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Impact of the Feed Metabolizable Energy on Protein and Amino Acids Demand of Japanese Quails

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ABSTRACT

The production of Japanese quail has great importance in the production of foods and their nutritional needs are well established, yet still make feed based on recommendations misleading and can reduce the efficiency of production. The nutritional recommendations are presented in different countries and methodological ways to achieve levels, but an important detail is not often considered, the relationship between the nutrients, especially between metabolizable energy and other nutrients. On this basis, it is clear that there is a gap in this direction and this paper will discuss nutritional recommendations, compare levels and simulate diets practices to make an assessment of how best and most efficiently. Based on these data and discussion in this paper, it is concluded that Japanese quails have similar recommendations, but the metabolizable energy: nutrients ratio is different and not be considerate and this can adversely affect production and efficiency of quails.

Key words: Amino acids, energy, Japanese quail, requirements

INTRODUCTION

With the need to increase the production of quality food and high availability in the market, studies were performed for this purpose and the act of formulating diets became one of the most important steps in the process of global poultry production. Thus, to formulate diets commercially viable and possible to demonstrate all the genetic potential of the poultry, the diet formulator must understand the whole process complex and responsible for much of the efficiency of poultry. Such as balancing the diet properly so that the bird does not intake much or little amount of nutrients necessary for their higher yield potential, which it seems simple, it often does not occur satisfactorily.

Protein and energy are required for egg maintenance, growth and production, being the energy the main component in diet formulating for all animal species, because the energy regulates feed intake and as quails have feed intake higher than the layers in the live weight proportion (Silva *et al*., 2007a), diets with inadequate energy level can influence to a bigger or lesser feed intake and quail performance. The prediction models are mathematical tools that help the animal nutritionist to make decisions, correct and set new feeding programs based on optimizing the performance of quails (Silva *et al*., 2004ab) and therefore can influence better performance during the egg production phase.

On this basis, especially concerning to the modification of nutritional recommendations of the birds in recent years, as well as the influence of metabolizable energy on the need for protein and amino acids, this material is intended to report the influence and impact of metabolizable energy of Japanese quail on the nutritional requirements of protein and amino acids for these birds.

Metabolized Energy

The energy value is a very important expressing base to the value of nutritional importance of feed used in the diets. The high energy relative to low protein in the diet, namely, a high metabolizable energy: protein ratio reduces feed intake (Page & Andrews, 1973; Bertechini, 2004), which promotes a lower intake of protein and other essential nutrients, also raising the accumulation of abdominal fat. Likewise a low metabolizable energy: protein ratio raises the use of protein as an energy source, causing an increased metabolic cost and, of course, economical, invalidating the efficient production.

The energy level is one of the most important components in the formulation of poultry feed, considering that the birds feed intake to meet their energy needs initially. According to Moura *et al*. (2010), the feed intake is regulated by the energy density of the diet and by nutritional requirements, which consequently affects the egg performance and egg quality. Thus according to Bertechini (2006), all nutrients must be related to the energy content of the diet. Excess energy in the diet in the form of carbohydrates, lipids and proteins (disequilibrium in the amino acid profile) causes a reduction in voluntary intake by birds (Baião & Lara, 2005) and fat deposition in the carcass. According Bertechini (2006) excess fat in the liver and ovary may occur due to the imbalance of energy in the diets of commercial laying hens, promoting a reduction in egg production.

The existing recommendations of metabolizable energy for Japanese quails are not, among many, widely divergent. So, the NRC (1994) recommends a diet with 2900 kcal/kg metabolizable energy (ME) for Japanese quails at the initial phase and egg production phase, while Silva & Costa (2009) recommend similar values, but differentiate the quails in three distinct phases, ie, 2900, 3050, 2800 and 2850 kcal/kg ME to quails from 1 to 21, 22 to 42 days of age and in the I and II egg production phases, respectively. Rostagno *et al*. (2011) recommend a level of 2900 and 2800 kcal / kg ME for Japanese quail I and II growth phases, and in egg production phase, when the quails have, at this stage, a weight of 177g body weight, respectively.

