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Classification of the Coefficients of Variation of Parameters Evaluated in Japanese Quail Experiments

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ABSTRACT

The objective of this study was to design a classification range of the coefficients of variation (CV) of traits used in experiments with egg-type Japanese quails (Coturnix coturnix japonica). The journal *Revista Brasileira de Zootecnia* was systematically reviewed, using the key word 'quail' during the period of January, 2000 to 2010. The CV of feed intake (g/bird/d), egg production (%/bird/d), egg weight (g), egg mass (g/bird/d), feed conversion ratio per dozen eggs (g/dozen), feed conversion ratio per egg mass (g/g), and egg specific gravity (g/mL) were collected. For each parameter, CV were classified using the following median (MD) and pseudo-sigma (PS) ratio as follows: low (CV ≤ MD – PS), medium (MD – PS < CV ≤ MD + PS), high (MD + PS < CV ≤ MD + 2PS) and very high (CV > MD + 2PS). According to the results, it was concluded that each parameter has a specific classification range that should be taken into account when evaluating experimental precision.

INTRODUCTION

The coefficient of variation is obtained by the residual standard deviation as a percentage of the general mean of the experiment. Therefore, it measures experimental precision because the residual standard deviation is the square root of residual mean square, which contains all the variation due to experimental error. In addition, the CV allows comparing experiments, independently of the unit used.

In experiments with Japanese quails, there are reference values of specific CV that identify classification ranges relative to their degree of precision, as it happens in pig production (Judice *et al*., 1999), beef cattle (Judice *et al*., 2002), equine nutrition (Lana *et al*., 2006), broilers (Mohallem *et al*., 2008), and commercial layers (Faria Filho *et al*., 2010).

Therefore, the distribution of CV values in experiments with Japanese quails need to be studied, as most researchers have compared their results with the classification suggested by Gomes (2000) as low, when CV values are lower than 10%; medium, with CV values between 10 and 20%, high, with CV value between 20 and 30%, and very high, when CV values are higher than 30%.

Amaral *et al*. (1997) and Judice *et al*. (1999) suggest that the normality of CV distribution should be determined to establish variability ranges. However, working with upland rice crops, Costa *et al*. (2002) presented a new method of CV classification that can be applied with data do not have normal distribution. This method is based on the use of median and pseudo-sigma, instead of mean and standard deviation.

In order to obtain a consistent compilation of published studies, the method of systematic literature review can be used (Castro *et al*. 2002). This is a scientific technique to review literature, using specific methods to identify, select, and critically analyze relevant studies. Therefore, search strategy, databases, period of review, and criteria for the inclusion of studies must be previously defined. All these aspects should be mentioned in the text. Excluded articles must be mentioned and their exclusion justified. This will render these systematic reviews reproducible and, in general, unbiased.

This study aimed at verifying if the parameters evaluated in experiments with Japanese quails (*Coturnix coturnix japonica*) have specific classification ranges of the coefficient of variation by using the method of systematic literature review for data collection and the method of Costa *et al*. (2002) to classify the CV.

MATERIALS AND METHODS

The systematic literature review (Castro *et al*., 2002) was carried out using the journal *Revista Brasileira de Zootecnia* of issues published between January, 2000 and January, 2010. The website of *Sociedade Brasileira de Zootecnia* (Brazilian Society of Animal Science) was accessed (www.sbz.org.br; access in April, 2010) and the path revista → revista on-line → entrar → consulta por palavra-chave (journal → online journal → enter → search key word) was followed. The key word used was "quail" to search in Portuguese the fields title, key words, and abstract.

Studies with egg-type Japanese quails (*Coturnix coturnix japonica*) during lay and presenting CV for at least one of the following parameters were selected: feed intake (g/bird/d), egg production (%/bird/d), egg weight (g), egg mass (g/bird/d), feed conversion ratio per dozen eggs (g/dozen), feed conversion ratio per egg mass (g/g), and egg specific gravity (g/mL).

The number of observations, minimum and maximum values, mean and standard deviation were calculated. The median (MD) was calculated according the equation: MD = (Q1 + Q3)/2, where Q1 is the first quartile and Q3 is the third quartile. pseudo-sigma (PS) was calculated according to the equation: PS = (Q3 – Q1)/1.35 (Tukey, 1977). Data normality was evaluated by the Cramer-Von-Mises test. Analyses were carried out using SAS® software package (Littell *et al*., 2002).

CV ranges were determined according to the methodology proposed by Costa *et al*. (2002) as a function of MD and PS. The following CV ranges were determined: low (CV ≤ MD – PS), medium (MD – PS < CV ≤ MD + PS), high (MD + PS < CV ≤ MD + 2PS), and very high (CV > MD + 2PS).

