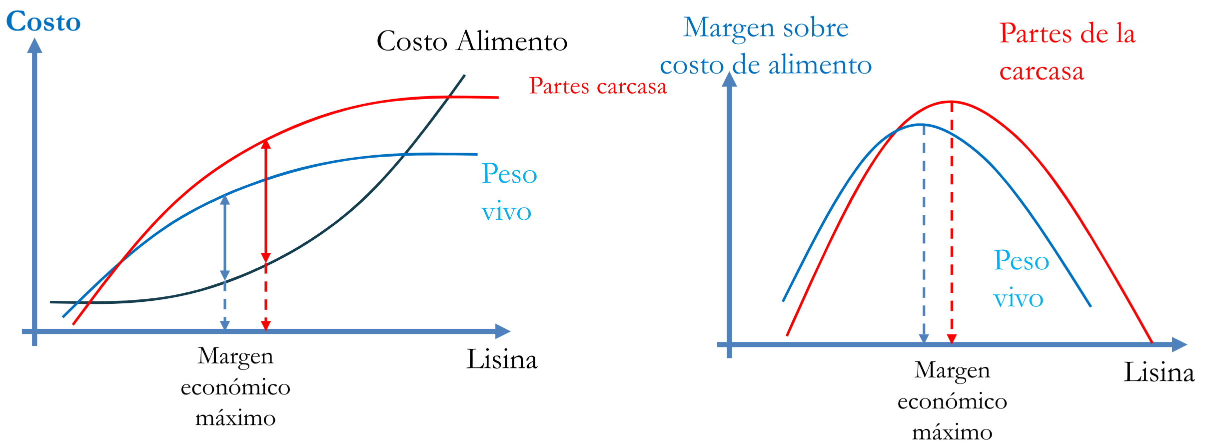
Aumento del precio de pollo a $3.750/kg Proteína Optima Macho 17,63%



Optimización para maximizar retorno económico

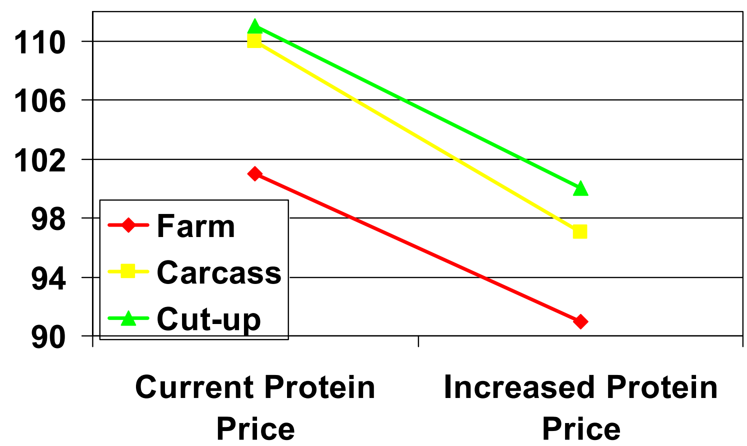


Densidad optima de aminoácidos (%) para pollos sin sexar

Centro de ingresos	1.7 kg	2.5 kg	3.0 kg
Granja	96	96	96
Carcas eviscerada	**97**	**99**	**102**
Cortes	98	102	103

Basado en costos e ingresos en Asia

Densidad óptima de aminoácidos (%) para pollos machos de 3 kg



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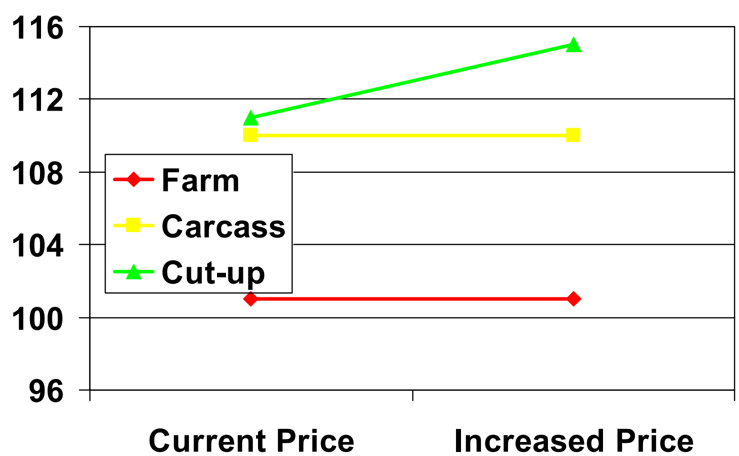
Densidad optima de aminoácidos (%) para pollos machos de 3 kg con aumento en el precio de pechuga



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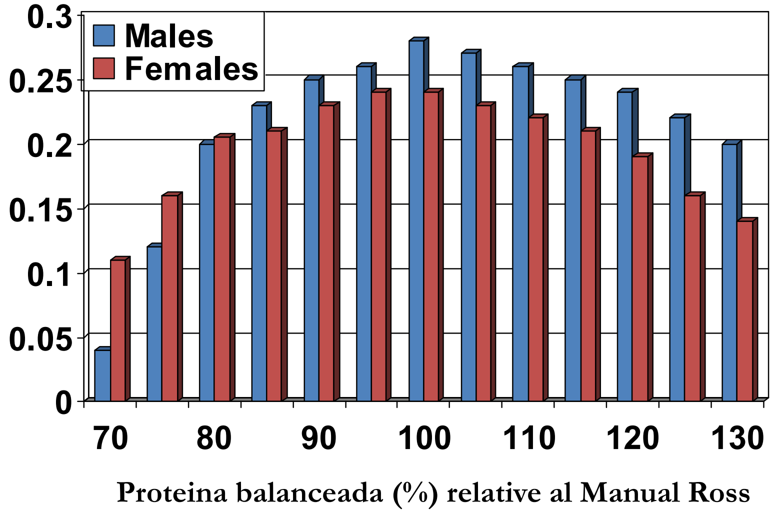
Margen a nivel de granja ($/ave) para pollos machos y hembras alimentados con diferentes niveles de proteina balanceada