Although the levels recommended for metabolizable energy of the three recommendations listed above are not quite variable, which draws more attention is the metabolizable energy: protein ratio of them. To get an idea, the NRC (1994) recommends a metabolizable energy: protein ratio of 120.8 and 145 for initial and egg production phase, respectively. Similarly, Silva & Costa (2009), based on the recommendations of metabolizable energy and crude protein, recommend a ratio of 116, 138.6, 140 and 129.5 for initial phase, growth, egg production I and egg production II. Meanwhile, Rostagno *et al.* (2011) recommend a ratio of 131.8 and 148.9.

Given this, we realize that we cannot formulate diets for quail just based on nutrition recommendations of metabolizable energy, but the important thing is to check what the ideal metabolizable energy: protein ratio is due, primarily not to promote changes in the metabolism of the Japanese quail that may cause loss in the efficiency of egg production. This effect on protein will influence, concomitant, the metabolizable energy: amino acids ratio and will affect in large scale the efficiency of the lot,because of the modified feed intake and amino acid disbalance that can be caused.

Moura *et al*. (2008) evaluated diets of different energy densities and metabolizable energy: nutrients ratios constantly in the feeding of Japanese quail and found an increase of 8.9% in feed intake when the energy density decreased from 2900 to 2500 kcal/kg. Freitas *et al*. (2005) also found a linear increase in feed intake by reducing the metabolizable energy level of Japanese quail. Thus, we can infer that the feeding behavior of Japanese quail is changed and that feed intake varies according to the level of dietary metabolizable energy directly influencing the quality of eggs produced.

Researches point the effect of different energy levels in the diet about the variables of egg production. Freitas *et al*. (2005) had observed a linear reduction in egg weight and egg mass with the increase in metabolizable energy level of the feed. Such authors have tested four levels of metabolizable energy (2585, 2685, 2785 and 2885 kcal/kg ME) in diets of Japanese quails and observed a 2.3% reduction in egg weight when compared to the egg weight of quails with feed diet containing 2585 and 2885 kcal/kg ME and 7.7% of reduction in the egg mass/hen/ day in these same metabolizable energy levels. Barreto *et al*. (2007) evaluating metabolizable energy levels (2650, 2750, 2850, 2950 and 3050 kcal/kg ME) in isonitrogenous diets (20% Crude Protein) for Japanese quails in initial phase of egg production observed linear reduction in feed intake, egg weight, yolk weight and albumen weight by the increasing of dietary metabolizable energy levels. It was further found that the increase in dietary metabolizable energy level has not resulted in an increase of yolk cholesterol concentration. Therefore, we can say that the low feed intake observed with the increasing metabolizable energy results in insufficient intake of nutrients for maintenance of egg weight and formation of their constituents, showing the adjustment of the bird between feed intake and energy in the detriment of reproductive processes, as the cholesterol present in the yolk of eggs is essential for embryo development.

The energy density of diet appear to exert little influence on the formation of the yolk, as Moura *et al*. (2010) evaluated the effect of the reduction in energy density (2900, 2800, 2700, 2600 and 2500 kcal/kg ME), keeping fixed the metabolizable energy: nutrients ratio from the diet on the characteristics of Japanese quail eggs, found no significant differences to the weight percentage of yolk, albumen and egg shell. Significant differences in weight and yolk percentage were not found by Costa *et al*. (2004) when evaluated diets with levels of 2700, 2800 and 2900 kcal/kg ME and 17.5% crude protein in laying hens. The results related to yolk suggest that Japanese quails and laying hens usually are not influenced by the energy density in the yolk formation, in other words, the percentage of egg yolk produced has values near to 30% of the egg weight.

Protein and Amino Acids to Japanese Quails

For many years, studies in poultry nutrition evaluated animal performance based on the levels of crude protein dietary. However, due to the increase in production costs associated with the rising prices of feed used as protein sources in the poultry diets, such as soybean meal, research began to evaluate the bird's nutritional requirements with respect to the levels of essential amino acids, what has become possible due to higher industrial production of amino acids by the feed industry. Thus, based on the protein structure knowledge, the poultry, in fact, do not have a specific requirement for crude protein, but for essential and non essential amino acids, the latter being synthesized from non-specific nitrogen, so that the energy: protein ratio ceases to be the first in importance, because what most affects the performance of Japanese quail is the energy: amino acids ratio.

