

CHAPTER 4

Nutritional Requirements of Japanese and European Quails

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INTRODUCTION

Quail rearing for meat and egg production in Brazil has attracted attention due to the increasing number of production flocks and egg production per bird. These achievements are supported by research on housing, nutrition, genetics, health, and the application of modern technologies in commercial farms. In recent years, advancements in breeding Japanese quails led to heavier and more productive birds with larger eggs. These fast changes have not allowed for the standardization of commercial strains, contributing to variations in performance results.

The anatomy, physiology, and behavior of Japanese quails differ from those of commercial laying hens; therefore, they require specific nutritional needs, justifying research to determine the requirements for optimal performance.

For a comprehensive understanding of the nutritional requirements of quails, it is essential to consider various factors that can affect their nutritional needs. These include breed, strain, sex, feed intake, dietary energy level, suitability for meat or egg production, nutrient availability, temperature, air humidity, and the health status of the flock. Moreover, the nutritional program is crucial to ensure the health and well-being of the birds, as well as to maximize meat and egg production.

The nutritional requirement tables for Japanese and European quails presented here were obtained by compiling the results of studies carried out at the Federal University of Northern Tocantins, the Federal University of Paraíba, the Federal University of the Semi-Arid Region, and the Federal University of Viçosa, in particular, as well as by other research institutions.

Feed intake of birds can be estimated through the correlation between the metabolizable energy (ME) requirement and dietary energy values. It is important to note, that when birds are fed *ad libitum*, feed intake, and, more specifically, feed conversion ratio depend largely on the dietary energy content. The tables include examples of nutritional requirements of Japanese and European quails, for diets containing dietary energy values commonly adopted in Brazil. For other dietary energy values, corresponding adjustments in feed intake and other dietary nutrients should be made.

In order to allow dynamic calculation of the quails' nutritional requirements, nutritionists need to apply models that calculate daily nutrient requirements as a function of birds' performance. For this purpose, equations for the daily nutritional requirements for the main nutrients were developed for Japanese quails during the grower, developer, and laying phases considering parameters that can be easily measured, such as body weight, weight gain, and egg mass. Additionally, recommendations for the nutritional requirements of European quails were included, although there is a lack of information about optimal levels for European quails.

Amino acid requirements of quails were determined using diets based mainly on corn and soybean meal. When other feedstuffs are used, corrections should be applied to take into account nutrient digestibility in these feedstuffs. This is the reason why requirements are expressed on standardized ileal digestible (SID) amino acids, which in previous editions were called true digestible amino acids.

Equations to determine the daily requirements of ME corrected for nitrogen balance, crude protein, and available phosphorus were developed for growing Japanese quails in the grower and developer phases. Due to the lack of information, SID lysine requirements for quails during the grower phase were estimated according to the values obtained by Silva et al. (2020). SID lysine requirements for quails during the developer phase were estimated according to data from the thesis of the Federal University of Paraiba (Felix, 2020). The amino acid/lysine ratios used during the growing and laying phases are from the Brazilian Tables for Poultry and Swine (Rostagno et al., 2017).

The daily requirements of laying Japanese quails were estimated as the amount of nutrients per bird per day through equations for ME, protein, and SID lysine. The total lysine requirement for growing and laying quails was calculated considering the average standardized ileal digestibility coefficients of lysine of 90 and 89%, respectively. For European quails, the average standardized ileal digestibility coefficient of lysine was 87.5%. The requirements of other essential amino acids were determined according to the ideal protein concept, expressed as SID amino acids and total amino acids.

In the absence of recent information on specific nutrient level recommendations, it was decided to adopt the values of quail requirements

listed in the previous edition of the Brazilian Tables for Poultry and Swine (Rostagno et al., 2017).

The nutritional requirements of European quails were determined through the results of nine dose-response experiments (metabolizable energy, crude protein, calcium, phosphorus, SID lysine, SID methionine + cystine, SID threonine, SID tryptophan, and SID valine), during the starter phase (1 to 14 days) and the grower phase (15 to 35 days). The requirement values of the remaining essential amino acids and nutrients were obtained from the Tables for European Quails (Silva & Costa, 2009).

During the starter phase of European quails, quadratic equations were used to determine the needs of metabolizable energy, available phosphorus, SID lysine, and SID threonine, considering weight gain as the main variable. Adjusted quadratic equations for the feed conversion ratio were used to estimate the values of calcium, SID methionine + cystine, SID tryptophan, and SID valine.

