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EGG PRODUCTION PERFORMANCE OF THE LOCAL RI HEN AND ITS CROSSBREEDS WITH ISA-BROWN STRAIN IN SEMI-INTENSIVE CONDITIONS

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Abstract

A cross between the ISA-Brown industrial strain and Vietnamese local (Ri) breed was compared with the Vietnamese local (Ri) hen. The comparison during the egg production period was done in individual cages, in a ventilated henhouse without any particular isolation. The same commercial diet has been provided over three time periods (35 to 36 weeks, 50 to 51 weeks and 65 to 66 weeks of age). Egg number and body weight at first egg was significantly lower in the Ri local breed. Mortality was almost equal during the breeding and the egg production periods for the two genotypes. The Ri hen eggs, in spite of a lower weight (43.70 to 53.37 g respectively at the same age), gave yolk to albumen ratio similar to that of the ISARI cross (0.52 to 0.58 g respectively at the same age). Finally, the ISARI cross was better in terms of egg production and egg quality than the local hen, in the test conditions.

Key words: Vietnam, biodiversity, Ri, local hen, egg production, egg quality

Abbreviations: Body weight (BW); Egg production period (EPP); F1 ♀Isa-brown x ♂Ri (ISARI); yolk to albumen ratio (Y/A).

Introduction

For millennia, bird eggs and particularly chicken eggs constitute an essential food source for humans (Van et al., 2015; Nau et al., 2003). The egg is considered by WHO as a "perfect natural food", belonging to this small category of complete proteinic foods. It contains the nine essential amino acids (Stadelman and Pratt, 1989). Eggs constitutes a rich source of proteins, lipids, minerals and vitamins which can be extracted again easily. Proteins are a vital component of human nutrition, needed in all physiological functions of the body. The low cost of the egg makes it an easily accessible source of proteins and lipids (Nys and Sauveur, 2004). Eggs are accepted as food all over the world and are not forbidden by any culture or religion (Bessadok et al., 2003).

The evolution of life styles and consumption habits with the development of fast food has increased its demand. Indeed the egg proteins are ingredients which are incorporated in many foods (Mine, 2002). Egg production and consumption through the world have tripled since the sixties and continue to increase with regularity (Gillin and Sakoff, 2003).

Nowadays, eggs are more than a source of dietary food. Their antioxidant effects, cryoprotector, antibacterial, antiviral, antihypertensive, emulsifying and coagulant (Van T. T et al, 2015 Nau et al., 2003; Mine and Kovacs-Nolan, 2003) allowed their use in a variety of industrial sectors (agriculture, pharmaceutical, cosmetic, etc).

In recent years the demand for food in Asian countries, including Vietnam, has had many changes; food production

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must comply with the higher hygiene standards, the environment and animal welfare (Hoan N. D., 2015; Lamine, 2005).

The local hen breeds throughout the world are among the most threatened animal genetic resources (FAO, 2008). In Vietnam, Ri chicken is one of the very famous local breeds because the quality of both its meat and eggs is good (Vang N. D., 2001). In this context, the present study has been conducted to characterize egg production by a local Ri hen breed and its crossbreed with the ISA-Brown industrial strain, both quantitatively and qualitatively. Indeed, the use of crossbreeds could help in the inclusive development of a semi-intensive egg production sector, adapted to rural environments. It would further give economic rationale for the conservation of the local breeds, needed as parental strains.

Materials and Methods

Breeding: A flock of 253 local Ri chicks and 218 crossbred chicks (Ri male x Isa-Browns female; hereafter ISA-RI) were bred. The chicks were installed at the same time (March 20, 2013) in two chicken coops with ventilation (six areas for animal of 6 m^2 each). A commercial starting diet of 18% crude proteins and 2 700 kcal/kg of metabolizable energy was distributed ad libitum until the age of 12 weeks, followed by commercial growing diet of 16.5% crude protein and 2 700 kcal/kg of metabolizable energy.

The temperatures and relative humidity were recorded daily. During this period, the temperatures varied from 22 to 35°C and 17 to 26°C for respectively the maxima and the minima. The relative humidity varied between 80 to more than 97% for the maximum and 62 to 80% for the minimum.

Experimental conditions during the egg production periods: Chicks were transferred during week 19 to a henhouse without heat insulation, with windows, equipped with cages, stacked by three. Each cage contained a hen and there was a common feeding trough for five cages. The tested genotypes were distributed randomly in the cages. One hundred chicks per crossing were installed at the beginning of the experiment. The duration of natural lighting was 12 hours at the 19th week and was increased by adding 30 minutes of artificial light per week at the 26th week. During the experimental period (19th to the 72nd weeks of age), a commercial farinaceous diet was distributed. The composition of this diet was recorded in Table 1. The ambient temperatures were noted during the egg control period with 18 to 30^0 C and 10 to 16^0C respectively for the maxima and the minima. The relative humidity varied from 75 to 99% for the maximum and 50 to 85% for the minimum