Research conducted with laying hens show the relationship between the levels of methionine and egg weight, showing that the increasing levels of methionine promotes a higher egg weight (Pinto *et al*., 2003; Freitas *et al.*, 2005). This occurs, possibly, by the fact that methionine is the initiator amino acid of protein synthesis and one of its main functions is to act on the weight and number of eggs. These values agree with the ones presented by Novak *et al*. (2004) who found that higher intake of methionine and lysine significantly influenced the weight of albumen.

According to Pinto *et al*. (2003) increased levels of methionine + cystine may cause amino acid disbalance, promoting reduction of protein synthesis and inhibiting the absorption of the limiting amino acids, along with an increase in the catabolism thereof. This is because, unlike what happens with carbohydrates and lipids, the birds present low ability to store protein. Thus, the bird may suffer from deficiency of vitamins, such as choline, which in these conditions can promote fat accumulation in the liver, generating a hepatose.

The estimate of its requirement in poultry feed provides adequate balance of diets based on the ideal protein concept, since lysine is considered the standard for establishing the protein requirements and other amino acids. This way, having lysine as the limiting amino acids standard, any changes to your requirement or recommendation, either by environmental factors, dietary or genetics, will not change the ratio of the ideal lysine and other amino acids, for it is always constant, but that does not mean that will be the same dietary level.

Costa *et al*. (2008) determined the digestible lysine requirements for Japanese quails and found that egg production was influenced and was higher in the level of 1.03% of digestible lysine. Similar results were observed by Ribeiro *et al*. (2003), who found higher egg production with 1.07 and 1.15% of total lysine in diets containing 20 or 23% of crude protein, respectively. Similarly, Pinto *et al*. (2003) estimated for better egg production, requirement of 1.045% digestible lysine in the diet. Already Garcia *et al*. (2005) evaluated three levels of protein (16, 18 and 20%), three of methionine + cystine (0.700, 0.875 and 1.050%) and two levels of lysine (1.100 and 1.375%) during the egg production phase of Japanese quail verified increase in the percentage of egg yolk with the increasing levels of methionine + cystine, but the protein had no effect on this variable. No effect was observed in the protein, methionine + cystine and lysine on the percentage of albumen. The percentage of protein in the yolk was influenced by the levels of protein and methionine + cystine, where quails fed with 18% or 20% of crude protein had higher levels of protein in the yolk compared to quails fed with 16%. As for methionine + cystine, the level of 0.700% provided higher amount of protein in the egg yolk, compared to the 0.875% level.

The excess of methionine causes a reduction in the growth of poultry due to a defect generated around threonine, with a reduction in plasma of threonine. Another factor is about the lysine amino acid, its excess can cause a deficiency of threonine (Umigi *et al*. 2007). Thus, a way to prevent any excess or lack of any amino acid, particularly threonine, is the study and evaluation of the best threonine: lysine ratio.

Lima *et al*. (2013) evaluating the supplementation of threonine from 0.66 to 0.86% varying 0.04% in each of total threonine level in diets of Japanese quails, equivalent to ratios of 66, 70, 74, 78, 82 and 86 with the total lysine. The authors found no significant effect on feed intake, as observed previously by Umigi *et al*. (2007), but unlike the data from Umigi *et al*. (2007) they found a quadratic effect on the egg production, egg weight, egg mass, egg mass conversion and the egg dozen conversion obtaining optimal ratios of 77, 75, 78, 79 and 81, respectively. The performance of Japanese quail can be significantly improved by supplementation of threonine in the diets and the levels recommended by the NRC (1994) no longer appear to attend the daily needs of the Japanese quails, which makes the levels recommended by Silva & Costa (2009) and Rostagno *et al*. (2011) to be more befitting with reality and corroborate with the recent literature.

Therefore, the threonine appears to influence the performance of the quails, but not the quality of the eggs, although noticeable histological differences in the reproductive system of the birds, according to Lima *et al*. (2013) when reported that the highest threonine: lysine ratio in diets of laying Japanese quail, the tubular glands of the magnum were presented in greater numbers, more active functional stage and presenting higher amount of albumen, which, according to the authors these features allow that the egg production to be done in a shorter period of time, thereby increasing egg production, egg weight, egg mass, egg mass conversion and egg dozen conversion. Lima *et al* (2013) also found that increasing threonine: lysine ratio also increased the amount of secondary folds of these quails uterus. Such characteristics, according to the authors, allow the formation of the shell in a shorter time, increasing, thus, the egg production since the egg formation is located in the uterus for a variable time to the deposition of calcium carbonate, being this one accelerated by the increase of the internal surface of the organ.