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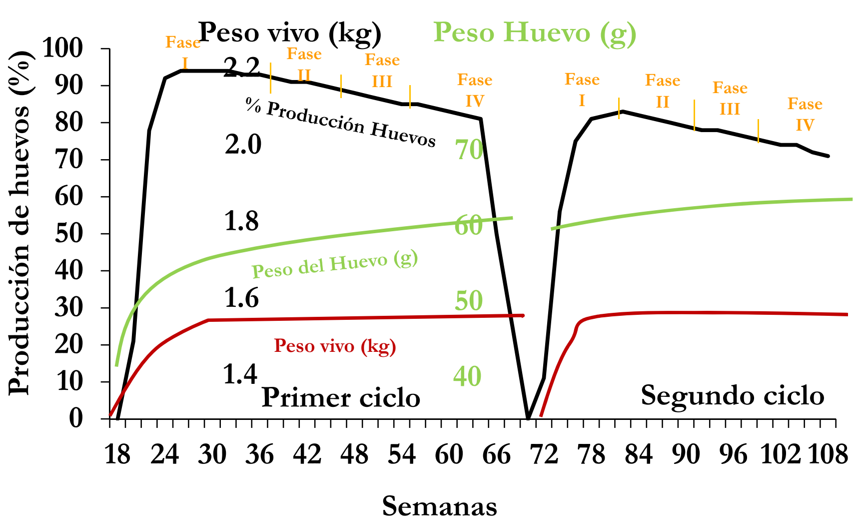
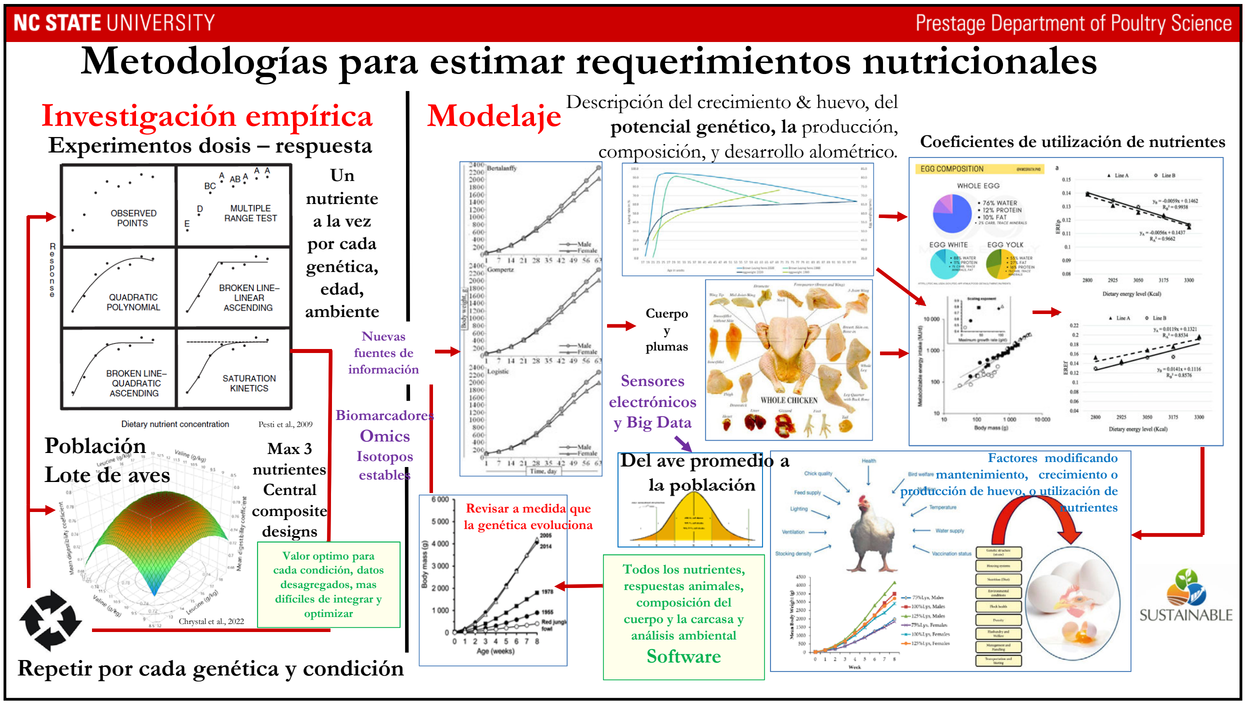
Factores a Considerar en Produccion de Huevo

Fase, Nivel de Producción, Peso de la gallina, Distribución del Peso del Huevo

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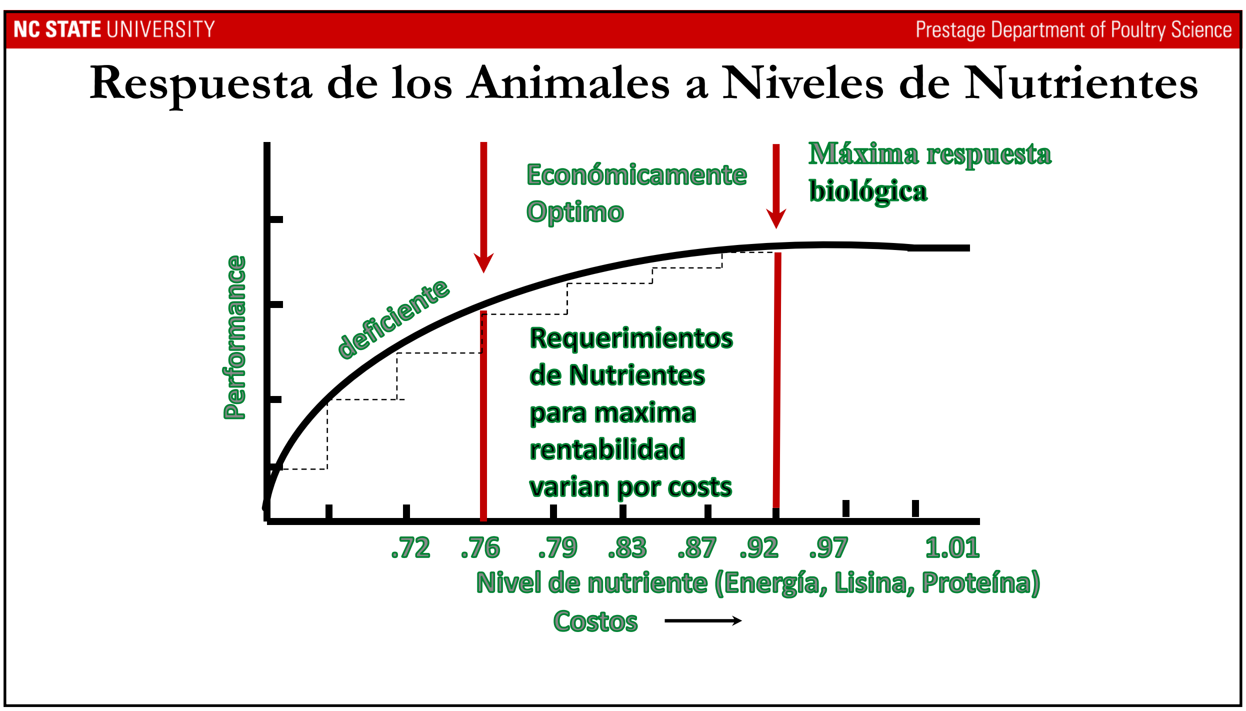
Metodologías para estimar requerimientos nutricionales
Investigación empírica
Experimentos dosis – respuesta
OBSERVED POINTS
MULTIPLE RANGE TEST
QUADRATIC POLYNOMIAL
BROKEN LINE–LINEAR ASCENDING
BROKEN LINE–QUADRATIC ASCENDING
SATURATION KINETICS
Response
Dietary nutrient concentration
Pesti et al., 2009
Un nutriente a la vez por cada genética, edad, ambiente
Población
Lote de aves
Max 3 nutrientes
Central composite designs
Chrystal et al., 2022
Valor optimo para cada condición, datos desagregados, mas difíciles de integrar y optimizar
Repetir por cada genética y condición
Nuevas fuentes de información
Biomarcadores
Omics
Isotopos estables
Modelaje
Descripción del crecimiento & huevo, del potencial genético, la producción, composición, y desarrollo alométrico.
Bertalanffy
Gompertz
Logistic
Time, day
Cuerpo y plumas
WHOLE CHICKEN
Sensores electrónicos y Big Data
Del ave promedio a la población
Coeficientes de utilización de nutrientes
EGG COMPOSITION
WHOLE EGG
EGG WHITE
EGG YOLK
Factores modificando mantenimiento, crecimiento o producción de huevo, o utilización de nutrientes
Revisar a medida que la genética evoluciona
Age (weeks)
Body mass (g)
Todos los nutrientes, respuestas animales, composición del cuerpo y la carcasa y análisis ambiental
Software
SUSTAINABLE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Respuesta de los Animales a Niveles de Nutrientes
Económicamente Optimo
Máxima respuesta biológica
deficiente
Requerimientos de Nutrientes para maxima rentabilidad varian por costs
Performance
.72 .76 .79 .83 .87 .92 .97 1.01
Nivel de nutriente (Energía, Lisina, Proteína)
Costos

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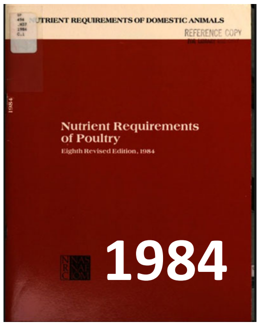
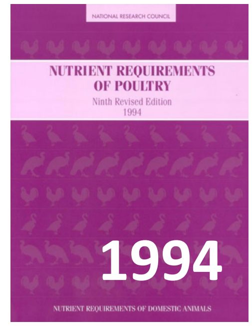
Larga historia usando modelos matemáticos en nutrición avícola



BARD
44 years
The United States - Israel Binational Agricultural Research and Development Fund



4 Referencias de modelos matemáticos → **Cerca de 300 Ref de Modelos matemáticos**

Hurwitz, S., and S. Bornstein. 1973. The protein and amino acid requirements of laying hens: Suggested models for calculation. Poult. Sci. 52:1124–1134.
Hurwitz, S., and S. Bornstein. 1977. The protein and amino acid requirements of laying hens: Experimental evaluation of models of calculation. 1. Application of two models under various conditions. Poult. Sci. 56:969–978.
Smith, W. K. 1978. The amino acid requirements of laying hens: Models for calculation. 2. Practical application. World's Poult. Sci. J. 34:129–136.