To estimate the requirements during the grower phase of European quails, adjusted quadratic equations for weight gain were used to determine the values of metabolizable energy, SID lysine, and SID valine. Adjusted quadratic equations for feed conversion ratio were used to determine the needs of calcium, available phosphorus, SID methionine + cystine, and SID threonine. Crude protein showed a linear increasing effect in both phases, as well as SID tryptophan during the grower phase.

Nutritional Requirements of Japanese Quails

Table 4.01 - Equations Used to Estimate Metabolizable Energy (ME) Requirements (kcal/bird/day) of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases¹

Grower Phase (01 to 14 days)

$$\text{ME Req. (kcal/bird/day)} = 54.96 \times W^{0.67} + 8.30 \times G$$

Developer Phase (15 to 35 days)

$$\text{ME Req. (kcal/bird/day)} = 92.11 \times W^{0.67} + 8.91 \times G$$

W: Body Weight (kg); G: Weight Gain (g/bird/day)

ME Req.: Metabolizable Energy Requirement

Example 1: Quails during the Grower Phase (01-14 days of age)

W: 0.025 kg/bird, $W^{0.67} = 0.08445$; G: 2.34 g/bird/day;

Dietary ME: 2.850 kcal/g

ME Req.: $54.96 \times 0.08445 + 8.30 \times 2.34$; ME Req.: 24.064 kcal/bird/day

Estimated Feed Intake: $(24.064/2.850)$: 8.44 g/bird/day

Example 2: Quails during the Developer Phase (15-35 days of age)

W: 0.080 kg/bird, $W^{0.67} = 0.1841$; G: 3.12 g/bird/day;

Dietary ME: 2.850 kcal/g

ME Req.: $92.11 \times 0.1841 + 8.91 \times 3.12$; ME Req.: 44.757 kcal/bird/day

Estimated Feed Intake: $(44.757/2.850)$; 15.7 g/bird/day

¹ Metabolizable Energy Requirements of Japanese Quails from 01-35 days of age were estimated according to Oliveira (2020) (Ph.D. Thesis, UFNT – Araguaína/TO) and Vieira et al. (2020). (Mathematical models to predict the energy requirements of Japanese quails from 01-35 days of age. Research, Society and Development, 9(8), e777986544-e777986544). Feed Intake, Metabolic Weight, and Weight Gain were estimated according to Oliveira (2020).

Table 4.02 - Equations Used to Estimate Crude Protein (CP) Requirements (g/bird/day) of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases¹

Grower Phase (01 to 14 days)

$$\text{CP Req. (g/bird/day)} = 2.095 \times W^{0.67} + 0.851 \times G$$

Developer Phase (15 to 35 days)

$$\text{CP Req. (g/bird/day)} = 6.30 \times W^{0.67} + 0.894 \times G$$

W: Body Weight (kg); G: Weight Gain (g/bird/day)

CP Req.: Crude Protein Requirement

Example 1: Quails during the Grower Phase (01-14 days of age)

W: 0.025 kg/bird, $W^{0.67} = 0.08445$; G: 2.34 g/bird/day

Estimated Feed Intake: 8.44 g/bird/day

CP Req.: $2.095 \times 0.08445 + 0.851 \times 2.34$; CP Req.: 2.168 g/bird/day;

Dietary CP: 25.7%

Example 2: Quails during the Developer Phase (15-35 days of age)

W: 0.080 kg/bird, $W^{0.67} = 0.1841$; G: 3.12 g/bird/day

Estimated Feed Intake: 15.7 g/bird/day

CP Req.: $6.30 \times 0.1841 + 0.894 \times 3.12$; CP Req.: 3.949 g/bird/day;

Dietary CP: 25.1%

¹ Crude Protein Requirements of Japanese Quails from 01-35 days of age were estimated according to Oliveira (2020) (Ph.D. Thesis, UFNT – Araguaína/TO) and Vieira et al. (2020) (Mathematical models to predict Japanese quail crude protein requirements from 01 to 35 days old, Research, Society and Development, 9(8), e763986160-e763986160). Feed Intake, Metabolic Weight, and Weight Gain were estimated according to Oliveira (2020).