According to the NRC (1994), the requirement of total tryptophan for Japanese quails in the initial phase and in reproduction is of 0.22 and 0.19%, with 24 and 20% CP and 2,900 kcal of ME/kg diet, respectively. Shim & Lee (1993) reported that, for optimum egg production and feed efficiency in the diets of laying quails shall contain, in total amino acids, 1.0% of lysine, 0.43% of methionine, 0.18% of tryptophan and 0.63% of threonine. However, studies performed by Shim (1984) determined the requirement of 0.25% of total tryptophan. Leeson & Summers (2005) disagreed with the previous authors, recommending 0.22% of total tryptophan in the diet of quail production phase.

Pinheiro *et al*. (2008) evaluated the levels of tryptophan in the Japanese quail's diet, using quails with 21-30 weeks of age, with weight and egg production averaging 158.5 g and 84.50%, respectively. The quails were fed with isocaloric and isoproteic diets, except for to the digestible tryptophan, which were, for each experimental diet, 0.120 to 0.280%, with a range of 0.04% for each level of digestible tryptophan, totalizing five levels, what corresponded to the digestible tryptophan: lysine digestible ratio at 12, 16, 20, 24 and 28%, respectively. After analyzing the data, the authors verified tryptophan influence on the tryptophan intake and in egg production, so that they had a linear increasing effect in relation to the tryptophan level in the diet, where for each 1% of the digestible tryptophan in the diet, the egg production increased 1.26%. The results obtained from Pinheiro *et al*. (2008) confirm those obtained by Harms & Russell (2000) and Deponti *et al*. (2007), that had worked with laying hens and observed improvements in egg production, as increasing levels of tryptophan were added to the diets.

Pinheiro *et al*. (2008) recommended 0.21% of digestible tryptophan, corresponding to the intake 45.0 mg of digestible threonine/quail/day for better performance and egg quality of Japanese quail. Moreover, Rizzo *et al*. (2008), working with tryptophan levels between 0.23 and 0.98%, found no effect on performance or on the physiological parameters of Japanese quail, concluding that 0.23% of tryptophan in diets with 18% protein gross and 2800 kcal ME / kg, are sufficient for these quails.

According to studies mentioned and discussed above, it is noticed the variation on the tryptophan nutritional recommendations for Japanese quails, since that there are few researches about these amino acids. Therefore, when comparing the suggested recommendations to Japanese quail with the suggested for laying hens, it is perceived the similarity in the diet level, however, as the quails intake about 25% of the laying hen diet quantity, so what directly influences is the energy daily intake, that will modify and regulate the amino acids intake. So the energy really determines the amino acid intake in Japanese quail, because if we base on a diet with 2900 kcal ME, one laying hen consuming 100g/bird/day and Japanese quail consuming 25g/bird/day, would be consuming 290kcal and 72.5 kcal/kg daily.

Comparative of the Nutricional Recommentadions for Japanese Quails

Based on the previously commented, the protein and energy are prymordial factores in an efficient diet and need to be always correlated. The knowing of the metabolize energy: nutrients ratio is essencial for the success of the Japanese quail production, as in any other animal production, principally because in the poultry production, more specifically the Japanese quail production, the feed offer is at will and so, the nutritional recommendations must be balanced according to energetic content of the diets that quails are consuming, which requires a correction as it alters the energy level of poultry feed.

Based on this, we will go further to do a practical comparative on nutritional recommendations such as those suggested by NRC (1994), Silva & Costa (2009) and Rostagno *et al*. (2011).When comparing the recommendations, according to Table 1, we found out that the level of metabolizable energy practically does not differentiate more than 4 points, especially, in the initial stages. The NRC (1994) maintains the same recommendation for initial and laying phase, Silva & Costa (2009), in the other hand, recommend varying levels, similar to Rostagno *et al*. (2011). However, Rostagno *et al*. (2011) divides the rearing phases of the quails production in just two phases, like the NRC (1994), unlike Silva & Costa (2009) that divides the rearing phases into four distinct phases, recommending specific nutritional levels for each one of them.