Scientifically based knowledge about many nutrient requirements is incomplete. Consequently, calculations and interpolations were necessary to derive estimated requirements. These nutrient requirements were derived mostly from empirical observations of responses of poultry to changes in dietary concentrations or intakes of specific nutrients. In some instances, nutritional models were used to estimate amino acid requirements.

Few nutritional models are available for poultry, primarily because data to support the development of these models are scarce. There are, however, modeling equations for estimating the energy and amino acid requirements of poultry. Hurwitz et al. (1978) integrated the energy and amino acid needs of broiler chicks to develop a mathematical model for predicting amino acid requirements. Models for estimating the amino acid requirements of growing turkeys were proposed by Fisher (1982a) and Hurwitz et al. (1983a). Modeling equations also have been developed for predicting the energy requirements (National Research Council, 1987a) and amino acid requirements (Hurwitz and Bornstein, 1973) of laying hens. Additional research is needed to determine maintenance requirements and partial efficiency of nutrient use for growth versus egg production.

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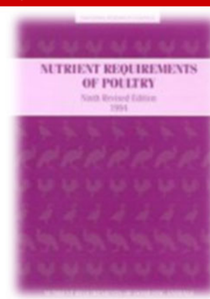
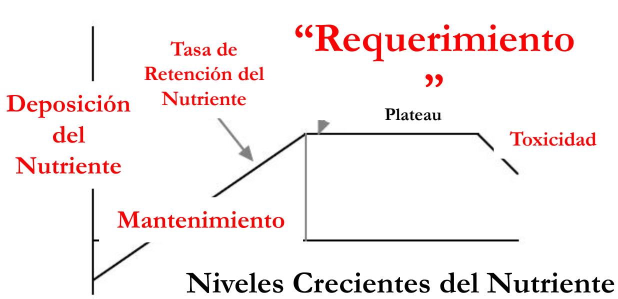
"Exigencias Nutricionales" estimadas para respuesta biológica máxima o deseada, pero no permiten estimar rentabilidad del negocio cuando las condiciones cambian





Recomendaciones Nutricionales de Manuales

ROSS BROILER NUTRITIONAL RECOMMENDATIONS

3.5 lb (1.6 kg) FEMALE BROILERS

	STARTER		GROWER		FINISHER		
% of Total feed	17%		40%		43%		
FEMALE BROILERS[1]	0-14D		15-25D		26-MKT		TOTAL
Amount fed - lb	1.0		2.0		2.4		5.4
Amount fed - kg	0.4		1.0		1.1		2.5
Approx. days on feed	15		11		9		35
ME kcal/kg	3086		3152		3196		
ME kcal/lb	1400		1430		1450		
ME MJ/kg	12.91		13.19		13.37		
Protein, %	22.00		20.00		18.00		
AMINO ACIDS	TOTAL	AVAILABLE	TOTAL	AVAILABLE	TOTAL	AVAILABLE	
Lysine, %	1.35	1.21	1.10	0.98	1.01	0.90	
Methionine, %	0.53	0.46	0.43	0.38	0.40	0.36	
MET+CYS, %	0.97	0.86	0.79	0.70	0.75	0.66	
Threonine, %	0.87	0.77	0.70	0.63	0.67	0.59	
Isoleucine, %	0.91	0.81	0.74	0.66	0.68	0.59	
Arginine, %	1.46	1.32	1.19	1.07	1.11	0.99	
Valine, %	1.04	0.92	0.85	0.74	0.78	0.68	
Tryptophan, %	0.22	0.19	0.18	0.15	0.17	0.15	
Calcium, %	1.00		0.90		0.85		
Avail. Phosphorus, %	0.50		0.45		0.42		
Sodium, %	0.21		0.21		0.21		
Chloride, %	0.17		0.17		0.17		
Potassium, %	0.40		0.40		0.40		
Choline, ppm	1550		1500		1400		

[1]Assumes 3.5 lb (1.6 kg) female broilers at 34 days with 1.56 FCR

ROSS BROILER NUTRITIONAL RECOMMENDATIONS

6.6 lb (3.0 kg) STRAIGHT-RUN AND MALE BROILERS

	STARTER		GROWER		FINISHER		WITHDRAWAL		
% of Total feed	8%		18%		39%		36%		
STRAIGHT-RUN BROILERS[1]	0-14D		15-26D		27-40D		41-MKT		TOTAL
Amount fed - lb	1.0		2.2		4.8		4.5		12.5
Amount fed - kg	0.5		1.0		2.2		2.0		5.7
Approx. days on feed	15		12		14		13		54
MALE BROILERS[2]	0-14D		15-24D		25-38D		39-MKT		
Amount fed - lb	1.0		2.1		4.6		4.2		12.0
Amount fed - kg	0.5		1.0		2.1		1.9		5.4
Approx. days on feed	15		11		14		12		52
ME kcal/kg	3042		3141		3196		3218		
ME kcal/lb	1380		1425		1450		1460		
ME MJ/kg	12.73		13.14		13.37		13.46		
Protein, %	22.00		20.00		17.50		16.50		
AMINO ACIDS	TOTAL	AVAILABLE	TOTAL	AVAILABLE	TOTAL	AVAILABLE	TOTAL	AVAILABLE	
Lysine, %	1.35	1.21	1.18	1.05	1.06	0.95	1.01	0.91	
Methionine, %	0.53	0.46	0.46	0.41	0.42	0.37	0.42	0.37	
MET+CYS, %	0.97	0.86	0.85	0.75	0.78	0.69	0.77	0.68	
Threonine, %	0.87	0.77	0.76	0.67	0.70	0.62	0.69	0.61	
Isoleucine, %	0.91	0.81	0.79	0.70	0.71	0.62	0.71	0.62	
Arginine, %	1.46	1.32	1.28	1.15	1.16	1.04	1.11	0.98	
Valine, %	1.04	0.92	0.91	0.80	0.81	0.72	0.78	0.69	
Tryptophan, %	0.22	0.19	0.19	0.16	0.18	0.15	0.17	0.15	
Calcium, %	1.00		0.90		0.85		0.76		
Avail. Phosphorus, %	0.50		0.45		0.42		0.37		
Sodium, %	0.20		0.20		0.20		0.19		
Chloride, %	0.17		0.17		0.17		0.17		
Potassium, %	0.40		0.40		0.40		0.40		
Choline, ppm	1550		1500		1400		1250		

[1]Assumes 6.6 lb (3.0 kg) straight-run broiler at 53 days with 1.90 FCR
[2]Assumes 6.6 lb (3.0 kg) male broiler at 50 days with 1.81 FCR

Cobb 500 Broiler Performance & Nutrition Supplement

Broiler Nutrition

Recommended Broiler Feed Formulation

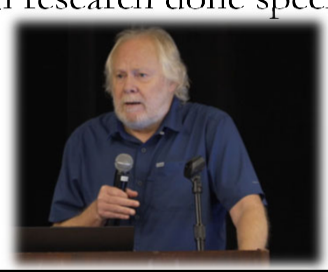
		Starter	Grower	Finisher 1	Finisher 2
FEEDING AMOUNT/bird		250 g	1000 g		
FEEDING PERIOD days		0 - 10	11 - 22	23 - 42	42 +
Crude Protein	%	21.00	19.00	18.00	17.00
Metabolizable	Kcal/lb	1358	1401	1444	1444
Energy	Kcal/kg	2988	3083	3176	3176
Lysine	%	1.20	1.10	1.05	1.00
Digestible Lysine	%	1.08	0.99	0.95	0.90
Methionine	%	0.46	0.44	0.43	0.41
Digestible Methionine	%	0.41	0.40	0.39	0.37
Met + Cys	%	0.89	0.84	0.82	0.78
Digestible Met + Cys	%	0.80	0.75	0.74	0.70
Tryptophan	%	0.20	0.19	0.19	0.18
Threonine	%	0.79	0.74	0.72	0.69
Arginine	%	1.26	1.17	1.13	1.08
Calcium	%	1.00	0.96	0.90	0.85
Available Phosphorus	%	0.50	0.48	0.45	0.42
Sodium	%	0.22	0.19	0.19	0.18
Chloride	%	0.20	0.20	0.20	0.20
Cal: Protein Ratio		142	162	176	187

Nutrient Requirements of Poultry: 10th Revised Edition

NATIONAL ACADEMIES Sciences Engineering Medicine

… **Dynamic computer models need to be further developed** so that nutrient requirements can be predicted based on specifics of genetics, desired growth rates, body compositions, management, and marketing considerations.