Table 4.03 - Equations Used to Estimated Calcium (Ca) Requirements (mg/bird/day) of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases¹

Grower Phase (01 to 14 days)

$$\text{Ca Req. (mg/bird/day)} = 60.86 \times W^{0.67} + 24.91 \times G$$

Developer Phase (15 to 35 days)

$$\text{Ca Req. (mg/bird/day)} = 223.58 \times W^{0.67} + 15.67 \times G$$

W: Body Weight (kg); G: Weight Gain (g/bird/day)

Ca Req.: Calcium Requirement

Example 1: Quails during the Grower Phase (01-14 days of age)

W: 0.025 kg/bird, $W^{0.67} = 0.08445$; G: 2.34 g/bird/day

Ca Req.: $60.86 \times 0.08445 + 24.91 \times 2.34$; Ca Req.: 63.429 mg/bird/day

Estimated Feed Intake: 8.44 g/bird/day

Dietary Ca: 0.752%

Example 2: Quails during the Developer Phase (15-35 days of age)

W: 0.080 kg/bird, $W^{0.67} = 0.1841$; G: 3.12 g/bird/day

Ca Req.: $223.58 \times 0.1841 + 15.67 \times 3.12$; Ca Req.: 90.052 mg/bird/day

Estimated Feed Intake: 15.70 g/bird/day

Dietary Ca: 0.574%

¹ Calcium Requirements of Japanese Quails from 01-35 days of age were estimated according to Souza (2023) (Ph.D. Thesis, UFNT – Araguaína/TO). Feed Intake, Metabolic Weight, and Weight Gain were estimated according to Oliveira (2020) (Ph.D. Thesis, UFNT – Araguaína/TO).

Table 4.04 - Equations Used to Estimated Available Phosphorus (Pav) Requirements (mg/bird/day) of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases¹

Grower Phase (01 to 14 days)

$$\text{Pav Req. (mg/bird/day)} = 43.18 \times W^{0.67} + 14.12 \times G$$

Developer Phase (15 to 35 days)

$$\text{Pav Req. (mg/bird/day)} = 106.35 \times W^{0.67} + 8.48 \times G$$

W: Body Weight (kg); G: Weight Gain (g/bird/day)

Pav Req.: Available Phosphorus Requirement

Example 1: Quails during the Grower Phase (01-14 days of age)

W: 0.025 kg/bird, $W^{0.67} = 0.08445$; G: 2.34 g/bird/day

Pav Req.: $43.18 \times 0.08445 + 14.12 \times 2.34$; Pav Req: 36.6874 mg/bird/day

Estimated Feed Intake: 8.44 g/bird/day

Dietary Pav: 0.435%

Example 2: Quails during the Developer Phase (15-35 days of age)

W: 0.080 kg/bird, $W^{0.67} = 0.1841$; G: 3.12 g/bird/day

Pav Req.: $106.35 \times 0.1841 + 8.48 \times 3.12$; Pav Req.: 46.037 mg/bird/day

Estimated Feed Intake: 15.7 g/bird/day

Dietary Pav: 0.293%

¹ Available Phosphorus Requirements of Japanese Quails from 01-35 days of age were estimated according to Souza (2023) (Ph.D. Thesis, UFNT – Araguaína/TO). Feed Intake, Metabolic Weight, and Weight Gain were estimated according to Oliveira (2020) (Ph.D. Thesis, UFNT – Araguaína/TO).

Table 4.05 - Dietary Lysine Level and Amino Acid to Lysine Ratio (%) Used to Estimate Amino Acid Requirements of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35) Phases¹

Amino Acid ¹		Phase			
		Grower 1 to 14 days		Developer 15 to 35 days	
		SID	Total	SID	Total
Dietary Lysine	%	1.400	1.556	1.150	1.278
Lysine	%	100	100	100	100
Methionine	%	40	40	38	38
Methionine + Cysteine	%	68	68	67	67
Threonine	%	67	70	71	74
Tryptophan	%	17	17	19	19
Arginine	%	108	105	106	103
Glycine + Serine	%	89	92	89	92
Valine	%	82	83	86	87
Isoleucine	%	64	65	71	72
Leucine	%	137	136	137	136
Histidine	%	29	29	29	29
Phenylalanine	%	77	77	77	77
Phenylalanine + Tyrosine	%	146	145	146	145

¹ Standardized Digestible Lysine Requirement of Japanese Quails in the Grower Phase was estimated according to Silva et al. (2020), and in the Developer Phase was estimated according to Felix (2020) (Ph.D. Thesis – UFPB, Areia/PB) and Lima et al (2016). The Amino Acid to Lysine Ratios were from The Brazilian Tables for Poultry and Swine (Rostagno et al., 2017).