Table1. Resume of the nutritional recommendations of amino acids to Japanese quails according to NRC (1994), Silva & Costa (2009) and Rostagno *et al*. (2011)

Items	NRC(1994)		Silva & Costa (2009)				Rostagno (2011)	
	Initial	Laying	Initial (1-21d)	Growth. (22-42d)	LayingI	Laying II	Growth I and II	Laying (177g/quail)
Crude Protein,%	24	20	25	22	20	22	22	18.8
Metabolized Energy, kcal/kg	2900	2900	2900	3050	2800	2850	2900	2800
Arginine, %	1.25	1.26	1.16	1.05	1.26	1.38	1.19	1.273
Isoleucine,%	0.98	0.9	0.89	0.74	0.87	0.96	0.8	0.713
Lysine,%	1.3	1.0	1.19	1.05	1.03	1.05	1.12	1.097
Methionine +Cystine, %	0.75	0.7	0.8	0.74	0.7	0.72	0.76	0.9
Threonine, %	1.02	0.74	0.87	0.82	0.67	0.73	0.79	0.658
Tryptophan,%	0.22	0.19	0.2	0.15	0.18	0.2	0.21	0.23
Valine, %	0.95	0.92	0.84	0.74	0.87	0.94	0.95	0.823

Even though we realize a similarity in data presented on Table 1 of the recommendations, especially, when it comes to metabolizable energy and crude protein, in Table 2, we realized that is not enough to compare these two factors, but relations between the the other nutrients, because in Table 2 we introduce the metabolizable energy: nutrients ratio diets.

Table 2. Metabolizable energy: nutrients ratio based on the recommendations suggested by NRC (1994), Silva & Costa (2009) and Rostagno *et al*. (2011)

Item, %	NRC(1994)		Silva & Costa (2009)				Rostagno (2011)	
	Initial	Laying	Initial (1-21d)	Growth (22-42d)	Laying I	Laying II	Growth I and II	Laynig I (177g/bird)
Crude Protein	120.8	145.0	116.0	138.6	140.0	129.5	131.8	148.9
Arginine	2320.0	2301.6	2500.0	2904.8	2222.2	2065.2	2437.0	2199.5
Isoleucine	2959.2	3222.2	3258.4	4121.6	3218.4	2968.8	3625.0	3927.1
Lysine	2230.8	2900.0	2437.0	2904.8	2718.4	2714.3	2589.3	2552.4
Methionine	5800.0	6444.4	6304.3	7439.0	7179.5	6785.7	6904.8	5668.0
Methionine + Cystine	3866.7	4142.9	3625.0	4121.6	4000.0	3958.3	3815.8	3111.1
Threonine	2843.1	3918.9	3333.3	3719.5	4179.1	3904.1	3670.9	4255.3
Tryptophan	13181.8	15263.2	14500.0	20333.3	15555.6	14250.0	13809.5	12173.9
Valine	3052.6	3152.2	3452.4	4121.6	3218.4	3031.9	3052.6	3402.2

As seen before, Table 1 shows some similarity. However, when we calculate the metabolizable energy: Nutrients ratio we realize that there are far more differences than we have observed, either among the recommendations or between phases of growthig quail for all nutrients. To have an idea, the crude protein recommended for Initial Growth, and of Growth I and Growth II in diets of Japanese quail according to NRC (1994), Silva & Costa (2009) and Rostagno *et al*. (2011) is very similar, since recommended levels of 24, 25, 22 and 22%, respectively. But when we calculate the ME:CP ratio, we find much difference, as can be seen in Figure 1.

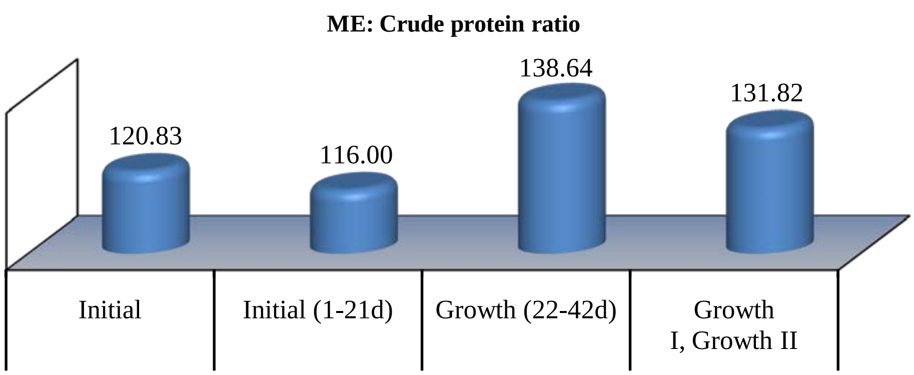

Figure1. Metabolizable energy: Crude protein ratio in the initial phases of Japanese quails according to the suggested recommendations by NRC (1994), Silva & Costa (2009) and Rostagno et al. (2011).