The models should be based on research done specifically for parametrizing them…



Kirk C. Clasing,
Committee Chair

July 15, 2024

Available online PSA August 27

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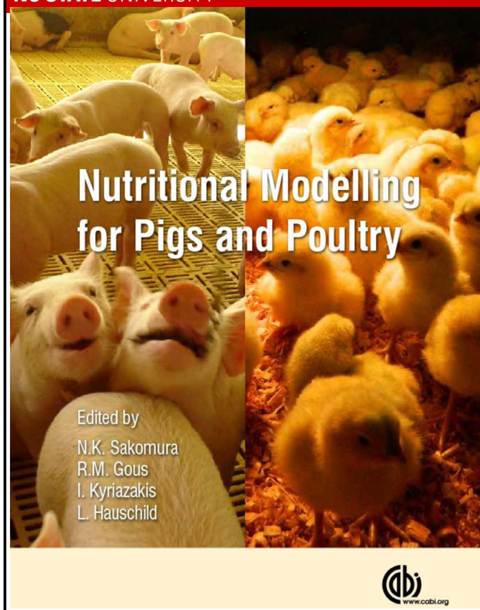

International Symposium of Modelling in Pig and Poultry Production (2013 : São Paulo, Brazil), author.

ISBN 978-1-78064-411-0

10 Model Applications in Poultry Production and Nutrition

E.O. Oviedo-Rondón*
North Carolina State University, Raleigh, North Carolina, USA

Abstract
Mathematical models have been developed in the past few decades to aid in decision making, management, research and teaching in many aspects of animal and poultry production. These are very useful tools that can offer a wide vision of complex problems common in enterprise process management, processing, live production and nutrition of animals to assist in developing solutions. Despite the advantages of using modelling approaches, many factors have limited their broad application in commercial poultry production. Currently, very few poultry companies and nutritionists worldwide use biological models on a daily basis. Modelling techniques are not even taught in animal and poultry nutrition classes in all universities. Because of this, it is very difficult for these excellent tools to advance sufficiently to benefit the poultry

EFG Software from Natal, South Africa (Gous, 2006, 2007, 2012), **Aviagen** (Alabama, USA) with **LIDM Software** from Israel (De Beer, 2009, 2010; Talpaz *et al.*, 2013); **Fee2Gain** (Frank Ivey, Missouri, USA); **Roland Consulting** (Economic Feeding and Management of Commercial Leghorns), **Cargill Animal Nutrition** (Minnesota, USA) and **Nutreco** (Canada) modelling divisions; **Danisco Animal Nutrition** (UK); and **INRA** (France). Companies such as **AGROINFO TI** (São Paulo, Brazil); **CyberAgra** (Virginia, USA); **M-Tech Systems** (Georgia, USA); **UniSoma** (São Paulo, Brazil); and **The Wala Group** (Minnesota, USA).

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Modelos desarrollados:

Pollos

- BPHL® King, 2001
- FORTEL®
- Guevara, 2004
- IGM™ (NOVUS)
- OmniPro® II (NOVUS)
- CHICKOPT
- Pesti/Brill
- BroilerOpt (Feed2Gain)
- Panorama (Cargill)
- BroilerMax (Cargill)
- Danisco
- NutriOpt's Broiler (Trouw Nutrition)
- BEEP (Aviagen)
- EFG software
- Avinesp (UNESP) BGM

Postura

- Reading Model
- Rolands
- Avinesp (UNESP)

Reproductoras

- Avinesp (UNESP) EFG

Pavos

- Rivera *et al.* (Trouw Nutrition)

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Compañias o grupos de investigación que han producido modelos y herramientas de optimización para la industria avícola

UniSoma
Linear Softwares Matemáticos www.linearsm.com.br
AGROINFO
EFG SOFTWARE
Feed2Gain
Optimal4 Software Optimizing Everything!
SAP
CAT2
MTechSystems Innovative Software Solutions for the Food Industry
CyberAgra
unesp LAVINESP
Cargill
Aviagen
lidm Software Systems Ltd.

Compañías que han desaparecido:

USC Consulting Group
Omnus
CMC Chilson's Management Controls
AgriSoft
CMC

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Modelos avícolas más avanzados y mejor referenciados

EFG SOFTWARE
South Africa
https://efgsoftware.net/

unesp LAVINESP
Brazil
poultrymodel.com

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EFG Modelo de Crecimiento®

EFG Software – Natal, South Africa and University of Edinburgh - Scotland

Calibración:

Parámetros de la curva de Gompertz, Composición corporal (Proteína, Lípidos, Agua)

Programa alimentación, Temperatura, Restricciones al crecimiento, y otros.

Simula, estima and Optimiza:

Crecimiento y desempeño productivo, calcula necesidades de energía, aminoácidos, niveles de Ca y P, consumo de alimento, y viabilidad. Costos de producción. Grafica

Características de carcasa. Análisis económico.

Ambiente = Excreción de nitrógeno.

Optimiza…

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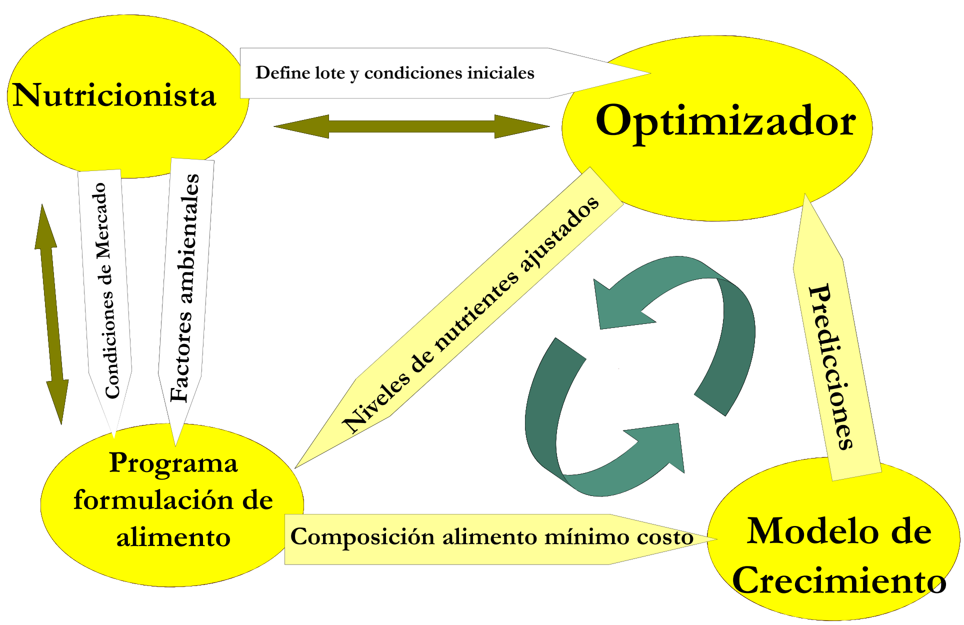