Table 4.06 - Nutritional Requirements of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases (kcal, g, or mg/day)¹

Phase (days)		Grower (1-14)		Developer (15-35)	
Body Weight	kg	0.025		0.080	
Weight Gain	g/day	2.34		3.12	
Metabolizable Energy	kcal/day	24.06		44.76	
Diet Metabolizable Energy	kcal/kg	2850		2850	
Feed Intake	g/day	8.44		15.70	
Crude Protein	g/day	2.17		3.95	
Calcium	mg/day	63.43		90.05	
Available Phosphorus	mg/day	36.69		46.04	
Digestible Phosphorus	mg/day	33.02		41.44	
Sodium	mg/day	17.30		33.60	
Amino Acid		SID	Total	SID	Total
Lysine	g/day	0.219	0.243	0.258	0.287
Methionine	g/day	0.087	0.097	0.098	0.109
Methionine + Cysteine	g/day	0.149	0.166	0.173	0.192
Threonine	g/day	0.147	0.163	0.183	0.203
Tryptophan	g/day	0.037	0.041	0.049	0.054
Arginine	g/day	0.236	0.262	0.274	0.304
Glycine + Serine	g/day	0.195	0.217	0.230	0.256
Valine	g/day	0.179	0.199	0.222	0.247
Isoleucine	g/day	0.140	0.156	0.183	0.203
Leucine	g/day	0.300	0.333	0.354	0.393
Histidine	g/day	0.063	0.070	0.075	0.083
Phenylalanine	g/day	0.168	0.187	0.199	0.221
Phenylalanine + Tyrosine	g/day	0.319	0.354	0.377	0.419

¹ Sodium Requirement from the Brazilian Tables Poultry and Swine (Rostagno et al., 2017). SID Lysine Requirement of Japanese Quails in the Grower Phase was according to Silva et al. (2020), and in the Developer Phase was according to Felix (2020) (Ph.D. Thesis – UFPB, Areia/PB). The other essential amino acid requirements were estimated considering the Amino Acid to Lysine Ratio in Table 4.05.

Table 4.07 - Nutritional Requirements of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases (%)

Phase (days)		Grower (1-14)		Developer (15-35)	
Body Weight	kg	0.025		0.080	
Weight Gain	g/day	2.34		3.12	
Metabolizable Energy	kcal/day	24.06		44.76	
Diet Metabolizable Energy	kcal/kg	2850		2850	
Feed Intake	g/day	8.44		15.7	
Crude Protein	%	25.7		25.2	
Calcium	%	0.752		0.574	
Available Phosphorus	%	0.435		0.293	
Digestible Phosphorus	%	0.391		0.264	
Sodium	%	0.205		0.214	
Amino Acid		Dig.	Total	Dig.	Total
Lysine	%	1.400	1.556	1.150	1.278
Methionine	%	0.560	0.622	0.437	0.486
Methionine + Cysteine	%	0.952	1.058	0.771	0.857
Threonine	%	0.938	1.042	0.817	0.908
Tryptophan	%	0.238	0.264	0.219	0.243
Arginine	%	1.512	1.680	1.219	1.354
Glycine + Serine	%	1.246	1.384	1.024	1.138
Valine	%	1.148	1.276	0.989	1.099
Isoleucine	%	0.896	0.996	0.817	0.908
Leucine	%	1.918	2.131	1.576	1.751
Histidine	%	0.406	0.451	0.334	0.371
Phenylalanine	%	1.078	1.198	0.886	0.984
Phenylalanine + Tyrosine	%	2.044	2.271	1.679	1.866

¹ Sodium Requirement from the Brazilian Tables Poultry and Swine (Rostagno et al., 2017). SID Lysine Requirement of Japanese Quails in the Grower Phase was according to Silva et al. (2020), and in the Developer Phase was according to Felix (2020) (Ph.D. Thesis – UFPB, Areia/PB). The other essential amino acid requirements were estimated considering the Amino Acid to Lysine Ratio in Table 4.05.

Table 4.08 - Equation Used to Estimate Metabolizable Energy (ME) Requirements and Feed Intake of Laying Japanese Quails (kcal or g/bird/day)¹

$$\text{ME Req (kcal/bird/day)} = 150.37 \times W^{0.67} + 6.01 \times G + 2.349 \times \text{Egg}$$

W: Body Weight (kg); G: Weight Gain (g/bird/day)

Egg = Egg Mass (g egg/bird/day) = $\frac{\% \text{ Lay}}{100} \times \text{Egg Weight}$

Example:

Laying Japanese Quails at 22 weeks of age

W = 0.179 kg; $W^{0.67} = 0.3150$; G = 0.09 g/bird/day;

Egg = 10.72 g/bird/day

Dietary ME = 2.850 kcal/g

ME Req. = $(150.37 \times 0.3150) + (6.01 \times 0.09 + (2.349 \times 10.72)$

ME Req. = $47.3666 + 0.5409 + 25.1812$

ME Req. = 73.1 kcal/bird/day

Estimated Feed Intake = $73.1 / 2.850 = 25.7$ g/bird/day

¹ Metabolizable Energy Requirements of Laying Japanese Quails were estimated according to Bourdon (2022) (Ph.D. Thesis, UFNT – Araguaína/TO).