The variation shown in Figure 1 represents a great variation that can surely influence the performance of Japanese quails in the initial stages directly and possibly affect the performance in the later stage, ie laying phase. The appropriate metabolizable energy: crude protein ratio is vital for the perfect performance of Japanese quail and the metabolizable energy: amino acids ratio seems to expose in more details the best diet for Japanese quail today, especially, because it is not worth a diet with high crude protein if this is not of good quality, ie, there is disbalance of their fundamental units, the amino acids.

Also based on Figure 1, we see that the metabolizable energy: crude protein ratio recommended by the NRC (1994), is similar to that recommended for the same age, 1-21 days, by Silva & Costa (2009). However, Rostagno *et al*. (2011), by joining the phases of Growth I and Growth II in just a recommendation, can, in one of two phases of growth, be overestimating this ratio or not, because if we compare the ratio recommended by Silva & Costa (2009), such ratio is lower, so there is more crude protein in relation to the metabolizable energy level, which could, into what we highlighted in the previously text, change the metabolism of Japanese quail and influence on the protein and fat tissue deposition of the quail.

Knowing the importance of lysine in the in the ideal protein concept, is perceived that there is significant variation between the recommendations presented here. This variation on the metabolizable energy: lysine ratio is more significant in the laying phase of the Japanese quail. We can see in Figure 2 that there is a variance of at least 400 points between the ratio recommended by the NRC (1994) and Rostagno *et al*. (2011).

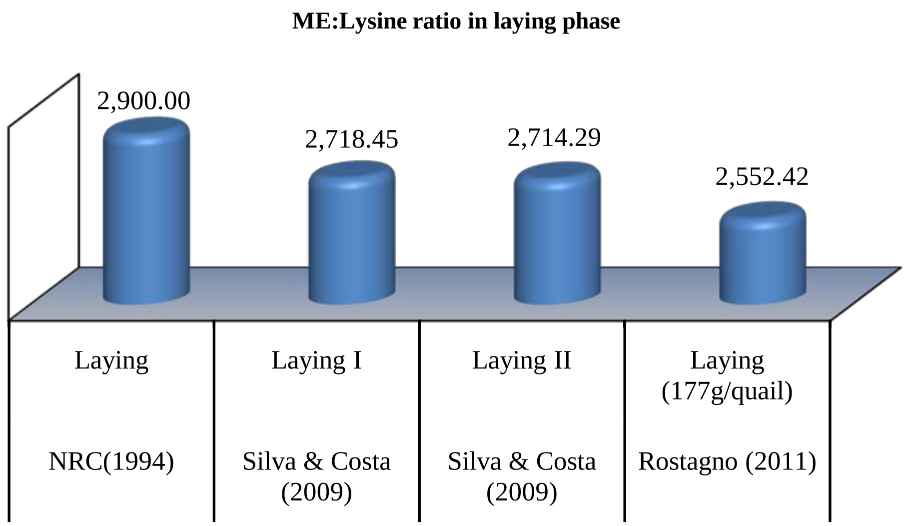

Figure 2. ME: Lysine ratio in lying phase of Japanese quail according to the recommendations suggested by NRC (1994). Silva and Costa (2009) and Rostagno et al. (2011).

Comparing the recommendations in a chronologically way, the reduction in the ME: Lysine ratio, does not indicate an elevation of the metabolizable energy recommendations, but actually a higher growth of the daily requirement of lysine in the Japanese quail diets, since this level increased from 1.0 to 1.12% from 1994 to 2011. Bearing in mind that the data recommended by the NRC (1994) are based on total amino acids, while the recommendations made by Silva & Costa (2009) and Rostagno *et al*. (2011) are based in digestible amino acids, what shows even more growth.