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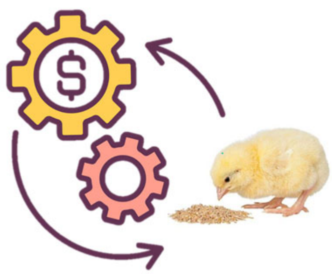
Broiler Growth Model, BGM

Optimización >> Programa nutricional

Objetivos
Energía y Lisina dig. (Proteína balanceada)



ELSEVIER
animal
Volume 17, Supplement 5, December 2023, 101016

Evaluation of a mechanistic model that estimates feed intake, growth and body composition, nutrient requirements, and optimum economic response of broilers

M.P. Reis [a] [1], R.M. Gous [b], L. Hauschild [a], N.K. Sakomura [a]

BGM es un software registrado a AUIN – UNESP

Disponible en la web: poultrymodel.com
Contactar:
Nilva Sakomura – nilva.sakomura@unesp.br
Matheus Reis – matheusdpreis@gmail.com
Bruno Leme - bruno-balbino@hotmail.com

BGM

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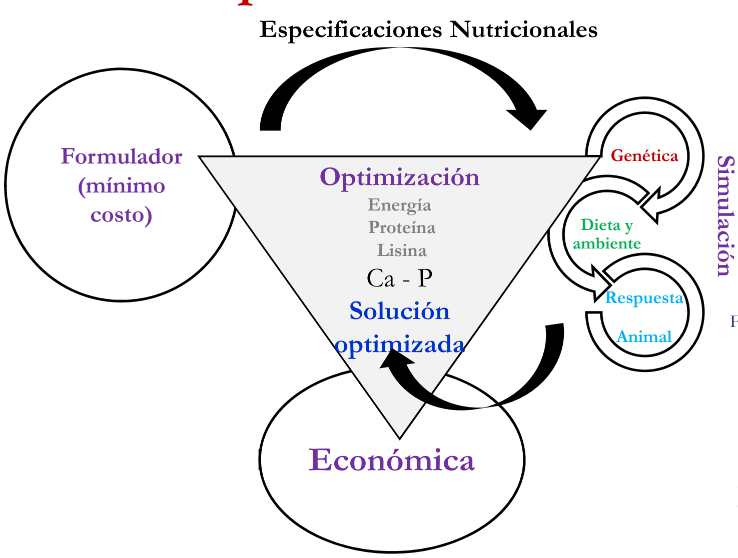
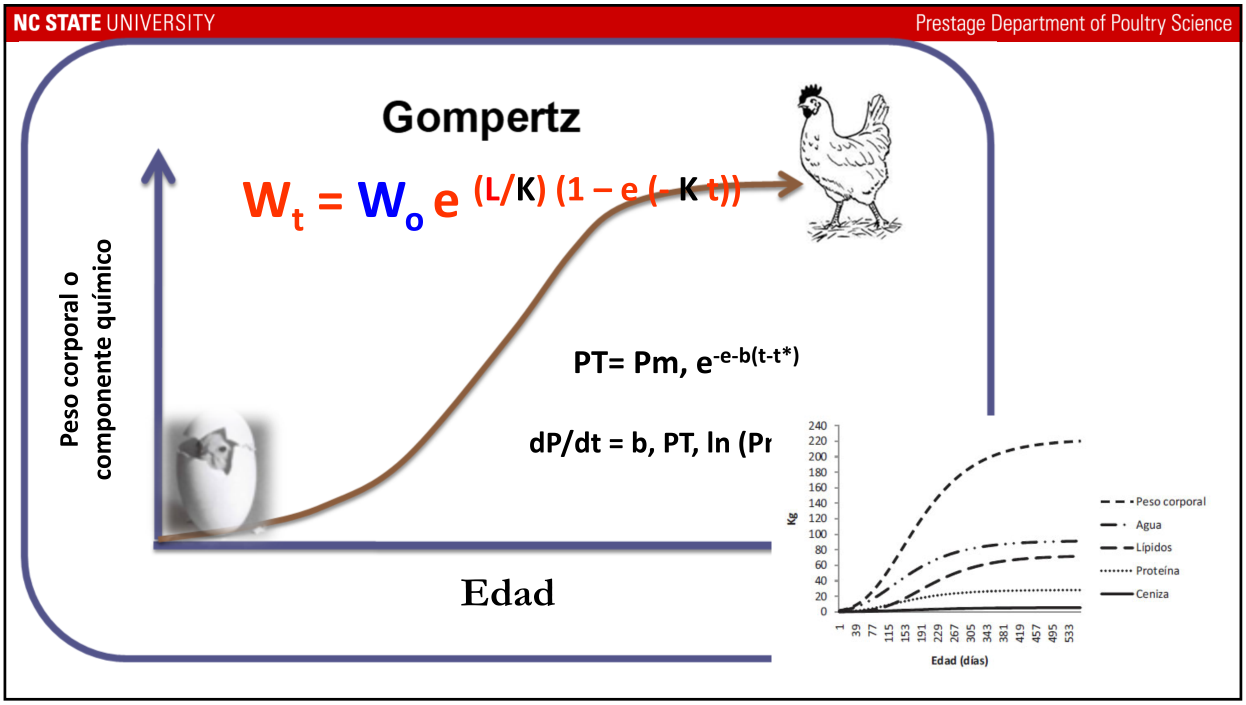
BGM - Optimización



Reis et al, 2023. Animal - Evaluation of a mechanistic model that estimates feed intake, growth and body composition, nutrient requirements, and optimum economic response of broilers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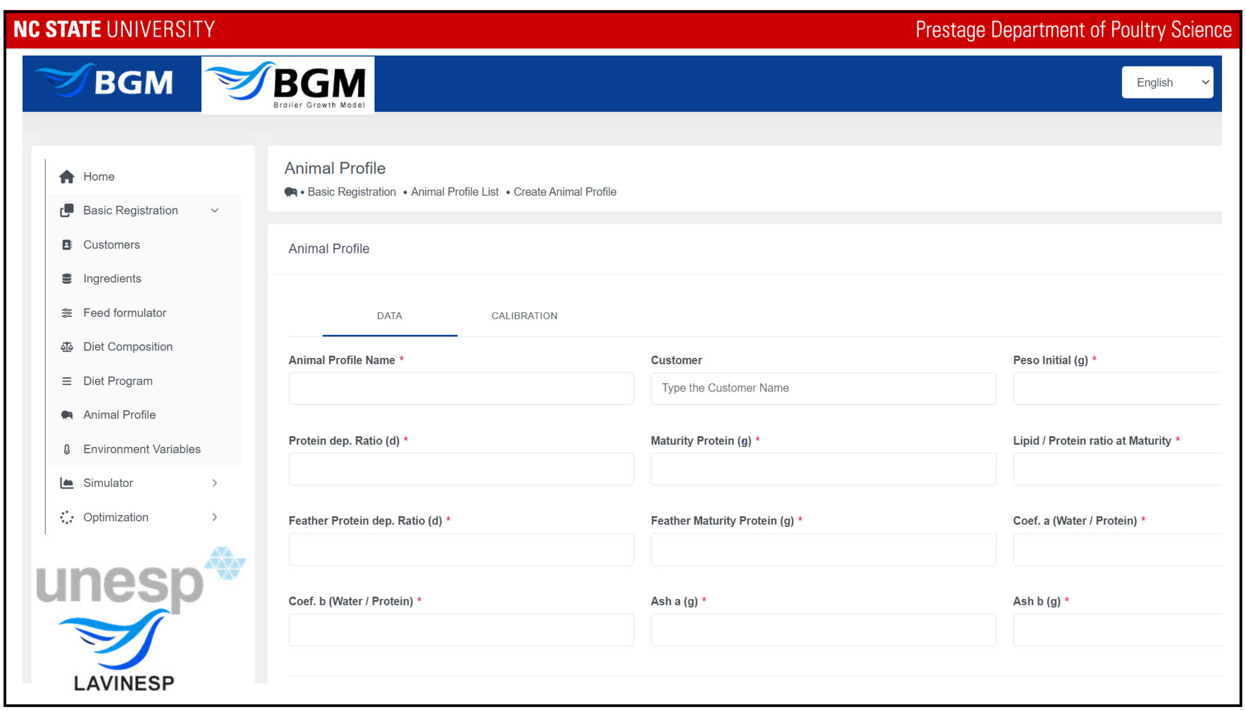
Gompertz
$W_t = W_o e^{(L/K)(1 - e(-K t))}$
PT= Pm, e^{-e-b(t-t*)}
dP/dt = b, PT, ln (Pr
Peso corporal o componente químico
Edad
Kg
240
220
200
180
160
140
120
100
80
60
40
20
0
1 39 77 115 153 191 229 267 305 343 381 419 457 495 533
Edad (días)
Peso corporal
Agua
Lípidos
Proteína
Ceniza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BGM
BGM
Broiler Growth Model
English
Home
Basic Registration
Customers
Ingredients
Feed formulator
Diet Composition
Diet Program
Animal Profile
Environment Variables
Simulator
Optimization
unesp
LAVINESP
Animal Profile
Basic Registration • Animal Profile List • Create Animal Profile
Animal Profile
DATA
CALIBRATION
Animal Profile Name *
Customer
Type the Customer Name
Peso Initial (g) *
Protein dep. Ratio (d) *
Maturity Protein (g) *
Lipid / Protein ratio at Maturity *
Feather Protein dep. Ratio (d) *
Feather Maturity Protein (g) *
Coef. a (Water / Protein) *
Coef. b (Water / Protein) *
Ash a (g) *
Ash b (g) *