Table 1
Feed mix composition for starting, growth and laying diets

Ingredients	Mix (%)		
	Starting	Growth	Laying
Soybean flour	30	26	20
Rice bran	25	20	7
Wheat	12	11	4
Corn	25	35	50
Soy oil	2.3	2	3
Calcium phosphate	1.5	1.8	1
Minerals (Vitamins, micronutrients)[1]	1.1	1	1
Methionine	1.08	1.2	7.5
Alfalfa	2.02	2	2.5
Cassava flour			4
Composition			
Metabolizable energy (kcal/kg)	2870	2950	3060.4
Crude protein (g/kg)	220	170	189
Fat content (g/kg)	55.13	52.18	54.53
Lysine (g/kg)	12.45	8.46	11.28
Methionine (g/kg)	5.39	3.45	4.36
Calcium (g/kg)	9.5	38	10
Phosphorus (g/kg)	6.03	5.62	5.68
Dry matter (g/kg)	872.01	849.56	861.06

[1]:Vitamin A 13500 UI/kg, Vitamin D3 3.000 UI/kg, Vitamin E 25 mg/kg, Copper sulfate 15 mg/kg

Controls and measures

Egg production performances: The egg production was recorded daily for each hen for all the production period. The hens' body weights were measured individually at the age of laying the first egg. Mortality was registered daily from the 1^{st} to the 72^{nd} week of age.

Egg quality: The external and internal quality of the eggs were assessed every 15 weeks (35-36, 50-51 and 65-66 weeks of age of the hens). For each hen, the 3 eggs laid during the first and the second week of the study were analyzed and the averages of the 6 eggs for each period (35-36, 50-51 and 65-66 weeks of age of the hens) were taken in consideration in the statistical analysis. In the recorded mortalities of Table 2, only the eggs of 50 hens for each genotype were taken into consideration in this study. For each age group parameter of the study, 600 eggs were considered. After numbering the new-laid egg (collected the same day), some measurements are taken. After breaking the egg at the equator, the height of the albumen was measured with a tripod micrometer placed in a middle distance. The Haugh units were calculated by the Haugh (1937) formula. The shell thickness was measured by a swab of the shell membranes on three points of the equator with an electronic micrometer.

The yolk and shell weights have also been measured to determine the yolk and shell proportions as well as the weight of shell by surface units.

Statistical analysis: The statistical analysis has been done with the SAS software (2001). The Generalized Linear Model has been used to do an analysis of variance on each parameter, in order to determine the differences between the two studied lines at each age and their statistical significance. For each parameter, the Least Squares Mean (LSmean) as well as the Standard Error (SE) have been calculated.

The following model was used:

$Yijk = \mu+Ai+Bj+(AB)ij+eijk$;

Where:

Y : The egg quality parameters

μ : General mean

Ai : Fixed effect of the genotype interaction "age x genotype", respectively.

Bj : Fixed effect of the age

(AB)ij : Effect of the interaction of the genotype and age

eijk : A random residual effect

Results and Discussion

Mortality rates during the study period are indicated in Table 2. Table 3 and 4 present, for the 35 to 36 weeks, 50 to 51 weeks and 65 to 66 weeks periods, the values for the various variables of production, the quality of the eggs per genetic type, with the significance of the variation source of the "genotype", the "age" and the interaction "age x genotype", respectively.

Mortality: The overall mortality was 12.04% and 10.63%, respectively, for the Ri and ISARI genotype until 19 weeks of age. During the breeding period in the cage, the mortality reached 20.68% and 18.26%, respectively. Table 2 shows that for all periods there is a similar mortality between the two studied genotypes. No pathology could explain this higher level of mortality. On the other hand, Benabdeljelil et al. (2003) reported that the poor adaptation of local breeds to the cages was a possible cause for that increased mortality.

Production performances: At first egg the groups presented highly significant differences (p<0.001) between the genetic types, the local Ri breed was the least precocious and the crossbred ISARI the most precocious. Table 3 indicates that the ISARI have an egg production significantly superior to that of the Ri genotype during the egg production period. For each period, mean egg weight difference between genotypes was around 4g. For the laying rate and the body weight at first egg, an advantage was observed for the ISARI crossbred, reflecting the more precocious age at first egg for the latter (Table 3). The start of egg laying occurred at 166 days. Among local breeds of the Vietnam, this appears late compared to the Vietnamese hen, an Mia breed, for instance, which starts laying at 185 days, as well as to the Dong Tao local poultry, which starts laying at 175 days (Van T. T. et al., 2015). However, the present individual production of 153 eggs per year is higher than that of the different known local breeds of Vietnam (Mia, 60-65 eggs/year; Dong Tao 65-70 eggs/year; Ho 50-55 eggs/year (Vang et al., 2001). But it is lower than that of almost all chicken feathers imported as well as Luong Phuong from China (180 eggs/year), Kabir from Israel (190-200 eggs/year), Egyp (200-220 eggs/year) (Van T.T et al., 2015).

