MINISTRY OF EDUCATION AND TRAINING

MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

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DETERMINE SOME PHYSICAL CHARACTERISTICS, PERFORMANCE AND EVALUATE GENETIC DIFFERENCES OF SIN CHÉNG DUCK

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BRIEF INFORMATION OF PhD THESIS

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INTRODUCTION

1. Rationable

Indigenous ducks are an important part of biodiversity and have many advantages for many purposes over future. By the policy of adjusting the structure and forms of rearing - duck rearing tends to develop strongly in the direction of goods, especially indigenous duck genetic resources. To further develop duck rearing, research, conservation and development of indigenous duck breeds with good meat-egg quality suitable to the rearing conditions of each ecological region and meets the tastes of people, consumption should be conducted. In order to have more scientific evidence to help preserve, select to keep the pure population, as well as the delicious properties of meat and eggs, an in-depth study of conformation, production capacity and genetic relative level of Sin Chéng duck with some other indigenous duck breeds is essential. For the above reasons, we conduct research on the topic: "Determine some physical characteristics, performance and evaluate genetic differences of Sin Chéng duck".

2. **Objectives of study**

Some physical features, production capacity of Sin Chéng duck and genetic relationship with some indigenous ducks in order to effectively exploit and develop the Sin Chéng duck genetic resource

3. Sientific and practical values

3.1. Sientific values

It is the first systematically researched scientific work in Vietnam on physical features, production capacity and genetic diversity of Sin Chéng duck genetic resources.

The results of the study have provided a scientific basis for the Sin Chéng duck selection and are a valuable reference for research and teaching.

3.2. Practical values

- The results of the study have selected nuclear herd of Sin Cheng

ducks. This is an important genetic resource for conservation, exploitation and development. Besides, it is also an important raw material source in breeding work.

- The results of the thesis are the scientific basis to recommend the application of suitable breeding methods to increase the value and maintain Sin Chéng quality meat and duck eggs to meet the increasing demand for product quality of society.

4. New contributions of thesis

- The thesis has confirmed that Sin Chéng duck is a precious indigenous duck genetic source of our country, with its genetic diversity and distinct genetic differences compared to some other indigenous duck populations of Vietnam on the basis of using the microsatellite molecule indicator to evaluate.

- The results of the thesis help to orient conservation, exploitation and sustainable and effective development of Sin Chéng duck genetic resources, contributing to the conservation of biodiversity in our country.

Chapter 1. **LITERATURE REVIEW**

A animal trait is feature of an individual that we can identify. There are two kinds of trait: quantity and quality. Quality traits are traits that can be observed (physical features, coat color, etc.) or can be described and classified, quality traits are usually dominated by very few genes and are less ìnluenced by the environment.

Quantitative traits are traits that can be measured in units of measure and are often important economic indicators to evaluate the quality of a breed.

Currently, there are many technologies to evaluate genetic diversity of livestock breeds. In particular, molecular indicators are effective tools in evaluating genetic variations, explaining genetic relationships between varieties and assisting in the management of genetic resources. The polymorphic nature of microsatellites can be produced by multiplying the total DNA of the genome using two

complementary primers with sequences adjacent to the ends of the repeating region. The microsatellites are used as a genetic marker to study population genetics, evolutionary relationships, and gene mapping ...

Sensory evaluation has a close relationship with natural science and human behavioral science. Sensory science was formed on technical methods (differentiation / descriptive research) and consumer perception / perception research. The role of sensory evaluation has changed over time. At first, sensory evaluation was intended for data analysis only. Today, however, almost every field of food are applied to evaluate sensory factors, especially in product development and market development. Sensory evaluation plays a part in a product's effective business and development strategy

Chapter 2. MATERIALS, CONTENTS AND METHODS

2.1. Objectives of study

- Sin Chéng ducks were reared and reproduced through three generations.
- Sin Chéng ducks were reared for reproduction and meat commercer according to two methods.

2.2. Period and location of study

- Sin Chéng commune, Si Ma Cai district, Lao Cai province
- Lao Cai Poultry Breeding Company - Xuan Giao Commune, Bao Thang District, Lao Cai Province.
- Department of Genetics - Faculty of Animal Science - Vietnam Academy of Agriculture.
- Laboratory for animal cell technology – National Institute of Animal Science.
- Research period: From January 2017 to April 2020

2.3. Content of study

- Determine some physical features, size of several dimensions and reproduction capacity of Sin Chéng ducks over three generations.

- Research on fertility and growth, meat production and meat quality of Sin Chéng duck in two rearing methods.
- Evaluate genetic differences of Sin Chie ducks with Minh Huong, Muong Khieng and Bau Ben ducks.