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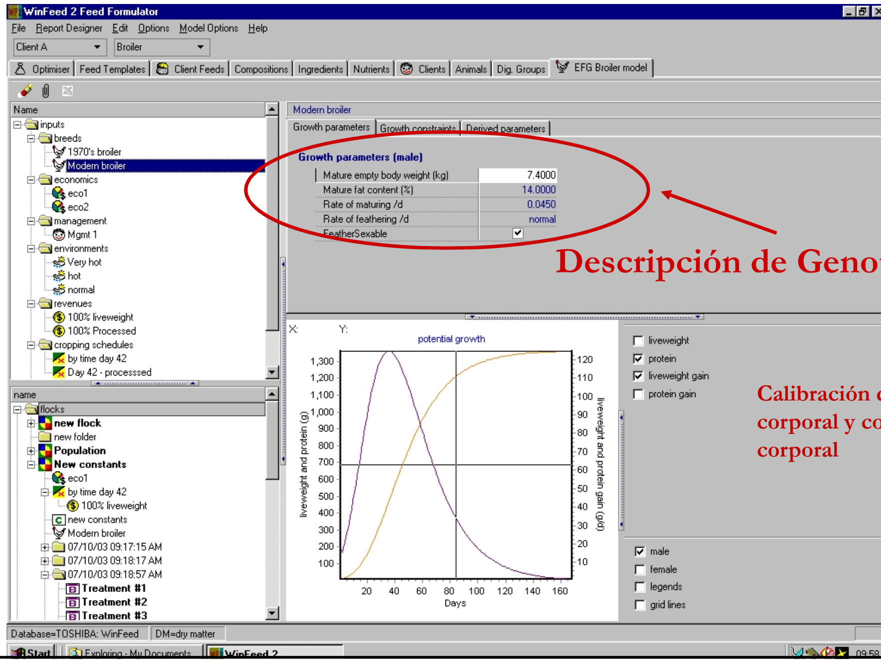

Descripción de Genotipo

Calibración de peso corporal y composición corporal

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Descripción de crecimiento o componentes corporales pollos

	Cobb		Ross	
	Macho	**Hembra**	**Macho**	**Hembra**
B (tasa de madurez)	0.047	0.050	0.037	0.044
Pm (protein a la madurez)	1,042	666	1,309	866
LPm (lipido:proteina ratio madurez)	0.80	1.17	1.00	1.00
Bf (tasa madurez plumas)	0.040	0.042	0.035	0.036
Pmf (proteina a madurez plumas)	303	233	483	395
a (agua/proteina)	1.74	1.74	1.74	1,74
b (agua/proteina)	0.92	0.92	0.92	0.92

Gonçalves *et al.* (2020)

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Predicción del consumo de alimento

BRITISH POULTRY SCIENCE
2020, VOL. 61, NO. 6, 676–683
https://doi.org/10.1080/00071668.2020.1799330

Taylor & Francis
Taylor & Francis Group

Check for updates

Prediction of maximum scaled feed intake in broiler chickens based on physical properties of bulky feeds

M. Q. D. Nascimento[a], R. M. Gous[b], M. D. P. Reis[a], J. B. K. Fernandes[a] and Nilva Sakomura[a]

Consumo de alimento$_{max}$ (g/kg$^{0.67}$/d) = 369.4–115.7*Capacidad de Retención de Agua + 11.96*CRA^2

CRA = Capacidad de retención del agua del alimento

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El crecimiento es limitado por:

Ambiente, temperatura efectiva, densidad de alojamiento, estado sanitario, etc.

$$ME = BW^{0.75}*(307.87-15.63\ T + 0.311\ T^2) + 13.52\ G_f + 12.59\ G_p$$

A meta-analysis of the feed intake and growth performance of broiler chickens challenged by bacteria

A. Remus,*[1] L. Hauschild,* I. Andretta,† M. Kipper,† C. R. Lehnen,‡ and N. K. Sakomura*

2014 Poultry Science 93:1149–1158
http://dx.doi.org/10.3382/ps.2013-03540

***Bacillus amyloliquefaciens* CECT 5940 alone or in combination with antibiotic growth promoters improves performance in broilers under enteric pathogen challenge**

Marllon José Karpeggiane de Oliveira,* Nilva Kazue Sakomura,*[1] Juliano Cesar de Paula Dorigam,† Kiran Doranalli,† Letícia Soares,* and Gabriel da Silva Viana*

2019 Poultry Science 98:4391–4400
http://dx.doi.org/10.3382/ps/pez223

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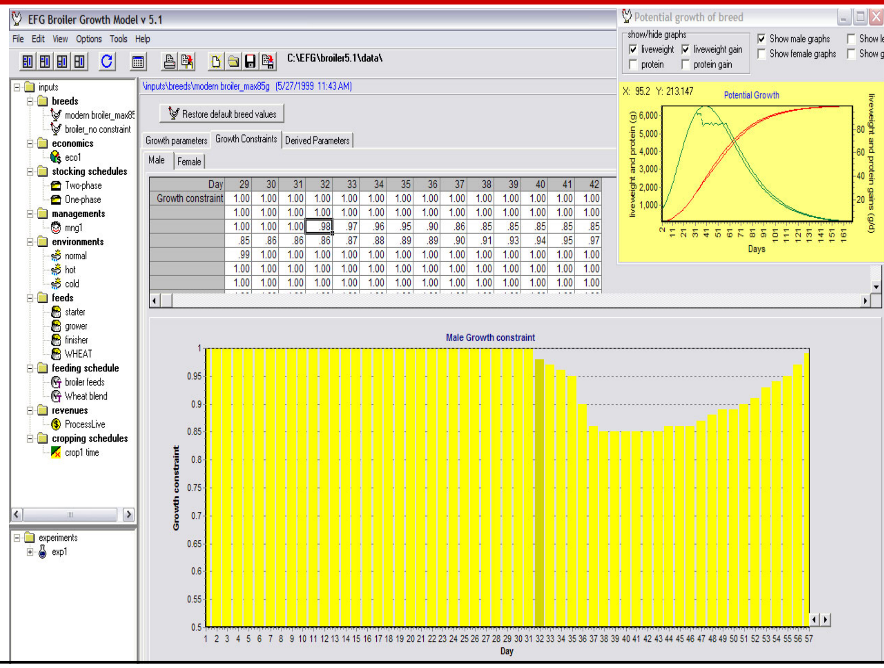
Restricciones al máximo potencial de crecimiento genético