For the comparative presented here, is perceived that there is a discrepancy between the recommendations in several aspects and that the formulation of a diet should, with no doubt, have these dots well connected. Especially in energetic level, lysine level and levels of the remaining amino acids, for all may suffer important variations, and any erroneous manipulation in mentioned items above can directly compromise the performance and efficiency of the Japanese quail production system.

Comparative of a practical formulation

Based on what was mentioned in this material about metabolizable energy: nutrient ratio and nutritional recommendations of Japanese quail suggested by NRC (1994), Silva & Costa (2009) and Rostagno *et al*. (2011), we will simulate practical diets formulations for these Japanese quails. The intention is to correlate in a clear and practical form the recommendations and, if possible, comment about the levels suggested and practiced, especially, on the economic effects caused by the choice.

Thus, in order to maintain the homogeneity of the data to be used in the diets formulations and economic evaluation, feed intake and daily egg production will be set at 25.5 g and 87.5%, respectively. The diets formulations presented in Table 3 are for Japanese quails in 40-240 days of age, and to generate data more convincing and real as the quail economic production, we will repeat this evaluations in the same time, i.e. simulate the production of four lots of quail under the same conditions.

Table 3. Diets according to the recommendations suggested by NRC (1994), Silva & Costa (2009) and Rostagno *et al*. (2011)

Item		NRC(1994)	Silva & Costa (2009)	Rostagno *et al.* (2011)
Corn		54.227	57.219	61.215
Soybean meal		35.367	31.362	29.011
Limestone		5.237	7.272	6.675
Soybean oil		3.026	2.191	0.954
Phosphate dicalcium		1.583	1.048	1.080
Salt		0.333	0.535	0.322
Choline		0.07	0.07	0.07
DL- Methionine		0.056	0.135	0.356
Vitaminic Mix		0.05	0.05	0.05
Mineral Mix		0.05	0.05	0.05
L-Lysine			0.017	0.159
L-Tryptophan				0.013
L-Isoleucine			0.052	
L-Arginine				0.044
Total		**100.00**	**100.00**	**100.00**
Cost/kg	U$	0.863	0.830	0.827
Crude Protein	%	20.00	20.00	18.80
Calcium	%	2.50	3.15	2.922
Available phosphorus	%	0.40	0.30	0.304
Metabolizable Energy	kcal/kg	2900	2800	2800
Total Arginine	%	1.26		
Digestible Arginine	%		1.26	1.273
Total Isoleucine	%	0.90		
Digestible Isoleucine	%		0.87	0.713
Total Lysine	%	1.00		
Digestible. Lysine	%		1.03	1.097
Total Methionine + Cystine	%	0.70		
Digestible Methionine + Cystine	%		0.70	0.90
Total Threonine	%	0.74		
Digestible Threonine	%		0.67	0.658
Total Tryptophan	%	0.19		
Digestible Tryptophan	%		0.18	0.23
Total Valine	%	0.92		
Digestible Valine	%		0.87	0.823
Sodium	%	0.15	0.23	0.146
Chlorine	%	0.14	0.24	0.240*
Potassium	%	0.40	0.46	0.460*

*Recommendations of Silva & Costa (2009)

Observing the diets, is perceived that industrial amino acid supplementation was, as expected, higher in the diets formulated based on the current recommendations, which can be explained due to the higher recommended levels. This greater amino acid supplementation has made it possible the easily attendance of the crude protein, which in the case of the recommendations suggested by Rostagno *et al*. (2011) is lower than the others. Furthermore, the amino acid supplementation provided a reduction in the Soybean meal and Soybean oil as well as an increase of the level of Corn, such as industrial amino acids have, in addition of amino acids at issue, metabolizable energy and crude protein, and with their use in feed, allows an enrichment of these items, reducing the importance of these sources of crude protein and metabolizable energy in feed currently practiced in the production of Japanese quail. Based on data, provided by the diets formulated, presented in Table 3, was calculated the cost per pound of diet, which made possible the economic evaluation, shown in Table 4.

Soon the production cost of a dozen eggs is influenced and, logically, the profir gross margin and, when we compare the data with the diet at levels recommended by the NRC (1994) we realized that, although diets have subsequent industrial amino acid supplementation, what appears to be a factor of higher costs, the relative gross margin was higher than 1.65 and 1.80% in the diets formulations that attended the recommendations of Costa & Silva (2009) and Rostagno *et al*. (2011), respectively.