Table 4.09 - Equation Used to Estimate Crude Protein (CP) Requirements of Laying Japanese Quails (g/bird/day)¹

$$\text{CP Req. (g/bird/day)} = 6.99 \times W^{0.67} + 0.662 \times G + 0.228 \times \text{Egg}$$

W: Body Weight (kg); G: Weight Gain (g/bird/day)

Egg = Egg Mass (g egg/bird/day) = $\frac{\% \text{ Lay}}{100} \times \text{Egg Weight}$

Example:

Laying Japanese Quails at 22 weeks of age

W = 0.179 kg; $W^{0.67} = 0.3150$; G = 0.09 g/bird/day;

Egg = 10.72 g/bird/day

Dietary ME = 2.850 kcal/g

CP Req. = $(6.99 \times 0.31508) + (0.662 \times 0.09) + (0.228 \times 10.72)$

CP Req. = 2.2018 + 0.0596 + 2.4442

CP Req. = 4.7056 g/bird/day

Estimated Feed Intake = 25.7 g/bird/day (Table 4.08)

Dietary CP = 18.3%

¹ Crude Protein Requirements of Laying Japanese Quails were estimated according to Bourdon (2023) (Ph.D. Thesis, UFNT – Araguaína/TO).

Table 4.10 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Laying Japanese Quails (mg/bird/day)¹

$$\text{SID Lys Req. (mg/bird/day)} = 156 \times W^{0.75} + 21.1 \text{ Egg}$$

W: Body Weight (kg)

$$\text{Egg} = \text{Egg Mass (g egg/bird/day)} = \frac{\% \text{ Lay}}{100} \times \text{Egg Weight}$$

Example:

Laying Japanese Quails at 22 weeks of age

W = 0.179 kg; $W^{0.75} = 0.2752$; Egg = 10.72 g/bird/day

Dietary ME = 2.850 kcal/g

$$\text{SID Lys Req.} = (156 \times 0.2752) + (21.1 \times 10.72)$$

$$\text{SID Lys Req.} = 42.9312 + 226.192$$

$$\text{SID Lys Req.} = 269.13 \text{ mg/bird/day}$$

$$\text{Estimated Feed Intake} = 25.7 \text{ g/bird/day (Table 4.08)}$$

$$\text{Dietary SID Lys} = 1.048\%$$

¹ Standardized Digestible Lysine Requirements of Laying Japanese Quails were estimated according to Silva (2019).

Table 4.11 - Performance, Metabolizable Energy (ME), Crude Protein (CP), Standardized Digestible Lysine (SID Lys) Requirements and Feed Intake of Japanese Quails as a Function of Productivity

Age	Weight	Gain	Egg Mass	ME ¹	Intake ¹	Protein ²	Protein ²	SID Lys ³	SID Lys ³
weeks	kg	g/day	g/day	kcal/day	g/day	g/day	%	g/day	%
8	0.156	1.30	4.7	— ⁴	— ⁴	— ⁴	— ⁴	— ⁴	— ⁴
14	0.160	0.05	10.7	69	24.4	4.52	18.5	0.265	1.088
22	0.179	0.09	10.7	73	25.7	4.71	18.3	0.269	1.048
29	0.187	0.01	10.6	74	25.9	4.70	18.1	0.269	1.036
35	0.183	0.03	10.5	73	25.6	4.64	18.1	0.264	1.032
48	0.186	0.08	9.9	72	25.4	4.56	18.0	0.252	0.993
55	0.186	0.01	9.6	71	25.0	4.46	17.8	0.247	0.986
62	0.187	0.02	9.4	71	24.9	4.42	17.7	0.242	0.972

¹ Determined by the equation in Table 4.08, using the dietary level of 2850 kcal ME/kg.

² Determined by the equation in Table 4.09.

³ Determined by the equation in Table 4.10.

⁴ Use the requirements of week 14.

