

CONSTRUINDO SABERES, FORMANDO PESSOAS E TRANSFORMANDO A PRODUÇÃO ANIMAL

## COMPARISON OF NON-LINEAR MODELS ADJUSTMENT IN NEW ZEALAND RABBITS GROWTH CURVE

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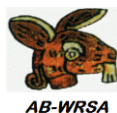
**Resumo:** Objetivou-se definir o modelo não-linear mais adequado para estimar o crescimento de coelhos da raça Nova Zelândia e estudar os parâmetros da curva de crescimento, ajustada a dados de peso e de idade. Os dados foram obtidos do registro de pesos corporais de lâparos, do desmame (30 dias) até a idade adulta (150 dias). Utilizou-se cinco modelos não-lineares para verificar o que melhor descreveu a curva de crescimento médio dos animais. Os critérios utilizados para selecionar o modelo que melhor descreveu a curva foram: quadrado médio do resíduo (QMR), coeficiente de determinação ( $R^2$ ), desvio médio absoluto dos resíduos (DMA) e percentual de convergência (%C). Ao se analisar os coeficientes de determinação, observou-se que os modelos de Gompertz e Logístico apresentaram melhores valores. Em relação ao quadrado médio do resíduo, desvio médio absoluto e percentual de convergência, os modelos de Richards, Gompertz e Logístico tiveram destaque. O modelo de Gompertz apresentou um melhor ajuste aos dados, o que permitiu descrever de forma mais clara o crescimento dos coelhos Nova Zelândia, do nascimento aos 150 dias de vida.

**Palavras-chave:** Cunicultura, Peso corporal, Regressão não-linear

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## Introduction

In terms of production, the New Zealand rabbit breed is the most economically exploited. It comes from the United States and is considered one of the most suitable strains for meat and skin production. It belongs to the group of medium-sized breeds, considered the most important, since it includes the most rustic, early, resistant and productive breeds (FERREIRA, 2012).

In many areas of research, analyzing growth data is important. In several situations, non-linear models have satisfactorily explained the behavior of the observations under study, causing researchers to search for new classes of models (ALVES, 2012).

The use of mathematical models for the study of growth levels in animals is a practice that can help in choosing the best method of exploration of a particular zootechnical species. The growth curves relate the animal's weight to its age, being important for research and recommendations on the production efficiency, thus contributing to increase the producer's profit (GUEDES, 2004).

In general, to study how to adjust non-linear functions, the possibility of synthesizing the information of the entire life span of the animals. The literature includes several models, among them the most common are: Richards, Logistic, Brody, Von Bertalanffy and Gompertz (RODRIGUES et al., 2007). Aiming at this, the objective was to define the most appropriate nonlinear model to estimate New Zealand weight growth and to study growth, weight and age adjustment indicators.

## Material and methods

The experiment was carried out in the Didactic-Productive Module of Cunicultura of the Colégio Técnico de Bom Jesus, Campus Professora Cinobelina Elvas in Bom Jesus, in Piauí, with New Zealand laparos with 45 days of life. This research was approved and has authorization from the Committee of Ethics in

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Animal Experimentation at the Federal University of Piauí, under process registered with number 328/17.

The animals were submitted to the same food and sanitary management. After weaning, they were reared in individual galvanized iron cages and distributed randomly in the rabbit breeding room with plastic feeders and drinking fountains. Water ad libitum and 300g of pelleted feed / day / rabbit were supplied. The data collection was standardized every 7 days during the morning shift and the animals' weight was measured on a digital scale.

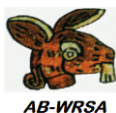
Five non-linear models were used to verify what best described the average growth curve of rabbits: Richards, Logistic, Brody, Von Bertalanffy and Gompertz. The parameters used for growth curves are: adult weight (parameter A), maturity at birth (parameter b), precocity (parameter k) and inflection point (parameter M).

The parameters for the studied models were estimated by the modified Gauss Newton method through the NLIN procedure of the SAS program (SAS, 2017 version University Edition). The criteria used to select the model that best described the curve were: the mean square of the residue (MSRs), coefficient of determination ( $R^2$ ), mean absolute residues deviation (MAD), and percentage of convergence (%C).