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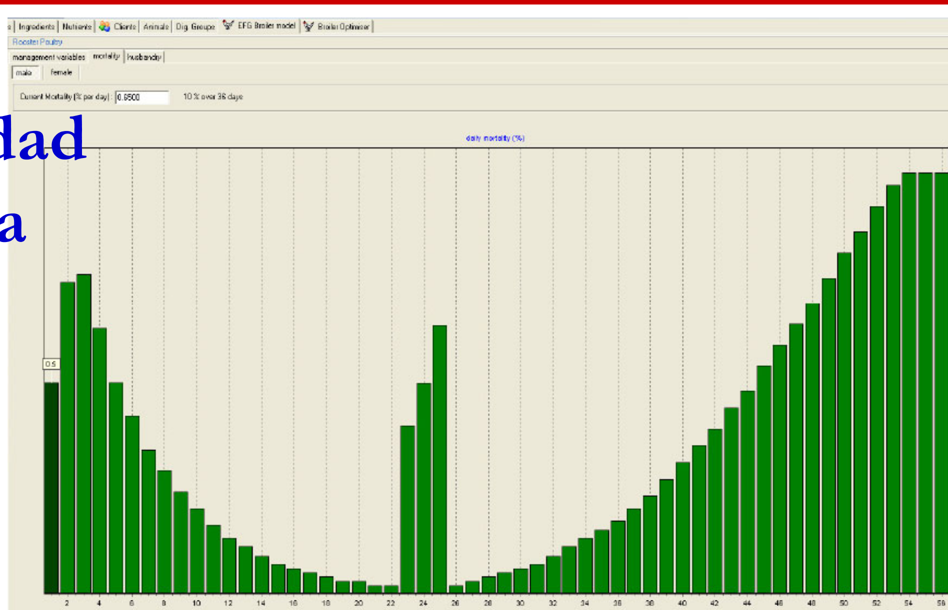
Mortalidad por día



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Resultados de desempeño de Broilers

ACTUAL growth (/bird) | POTENTIAL growth (/bird) | Amino acid requirements (/bird)

Growth data | Commercial | Economics | Biological diary | Indices | Processing | Portions, % | Portions, wt | Meat | Energy | Management | Body chem, Wt | Body chem, % | Body chem, growth

		Growth data							FCR (g food/g l.wt. (bird))	
Day	% male	Re str ict	Feed name	Second feed	Live Weight (g)	Weight gain (g/d)	Food in cum (g)	Food in daily (g)	cum.	daily
0	50.00		\Starter		50	0.0	0	0	0.000	0.000
1	50.00		\Starter		69	19.0	12	12	0.170	0.618
2	50.00		\Starter		83	14.4	26	14	0.309	0.972
3	50.00		\Starter		100	16.6	42	16	0.422	0.993
4	50.00		\Starter		119	19.0	62	19	0.517	1.015
5	50.00		\Starter		141	21.5	84	22	0.596	1.039
6	50.00		\Starter		165	24.1	109	26	0.664	1.061
7	50.00		\Starter		192	26.9	138	29	0.723	1.085
8	50.00		\Starter		221	29.7	171	33	0.775	1.108
9	50.00		\Starter		254	32.7	208	37	0.820	1.130
10	50.00		\Starter		292	37.7	250	42	0.858	1.111
11	50.00		\Starter		332	40.2	299	49	0.901	1.217
12	50.00		\Starter		375	43.4	353	54	0.942	1.256
13	50.00		\Starter		422	46.9	414	60	0.981	1.295
14	50.00		\Starter		473	50.3	481	67	1.018	1.335
15	50.00		\Starter		526	53.7	554	73	1.055	1.375
16	50.00		\Grower		583	56.5	636	82	1.094	1.474
17	50.00		\Grower		643	59.9	730	93	1.138	1.563
18	50.00		\Grower		705	62.3	829	100	1.179	1.601
19	50.00		\Grower		771	65.5	935	105	1.216	1.616
20	50.00		\Grower		839	68.2	1046	111	1.250	1.641
21	50.00		\Grower		910	70.8	1163	117	1.282	1.666
22	50.00		\Grower		983	73.1	1286	123	1.312	1.692
23	50.00		\Grower		1058	75.2	1415	128	1.341	1.718
24	50.00		\Grower		1135	77.2	1549	134	1.368	1.744
25	50.00		\Grower		1214	79.0	1688	139	1.394	1.770
26	50.00		\Grower		1295	80.5	1831	144	1.419	1.797
27	50.00		\Grower		1379	84.7	1981	150	1.441	1.776
28	50.00		\Grower		1464	84.3	2137	155	1.464	1.854

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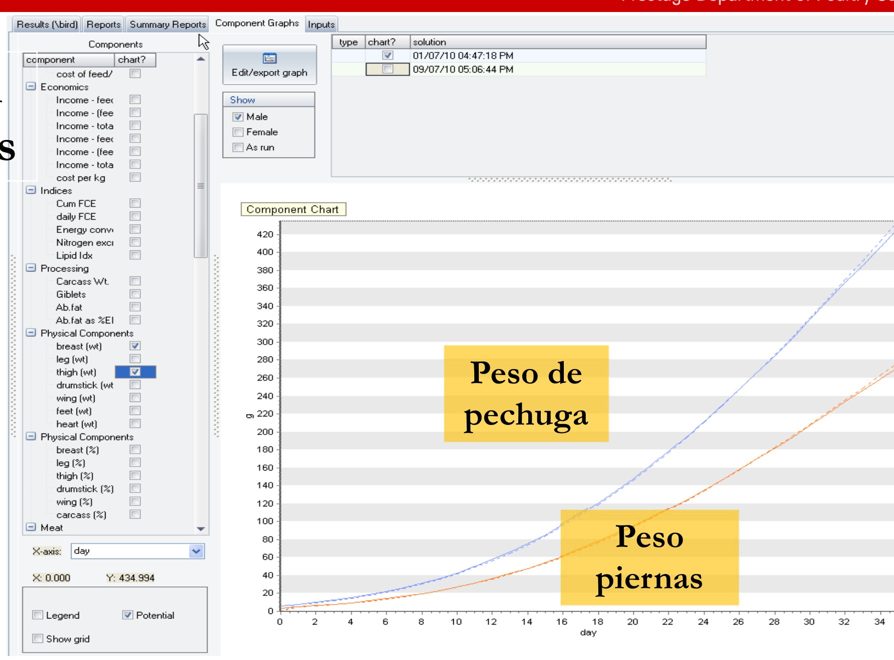
Composición de las carcasas



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Análisis Económico y Optimización

"Inputs"

cleanout costs	
down time (days)	7
fixed costs (R/m²/yr)	
insurance	0.20
repairs & maintenance	0.50
depreciation	0.10
other	0.30
labour and management	1.00
total fixed cost	2.10
variable costs (R/bird/cycle)	
chick	1.50
heating	0.30
litter	0.10
water	0.10
catching	0.10
clean out	0.10
medication	0.50
vaccination	0.60
processing	0.10
other	1.00
total variable cost	4.40

Fuentes de ingresos

% sold live			20.0
% downgraded			2
Revenue (R/kg liveweight)			
good	downgraded	R 7.00	R 2.00
% sold dressed			30.0
% downgraded			5
Revenue (R/kg dressed)			
good	downgraded	R 15.00	R 4.00
include giblets?		☑	
include feet?		☐	
include abdominal fat?		☑	
include head?		☐	
% sold processed			50.0
portions (includes skin and bone) (R/kg)			
breast		R 25.00	☑
thigh		R 15.00	☑
drum		R 15.00	☑
wing		R 14.00	☑
deboned meat (R/kg)			
breast		R 0.00	☐
dark meat		R 0.00	☐
other (R/kg)			
skin		R 0.00	☐
giblets		R 0.00	☐
ab. fat		R 0.00	☐
head		R 0.00	☐
feet		R 0.00	☐
guts		R 0.00	☐
remainder		R 0.00	☐

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Resultados económicos diarios

ACTUAL growth (/bird) | POTENTIAL growth (/bird) | Amino acid requirements (/bird)

Growth data | Commercial | Economics | Biological diary | Indices | Processing | Portions, % | Portions, wt | Meat | Energy | Management | Body chem, Wt | Body chem, % | Body chem, growth