Table 4.12 - Amino Acid to Lysine Ratio Used to Estimate the Amino Acid Requirements of Laying Japanese Quails¹

Amino Acid		Laying	
		SID	Total
Lysine	%	100	100
Methionine	%	45	44
Methionine + Cysteine	%	82	81
Threonine	%	61	64
Tryptophan	%	21	21
Arginine	%	115	112
Glycine + Serine	%	114	119
Valine	%	75	76
Isoleucine	%	65	65
Leucine	%	150	148
Histidine	%	42	41
Phenylalanine	%	74	73
Phenylalanine + Tyrosine	%	135	133

¹ Values obtained from the Brazilian Tables for Poultry and Swine (Rostagno et al., 2017).

Table 4.13 - Nutritional Requirements of Laying Japanese Quails (kcal or g/bird/day)¹

Nutrients	Laying Japanese Quails			
Body Weight, g	179		186	
Gain, g/day	0.09		0.08	
Egg Mass, g/day	10.7		9.9	
Metabolizable Energy, kcal/day	73.2		72.3	
Diet Metabolizable Energy, kcal/kg	2850		2850	
Feed Intake, g/day	25.7		25.4	
Crude Protein, g/day	4.71		4.56	
Calcium, g/day	0.773		0.773	
Available Phosphorus, g/day	0.080		0.080	
Digestible Phosphorus, g/day	0.073		0.073	
Sodium, g/day	0.040		0.040	
Linoleic Acid, g/day	0.256		0.256	
Amino Acid	SID	Total	SID	Total
Lysine, g/day	0.269	0.302	0.252	0.283
Methionine, g/day	0.121	0.133	0.113	0.125
Methionine + Cysteine, g/day	0.221	0.245	0.207	0.229
Threonine, g/day	0.164	0.194	0.154	0.181
Tryptophan, g/day	0.057	0.064	0.053	0.059
Arginine, g/day	0.310	0.339	0.290	0.317
Glycine + Serine, g/day	0.307	0.360	0.287	0.337
Valine, g/day	0.202	0.230	0.189	0.215
Isoleucine, g/day	0.175	0.197	0.164	0.184
Leucine, g/day	0.404	0.448	0.378	0.419
Histidine, g/day	0.113	0.124	0.106	0.116
Phenylalanine, g/day	0.199	0.221	0.186	0.207
Phe + Tyr, g/day	0.364	0.402	0.340	0.376

¹ Calcium, Available Phosphorus, Digestible Phosphorus, Sodium, and Linoleic Acid Requirements were obtained from the Brazilian Tables for Poultry and Swine (Rostagno et al. 2017).

Table 4.14 - Nutritional Requirements of Laying Japanese Quails (%)¹

Nutrients	Laying Japanese Quails			
Body Weight, g	179		186	
Gain, g/day	0.09		0.08	
Egg Mass, g/day	10.7		9.9	
Metabolizable Energy, kcal/day	73.2		72.3	
Diet Metabolizable Energy, kcal/kg	2850		2850	
Feed Intake, g/day	25.7		25.4	
Crude Protein, %	18.3		18.0	
Calcium, %	3.01		3.04	
Available Phosphorus, %	0.311		0.080	
Digestible Phosphorus, %	0.284		0.073	
Sodium, %	0.156		0.157	
Linoleic Acid, %	0.996		1.008	
Amino Acid	SID	Total	SID	Total
Lysine, %	1.048	1.177	0.993	1.116
Methionine, %	0.472	0.518	0.447	0.491
Methionine + Cysteine, %	0.859	0.953	0.814	0.904
Threonine, %	0.639	0.753	0.606	0.714
Tryptophan, %	0.220	0.247	0.209	0.234
Arginine, %	1.205	1.318	1.142	1.250
Glycine + Serine, %	1.195	1.401	1.132	1.328
Valine, %	0.786	0.895	0.745	0.848
Isoleucine, %	0.681	0.765	0.645	0.725
Leucine, %	1.572	1.742	1.490	1.652
Histidine, %	0.440	0.483	0.417	0.458
Phenylalanine, %	0.776	0.859	0.735	0.815
Phe + Tyr, %	1.415	1.565	1.341	1.484

¹ Calcium, Available Phosphorus, Digestible Phosphorus, Sodium, and Linoleic Acid Requirements were obtained from the Brazilian Tables for Poultry and Swine (Rostagno et al. 2017).