Table 4. Economic evaluation of diets formulated according to the recommendations suggested by NRC (1994) Silva & Costa (2009) and Rostagno *et al*. (2011)

Variables	Used Recommendations		
	NRC	Silva & Costa	Rostagno
Feed Intake in Period of 200 days, kg/quail	5.10	5.10	5.10
Cost of Feed in the Period, U$/quail	4.40	4.23	4.22
Egg Dozen, dozen/quail	14.58	14.58	14.58
Cost of Feed for Egg Dozen, U$/ dozen	0.30	0.29	0.29
Gross Income, U$ (U$ 1,00/dozen)	14.58	14.58	14.58
Gross Margin U$	10.18	10.35	10.37
Relative Gross, %	100.00	101.65	101.80

Although it seems a small difference in a gross margin, let remember that the calculations were made based on taking only one Japanese quail of 40-240 days old. If we consider that a commercial production shed of Japanese quail houses an average of 10 thousands quails, the gross margin of diets based in the recommendations suggested by Silva & Costa (2009) and Rostagno *et al*. (2011) would have an increase of U$ 1,683.00 and U$ 1,836.00, respectively. If we consider the repetition of these diets formulations on time, as mentioned previously, in a hypothetical situation, we would have a savings of U$ 6,732.00 and U$ 7,344.00, respectively.

So even though the changes in nutritional recommendations for these birds, we realized that the metabolizable energy enforces great deciding factor in the diets formulations, because as we have seen it is not very discrepant in the recommendations presented, but the other nutrients are, in particular the amino acids, and this causes clear changes in production performance, so far as to even keeping the same zootechnical parameters, yet there is economic loss. Hence, the maintenance of the metabolizable energy levels of diets is interesting, but for any modifications of it, is necessary to balance the diets based on the other nutrients and to verify the influence of any changes on the economic impact due to the importance of animal production activity, ie, it must be able to promote greater financial return, the profit, so that it can maintain and develop efficient and fulfill, in quantity and quality, the prerequisites of any food production, as previously mentioned at the beginning of this material .

Final Considerations

Despite of its great economic significance, few researches has been done concerning nutritional requirement of Japanese quails, being the diet formulation for this birds usually made based on charts, like the National Research Council - NRC (1994) and Institute National de la Recherch Agronomique – INRA, or by extrapolation of the requirements for some laying hens or broiler chickens. Nevertheless, Silva & Costa (2009) published the Japanese and European Quails Tables, where it's possible to obtain several nutritional recommendations, and yet Rostagno *et al*. (2011) besides that had already contemplate nutritional recommendations of laying hens, broiler chicken and breeders on poultry's recommendation, included in this last edition, the Japanese quails. Although, the data presented by Silva & Costa. (2009) are more complete and the information amount is bigger than the cited recommendations, ensuring a greater reliability for the quail farmer.

The use of inappropriate levels of amino acids may lead to a lower performance of Japanese quails, since the deficiency results in the limitation of the protein synthesis, with consequent decrease of weight gain and egg production in the same way that the excess can result in deviation of the energy for the process of excretion, reducing, thus, the energy to be used for the egg production, besides environmental cost of increased nitrogen excretion. This effect is more real when there is a constant search for reduction of the contents of crude protein of the feed, since this reduction is not totally efficient, since it can lead to a situation in which other amino acids such as threonine and tryptophan, for example, become bounds to the best performance of Japanese quails. In this way, to achieve the increased performance of Japanese quails submitted to these feed diets with higher crude protein reductions; one should take care to establish more precisely the nutritional requirements of amino acids.

Another aspect based on the information that the energy regulates feed intake of the birds is that it is not enough to recommend the level of a nutrient, such as lysine, but recommend the daily intake of it, since the influence of the energy can, due to factors previously commented, alter feed intake and logically intake of amino acids. If there is a higher energy density, then the diet should be more concentrated in certain nutrients, so that when the Japanese quail satisfy the hunger it can be possible to meet their nutritional needs in the most complete and as satisfying form as possible. This way the nutritional recommendations can be made based on the energy content of the diets, in other words, the amino acid mg/kcal per kg of diet.

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