RESULTS AND DISCUSSION

The systematic literature review found 41 articles, out of which 24 were selected: Araújo *et al*. (2007), Barreto *et al*. 2007 a, 2007 b, 2007 c, 2007 d), Costa *et al*. (2007), Costa *et al*. (2008 a, 2008 b), Costa *et al*. (2009), Freitas *et al*. (2005), Mori *et al.* (2005), Moura *et al*. (2008), Murakami *et al*. (2006), Oliveira *et al*. (2009), Pinheiro *et al*. (2008), Pinto *et al*. (2002), Pinto *et al*. (2003 a, 2003 b), Ribeiro *et al*. (2003), Rizzo *et al*. (2008), Silva *et al*. (2002), Silva *et al*. (2003), Soares *et al*. (2007), and Umigi *et al*. (2007).

The number of observations, minimum and maximum values, mean, standard deviation, median, pseudo-sigma, and Cramer-Von-Mises test results of the CV values of the evaluated parameters are presented in Table 1. Only feed intake CV values presented normal distribution, and therefore the methodology proposed by Costa *et al*. (2002) was applied to establish CV classification ranges because it does not assume data normality.

Table 2 shows the CV classification ranges for the main parameters used in Japanese quail experiments.

The parameter egg specific gravity is highlighted as its classification range is very narrow, which indicated it is a very stable parameter. The same behavior of egg specific gravity results was found by Faria Filho *et*

Table 1 – Number of observations (N), minimum value (Min), maximum value (Max), mean (X), standard deviation (SD), median (Me), pseudo-sigma (PS), and Cramer-Von-Mises normality test of feed intake (FI), egg production (EP), egg weight (EW), egg mass (EM), feed conversion ratio per dozen eggs (FCRDz), feed conversion ratio per egg mass (FCREM), and egg specific gravity (ESG) of egg-type Japanese quails.

Parameter	N	Min	Max	Mean	SD	Me	PS	Normality
FI	24	2.48	11.19	5.23	2.12	5.08	2.25	0.08 ns
EP	25	2.50	16.23	6.93	3.68	7.13	3.55	0.15*
EW	23	1.37	6.22	3.17	1.06	2.95	0.78	0.13*
EM	23	3.50	15.81	8.02	3.62	7.34	3.61	0.15*
FCRDz	19	3.30	34.67	8.31	7.01	6.74	3.14	0.37**
FCREM	22	3.17	39.96	9.18	7.95	7.54	4.20	0.36**
ESG	8	0.09	2.06	0.47	0.69	0.33	0.30	0.27**

ns = not significant, * p<0.05, ** p<0.01

Table 2 – Coefficient of variation ranges (CV, %) of feed intake (FI), egg production (EP), egg weight (EW), egg mass (EM), feed conversion ratio per dozen eggs (FCRDz), feed conversion ratio per egg mass (FCREM), and egg specific gravity (ESG) of egg-type Japanese quails.

Parameter	Low	Medium	High	Very high
FI	CV ≤ 2.83	2.83 < CV ≤ 7.33	7.33 < CV ≤ 9.58	CV ≤ 9.58
EP	CV ≤ 3.58	3.58 < CV ≤ 10.67	10.67 < CV ≤ 14.22	CV ≤ 14.22
EW	CV ≤ 2.17	2.17 < CV ≤ 3.72	3.72 < CV ≤ 4.50	CV ≤ 4.50
EM	CV ≤ 3.73	3.73 < CV ≤ 10.94	10.94 < CV ≤ 14.55	CV ≤ 14.55
FCRDz	CV ≤ 3.60	3.60 < CV ≤ 9.88	9.88 < CV ≤ 13.02	CV ≤ 13.02
FCREM	CV ≤ 3.35	3.35 < CV ≤ 11.72	11.72 < CV ≤ 15.90	CV ≤ 15.90
ESG	CV ≤ 0.02	0.02 < CV ≤ 0.63	0.63 < CV ≤ 0.93	CV ≤ 0.93

al. (2010) in experiments with commercial layers. On the other hand, feed conversion ratio per egg mass presented the widest CV classification range.

The classification of coefficients of variation in the present study should be used as reference by researchers to verify if the CV results obtained, and consequently the precision of their experiments, are within the acceptable range of values. When comparing the classification ranges used in the present study with that proposed by Gomes (2000), in which CV values lower than 10% are considered low, between 10 and 20%, medium; between 20 and 30%, high; and higher than 30% are very high, it is clear that this proposed range does not apply to Japanese quails. For instance, 8% CV would be considered low in the classification of Gomes (2000), but according to our classification, it is very high for the parameters egg weight and egg specific gravity. This difference may be due to the fact that the proposal of Gomes (2000) is based on agronomic parameters. Moreover, there is considerable variation among animal species, and there are specific classifications for pigs (Judice *et al*., 1999), beef cattle (Judice *et al*., 2002), equine nutrition (Lana *et al*., 2006), broilers (Mohallem *et al*., 2008), and commercial layers (Faria Filho *et al*., 2010).

CONCLUSIONS

It is concluded that there is a specific classification range for each parameter evaluated in egg-type Japanese quails (*Coturnix coturnix japonica*) that should be taken into account when evaluating experimental precision.

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