Nutritional Requirements of European Quails

Table 4.15 - Dietary Lysine Level and Amino Acid to Lysine Ratio (%) Used to Estimate the Amino Acid Requirements of European Quails During Starter, Grower, and Total Production Period

Phase	Starter		Grower		Total	
Age (days)	1 – 14		15 - 35		1 - 35	
Amino Acid	SID	Total ¹	SID	Total ¹	SID	Total ¹
Dietary Lysine	1.401%	1.595%	1.178%	1.351%	1.27%	1.45%
Lysine	100	100	100	100	100	100
Methionine ²	44	42	37	36	40	38
Methionine + Cysteine	82	85	73	71	77	77
Threonine	87	90	76	78	80	83
Tryptophan	15	14	15	15	15	15
Arginine ²	140	133	146	137	144	135
Glycine + Serine ³	89	92	89	92	89	92
Valine ²	81	80	67	66	73	72
Isoleucine ²	83	80	88	85	86	83
Leucine ²	176	163	203	187	192	177
Histidine ²	57	54	62	58	60	56
Phenylalanine ²	101	96	110	104	106	101
Phenylalanine+Tyrosine ²	148	142	161	154	156	149

¹ The values were estimated using the digestibility coefficients from Tables for European Quails 2009 (Silva e Costa, 2009).

² Amino Acid to Lysine Ratios were obtained from the Tables for European Quails 2009 (Silva e Costa, 2009).

³ Amino Acid to Lysine Ratios were obtained from the Brazilian Tables for Poultry and Swine (Rostagno et al., 2017), for Japanese Quails in the Starter and Grower Phases.

Table 4.16 - Equations Used to Estimate Metabolizable Energy, Crude Protein, Calcium, Phosphorus, SID Lysine, SID Methionine + Cystine, SID Threonine, SID Tryptophan, and SID Valine Requirements of Europeans Quails During the Starter and Grower Phases

Nutrients	Tested Levels	Variable	Equation	Effect	R ²
Starter (1 to 14 days)					
ME, kcal/kg	2900 ± 200	G	$-0.00000443X^2 + 0.02628X - 34.93071$	Quadratic	0.8509
CP, %	23 ± 2	FCR	$-0.14383X + 6.29883$	Linear	0.8988
Ca, %	0.850 ± 0.170	FCR	$-1.41943X^2 + 2.47279X + 0.7056$	Quadratic	0.9989
P, %	0.320 ± 0.064	G	$-34.58333X^2 + 25.10556X + 0.46289$	Quadratic	0.8590
SID Lys, %	1.370 ± 0.274	G	$0.785X^2 - 2.19972X + 6.31136$	Quadratic	0.9360
SID Met+Cis, %	1.040 ± 0.208	FCR	$13.54517X^2 - 31.287X + 20.4106$	Quadratic	0.9637
SID Thr, %	1.040 ± 0.208	G	$-8.73409X^2 + 21.3187X - 6.17068$	Quadratic	0.8424
SID Trp, %	0.190 ± 0.038	FCR	$-6.16667X^2 - 2.56667X + 2.69967$	Quadratic	0.8514
SID Val, %	1.010 ± 0.202	FCR	$9.36574X^2 - 21.18611X + 13.84527$	Quadratic	0.9295
Grower (15 to 35 days)					
ME, kcal/kg	3050 ± 200	G	$-0.00001408X^2 + 0.08764X - 127.94762$	Quadratic	0.8734
CP, %	20 ± 2	FCR	$-0.189X + 6.75467$	Linear	0.9502
Ca, %	0.700 ± 0.140	FCR	$5.50278X^2 - 7.75651X + 6.7185$	Quadratic	0.9431
P, %	0.270 ± 0.054	FCR	$97.58333X^2 - 62.21078X + 13.79108$	Quadratic	0.8737
SID Lys, %	1.020 ± 0.204	G	$-13.45652X^2 + 31.69957X - 11.5464$	Quadratic	0.9032
SID Met+Cis, %	0.800 ± 0.160	FCR	$15.53978X^2 - 26.56586X + 14.60265$	Quadratic	0.9484
SID Thr, %	0.780 ± 0.156	FCR	$8.1278X^2 - 14.5602X + 9.78411$	Quadratic	0.9735
SID Trp, %	0.150 ± 0.030	FCR	$-21.79825X + 7.16667$	Linear	0.8854
SID Val, %	0.760 ± 0.152	G	$-34.33242X^2 + 54.33137X - 14.57972$	Quadratic	0.8589

G: Weight Gain

FCR: Feed Conversion Ratio

Table 4.17 - Nutritional Requirements of European Quails During the Starter, Grower, and Total Production Period (kcal or g/bird/day)