					Income - feed cost		Income - (feed + var. costs)		Income - total costs	
Day	% male	Restrict	Feed name	Second feed	(R /flock cum)	(R /flock day)	(R /flock cum)	(R /flock day)	(R /flock cum)	(R /flock day)
0	50.00		\Starter							
1	50.00		\Starter		28226	3528	-103774	-12972	-104258	-13032
2	50.00		\Starter		33340	3704	-98660	-10962	-99143	-11016
3	50.00		\Starter		39219	3922	-92781	-9278	-93264	-9326
4	50.00		\Starter		45915	4174	-86085	-7826	-86569	-7870
5	50.00		\Starter		53462	4455	-78538	-6545	-79021	-6585
6	50.00		\Starter		61926	4764	-70074	-5390	-70557	-5427
7	50.00		\Starter		71327	5095	-60673	-4334	-61157	-4368
8	50.00		\Starter		81695	5446	-50305	-3354	-50789	-3386
9	50.00		\Starter		93083	5818	-38917	-2432	-39400	-2462
10	50.00		\Starter		106256	6250	-25744	-1514	-26227	-1543
11	50.00		\Starter		120112	6673	-11888	-660	-12371	-687
12	50.00		\Starter		134991	7105	2991	157	2508	132
13	50.00		\Starter		150989	7549	18989	949	18506	925
14	50.00		\Starter		168071	8003	36071	1718	35587	1695
15	50.00		\Starter		186223	8465	54223	2465	53739	2443
16	50.00		\Grower		205363	8929	73363	3190	72880	3169
17	50.00		\Grower		225808	9409	93808	3909	93325	3889
18	50.00		\Grower		246986	9879	114986	4599	114502	4580
19	50.00		\Grower		269221	10355	137221	5278	136738	5259
20	50.00		\Grower		292303	10826	160303	5937	159819	5919
21	50.00		\Grower		316211	11293	184211	6579	183727	6562
22	50.00		\Grower		340816	11752	208816	7201	208333	7184
23	50.00		\Grower		366057	12202	234057	7802	233574	7786
24	50.00		\Grower		391889	12642	259889	8384	259406	8368
25	50.00		\Grower		418231	13070	286231	8945	285747	8930
26	50.00		\Grower		444962	13484	312962	9484	312479	9469
27	50.00		\Grower		473128	13916	341128	10033	340645	10019
28	50.00		\Grower		500871	14311	368871	10539	368387	10525

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Optimizaciones para diversos objetivos de producción

Optimum Feeds | Results (\bird) | Reports | Summary Reports | Component Graphs | Inputs

Feed	Sched. Type	N.D. Base AMEn (MJ/kg)	N.D. Optimum AMEn (MJ/kg)	Dig. ?	Lysine Base	Lysine Optimum
\Starter	amount	12.60	12.60	✓	1.400	1.225
\Grower	amount	13.00	13.00	✓	1.120	1.100
\Finisher	days	13.00	13.00	✓	1.020	1.000

Name	Unit	Base	Optim.
Liveweight, bird	g	1816	1850
Cumulative food intake, pop	g/bird	2800	2949
Cum.FCR, bird	g food/g l.w	1.536	1.588
Breast meat, bird	%	17.2	17.2
Breast meat, bird	g	312	318
Ab. fat, bird	%	0.5	0.8
Ab. fat, bird	g	9	16
N excretion, pop	kg	1308	1330
Cost of feeding, pop	c/bird	386	391
Revenue, pop	c/bird	1280	1304
Margin over feed cost, pop	c/bird	894	913
Margin/m²/annum, pop	R	1003	1003
Cost/kg	R/kg	2.16	2.15

Cambiar a formulación para la rentabilidad y por objetivos en vez de solo costo mínimo

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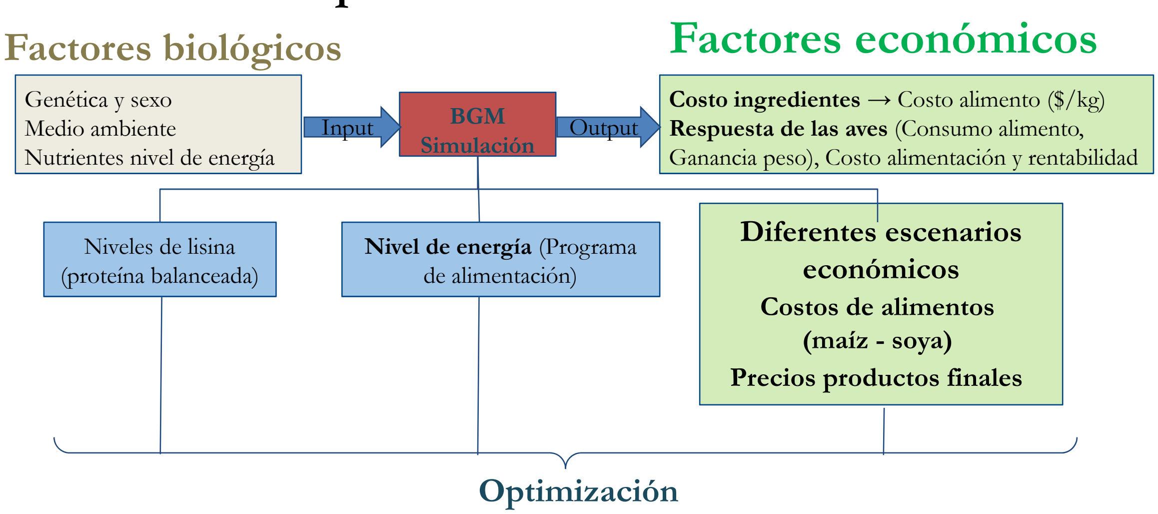
Simulación & Optimización de Diferentes escenarios



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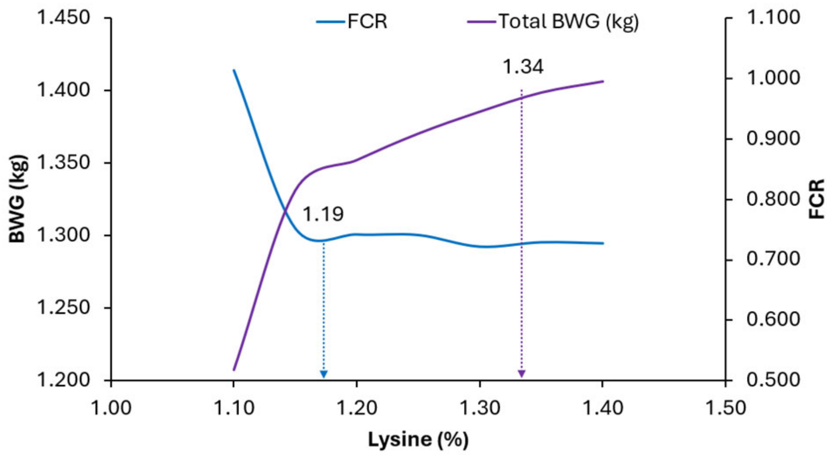
Optimización: Nivel de lisina digestible (proteína balanceada)

- Respuesta animal



Optima respuesta biológica

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Máximo rendimiento económico

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Perspectivas Futuras

- Mejorar modelos en utilización de minerales y vitaminas
- Adicionar efectos de aditivos en consumo y crecimiento
- Impacto de programas de luz, condiciones de cama y ambiente, etc.
- **Integrar resultados de "big data", machine learning/AI en los modelos mecanísticos existentes.**
- **Principal desafío: Entrenamiento para uso y desarrollo**

Conclusiones

- **Los modelos son necesarios para integrar información biológica y económica y optimizar.**
- **Existen varios modelos con acuracia aceptable, pero baja utilización.**
- **Todo modelo depende de descripción adecuada de alimentos, crecimiento, crecimiento, producción y sus componentes químicos.**
- **Big data puede ser integrada en modelaje mecanístico**
- **Falta entrenamiento académico en modelaje y patrocinio para desarrollo y aplicación.**

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