## Results and discussion

By analyzing the coefficients of determination ( $R^2$ ), it was observed that the Gompertz model and the Logistic presented the best values in the selection criteria (Table 1). Regarding the mean square of the residue (MSRs), the Richards model presented the lowest value, followed by the Gompertz model. Regarding the mean absolute deviation (DMA), the Richards model presented better value result.

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Table 1 - Mean estimates of growth curve parameters (A, b, k and M) of New Zealand rabbits according to the models and selection criteria of the models

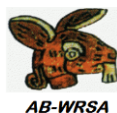
MODELS	PARAMETERS				CRITERIA			
	A	b	k	M	R <sup>2</sup>	QMR	DMA	%C
BRODY	2365,46	1,5524	0,0215	-	0,90	1661,64	27,52	80,0
GOMPERTZ VON	2026,84	1,4602	0,0362	-	0,96	1338,16	25,47	88,0
BERTALANFFY	2187,85	1,0082	0,0299	-	0,94	1341,68	25,34	88,0
RICHARDS	2039,78	0,9371	0,0189	1,36	0,95	1025,08	23,24	56,0
LOGÍSTICO	1975,66	16,3308	0,0528	-	0,96	1468,57	28,11	88,0

R<sup>2</sup> - coefficient of determination; MSRs - mean square of the residue; MAD - mean absolute deviation; %C - percentage of convergence.

Regarding the percentage of convergence (% C), the models that presented the best results were Gompertz, Von Bertalanffy and Logistic. The Brody model and the Logistic model presented the worst results in relation to MSRs and MAD.

According to the parameters of the estimated curve for the animals, the model that best matches the reality of the herd is that of Gompertz. Although the Richards model approached in relation to adult weight, it overestimated the birth weight of the animals, this can be verified in the graphic analysis (Figure 1). Brody's model is inadequate, because it overestimates the animal's weight to adulthood and presents negative values of weights for the first 20 days of the animal's life. The adjustment of growth curves of rabbits is the most complicated (FREITAS, 2007).

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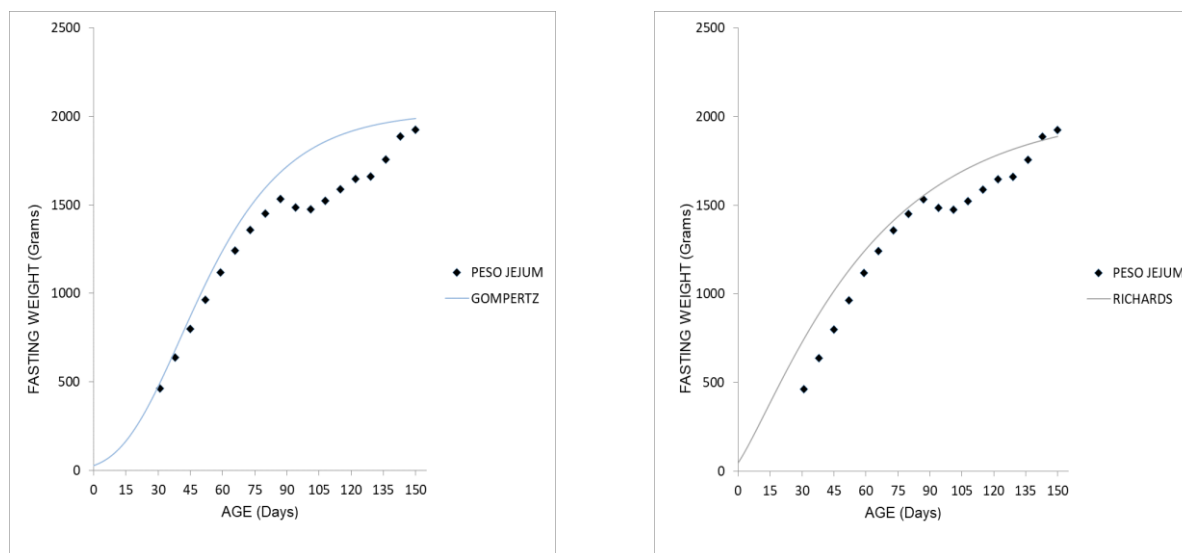


Figure 1 - Different growth curve models for New Zealand rabbits.

### Conclusion

The Gompertz model presented a better fit to the data, which allowed us to more clearly describe the growth of New Zealand rabbits from birth to 150 days of life.

### References

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