Therefore, the crossing had the more marked advantage for the precociousness of egg production and egg weight. For the number of eggs laid per year, its superiority is of about 31 eggs. Cross-breeding with the Isa-Brown has, therefore, led to more productive individuals, still using local genetic resources. In an earlier work, Tixier-Boichard *et al.* (2006) demonstrated that the crossbreeding of the Egyptian Fayou-

Table 2
Mortality during the breeding period and the egg production period according to the typical genetics, %

Periods weeks	Genotype		
	Ri	ISA- Ri	P
0-19	12.04	10.63	NS
19-36	3.23 [a]	1.58[b]	*
36-51	2.11	2.29	NS
51-66	1.87	2.06	NS
66-72	1.43	1.7	NS
EPP (19-72)	20.68[a]	18.26[b]	**

ns,*, **: p>0.05, p<0.05, P<0.01, respectively; BW: Body weight; EPP: Egg production period

Table 3
Laying performances of local breed and ISARI genotype under experimental semi- intensive conditions (LsMeans±SE)

Parameters	Genotype		Level of significance	R2
	Ri	Isa - Ri		
BW at first egg (g)	1334.05±15.26a	1538.03±15.38b	***	0.38
Age at first egg (days)	165.96±1.25a	146.76±1.26b	***	0.58
Eggs layed per year	153.44±2.45a	184.20±2.36b	***	0.21

***: p<0.0001; BW: Body weigh

Table 4
Egg quality parameters in local Ri breed and ISARI genotype under experimental semi-intensive conditions (Ls Means ± SE)

Parameters	Age	Genotype		Level of significance			R2
		Ri	Isa - Ri	Genotype	Age	Genotype x Age	
Egg weight (g)	35-36	43.70±0.34a	49.99±0.27b	***	***	***	0.72
	50-51	49.54±0.27a	53.70±0.26b				
	65-66	53.37±0.30a	57.13±0.29b				
Albumen weight (g)	35-36	25.38±0.27a	29.38±0.22b	***	***	*	0.56
	50-51	28.63±0.21a	31.41±0.21b				
	65-66	30.05±0.24a	32.78±0.26b				
Yolk weight (g)	35-36	13.60±0.22a	15.48±0.17b	***	***	***	0.52
	50-51	16.03±0.17a	17.00±0.17b				
	65-66	17.98±0.19a	18.91±0.21b				
Shell weight (g)	35-36	4.72±0.09a	5.14±0.07b	***	**	NS	0.13
	50-51	4.88±0.07a	5.28±0.07b				
	65-66	5.34±0.08	5.48±0.09				
Albumen (%)	35-36	58.08±0.37	58.76±0.29	**	***	NS	0.1
	50-51	57.81±0.28	58.51±0.28				
	65-66	56.31±0.32a	57.31±0.34b				
Yolk (%)	35-36	31.09±0.35	30.94±0.28	*	***	NS	0.14
	50-51	32.33±0.28	31.65±0.27				
	65-66	33.68±0.31	33.10±0.33				
Shell (%)	35-36	10.83±0.17a	10.30±0.14b	NS	***	NS	0.08
	50-51	9.86±0.14	9.84±0.13				
	65-66	10.01±0.15	9.60±0.16				
Shell thickness (10-2 mm)	35-36	34.89±0.43a	38.48±0.34b	***	***	**	0.33
	50-51	33.70±0.33a	36.42±0.33b				
	65-66	32.75±0.37	33.60±0.40				
Shape index1	35-36	76.98±0.14a	77.83±0.11b	***	***	NS	0.62
	50-51	75.79±0.11a	76.81±0.11b				
	65-66	74.29±0.13a	74.86±0.13b				
Y:A ratio (%)	35-36	52.34±0.95a	55.75±0.75b	NS	***	**	0.11
	50-51	55.70±0.74	54.17±0.72				
	65-66	59.77±0.83	57.79±0.89				
Haugh Units (HU)	35-36	90.02±0.54	89.76±0.43	NS	***	NS	0.48
	50-51	84.30±0.42	83.38±0.41				
	65-66	80.59±0.48	81.45±0.51				

[1]: egg length/width x 100; Y:A: yolk to albumen ratio; NS, *, **, ***: p>0.05, p<0.05, p<0.01, p<0.001, respectively

mi breed with the Isa-Brown strain leads to improved performances.

For the weights of the egg component, the shell thickness, the shape index, the differences between the two genotypes were significant ($p<0.01$). No difference was recorded between the two genotypes for the yolk to albumen ratio and the Haugh units. In the present experimental conditions, the ISARI crossbred proved a better perfomer than the Ri hen for all the assessed production parameters.

Conclusion

The present results suggest that, in the prospect of developing small-scale semi-intensive egg production in Vietnam, several crossbred of the local breed with hybrid strains may be used in order to achieve standard productivity while controlling risks with suboptimal conditions. This use would require the evaluation of different possible crossbreeding schemes, using different hybrid strain, to adequately choose strategies fitting the variable contexts met in Vietnam. To be sustainable, the use of crossbreeding is critical and must be included in a plan for the conservation of the native genetic pool on which the strategy is founded.

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