Phase	Starter		Grower		Total	
	(1 to 14)		(15 to 35)		(1 to 35)	
Body Weight, g	8.5 – 63.52		63.52 – 236.98		8.5 – 236.98	
Gain, g/day	3.93		8.26		6.53	
Metab. Energy, kcal/day	34.23		70.36		55.91	
Diet Metab. Energy, kcal/kg	2966		3112		3054	
Intake, g/day	11.54		22.61		18.18	
Crude Protein, g/day	2.885		5.200		4.327	
Calcium, g/day	0.101		0.159		0.140	
Avail. Phosphorus, g/day	0.042		0.072		0.061	
Dig. Phosphorus ¹ , g/day	0.037		0.065		0.054	
Sodium ² , g/day	0.020		0.034		0.029	
Amino Acid	SID	Total	SID	Total	SID	Total
Lysine, g/day	0.162	0.184	0.266	0.305	0.230	0.263
Methionine, g/day	0.071	0.077	0.099	0.109	0.092	0.101
Met + Cys, g/day	0.133	0.156	0.193	0.218	0.177	0.203
Threonine, g/day	0.141	0.165	0.203	0.239	0.186	0.219
Tryptophan, g/day	0.024	0.027	0.041	0.046	0.035	0.039
Arginine, g/day	0.226	0.245	0.389	0.418	0.330	0.356
Gly + Ser, g/day	0.144	0.169	0.237	0.281	0.205	0.242
Valine, g/day	0.131	0.147	0.179	0.202	0.169	0.191
Isoleucine, g/day	0.285	0.300	0.541	0.571	0.440	0.465
Leucine, g/day	0.285	0.300	0.541	0.571	0.440	0.465
Histidine, g/day	0.092	0.099	0.165	0.177	0.138	0.148
Phenylalanine, g/day	0.163	0.177	0.293	0.318	0.244	0.265
Phe + Tyr, g/day	0.239	0.261	0.429	0.470	0.358	0.392

¹ Values were estimated using the phosphorus digestibility coefficients for Japanese Quails in the Starter and Grower Phase according to the Brazilian Tables for Poultry and Swine (Rostagno et al. 2017).

² Values obtained from the Tables for European Quails, 2009 (Silva e Costa, 2009).

Table 4.18 - Nutritional Requirements of European Quails During the Starter, Grower, and Total Production Period (%)

Phase	Starter		Grower		Total	
	(1 to 14)		(15 to 35)		(1 to 35)	
Body Weight, g	8.5 – 63.52		63.52 – 236.98		8.5 – 236.98	
Gain, g/day	3.93		8.26		6.53	
Metab. Energy, kcal/day	34.23		70.36		55.91	
Diet Metab. Energy, kcal/kg	2966		3112		3054	
Intake, g/day	11.54		22.61		18.18	
Crude Protein, %	25.0		23.0		23.8	
Calcium, %	0.871		0.705		0.771	
Avail. Phosphorus, %	0.363		0.318		0.336	
Dig. Phosphorus ¹ , %	0.323		0.283		0.299	
Sodium ² , %	0.170		0.150		0.158	
Amino Acid	SID	Total	SID	Total	SID	Total
Lysine, %	1.401	1.595	1.178	1.351	1.267	1.449
Methionine, %	0.611	0.666	0.438	0.481	0.507	0.555
Met + Cys, %	1.155	1.355	0.855	0.962	0.975	1.119
Threonine, %	1.220	1.432	0.896	1.056	1.026	1.206
Tryptophan, %	0.208	0.230	0.180	0.204	0.191	0.214
Arginine, %	1.961	2.121	1.720	1.851	1.816	1.959
Gly + Ser, %	1.247	1.467	1.048	1.243	1.128	1.333
Valine, %	1.131	1.277	0.791	0.895	0.927	1.048
Isoleucine, %	2.466	2.600	2.391	2.526	2.421	2.556
Leucine, %	2.466	2.600	2.391	2.526	2.421	2.556
Histidine, %	0.799	0.861	0.730	0.784	0.758	0.815
Phenylalanine, %	1.415	1.531	1.296	1.405	1.343	1.456
Phe + Tyr, %	2.073	2.265	1.897	2.081	1.967	2.154

¹ Values were estimated using the phosphorus digestibility coefficients for Japanese Quails in the Starter and Grower Phase according to the Brazilian Tables for Poultry and Swine (Rostagno et al. 2017).

² Values obtained from the Tables for European Quails, 2009 (Silva e Costa, 2009).