2.4. Method

- Observing, taking pictures, describing the appearance of qualitative indicators and weighing and measuring quantitative indicators,
- Duck egg quality assessment by using the QCM + egg survey machine of Technical Services and Supplies
- Evaluate the quality of eggs and meat:

Use the TSS Technical Services and Supplies QCM + survey machine to evaluate the chemical composition of eggs. The chemical composition of the meat was analyzed according to the TCVN, the PH of meat was measured with a Testo 230 pH meter (Federal Republic of Germany), the color of the meat was measured (Minota CR-410, Japan). Meat toughness was measured by Warner - Bratzler 2000 (USA) mechanical cutter, post-processing water loss was measured by weight difference method before and after steaming in Waterbath at 750C for 60 minutes.

- Evaluate preference of consumer by method of Nguyen Hoang Dung (2005

2.5. Experimental arrangement method

2.5.1. Three generations selection scheme

Table 2.1. Experimental arrangement to select 3 generations

Content	Unit	Initial generation		First generation		Second generation	
		Male	Female	Male	Female	Male	Female
First day	Duck	2000		2050		2030	
8 weeks age	Duck	100	500	108	542	103	517
22 week age	Duck	50	300	63	378	58	350

2.5.2. Experimental diagram of reproductive ducks in two mothods

Table 2.2. ***Experimental diagram of reproductive ducks in two mothods***

Category	Lot 1 (Semi-grazing)	Lot 2 (Captivity)
Number of females and males at the first day age (duck / time)	50♀+10♂	50♀+10♂
Number of repetitions (time)	3	3
Total number of females and males at the first day age (duck / time)	150♀+30♂	150♀+30♂
Total number of females at 22 weeks age	127♀+26♂	130♀+26♂
Method	Semi-grazing	Captivity

2.5.3. Experimental diagram of rearing meat ducks by two methods

Table 2.3. ***Experimental diagram of rearing meat ducks by two methods***

Category	Lot 1 (Semi-grazing)	Lot 2 (Captivity)
Number of duck at the first day age (duck / time)	60 (30♀; 30♂)	60 (30♀; 30♂)
Number of repetitions (time)	3	3
Total number of duck at the first day age (duck / time)	180	180
Method	Semi-grazing	Captivity
Experimetal period	12	12

2.5.4. Sensory evaluation method

EVALUATION PAPER

Họ tên người thử:…… ngày thử: ……

Mức độ ưa thích của ông bà đối với mẫu có mã số…… là:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9

Use the Hedonic Scales built according to the product preference level corresponding to scores 1 to 9

2.5.5. ***Diagram of evaluating genetic differences of Sin Chie duck with Minh Huong duck, Muong Khieng duck and Bau Ben duck***

Total 160 blood samples talken from 04 studied duck populations (Sin Chieng duck with 40 samples; Minh Huong duck with 40 samples; Muong Khieng with 40 samples; Bau Ben duck with 40 samples) → Separated DNA by Quiagen kit (Germany) → Gennotyle analysis → results.

2.6. The method of carring and rearing experimental ducks

The process of caring and rearing Sin Cheng duck was applied by the standard of caring and rearing nuclear Bau Ben (Nguyen Van Duy, 2015).

2.7. Observation indicators

Research indicators were based on the guidance of Bui Huu Doan et al. (2011)

2.8. Data analysis

Data collection was processed according to the biological statistical methods including:

- Data and observation indicators were statistically processed (sample size, average value, standard error, coefficient of variation) by using Minitab 16 software.
- Comparing percentages by $\chi 2$ test through Minitab 16 software.
- The effects of different groups of ducks on observation indicators were analyzed by the variance 1 factor.
- Indicators related to genetic diversity was used by Genetix software version 4.0.5.2. (Belkhir et al 2004).
- Genetic difference coefficient (FsT) was calculated according to Weir (1984).
- Genetic distance between populations was calculated according to the method of Nei (1972)
- Genetic structure based on multivariable method - differential analysis of main components (Discriminant Analysis of Principal Components - DAPC) according to Jombart et al. (2011) using the software package "adegenet" in the R statistical language environment version 2.0.0.

- The tree genetic relation was determined by SRTUCTURE software version 2.2 (Pritchard et al., 2000).

Chapter 3. RESULTS AND DICUSSIONS

3.1. Some conformation, sizes of dimensions for the Sin Chéng duck reared over three generations.

3.1.1. Some conformation, sizes of dimensions for the Sin Chéng duck reared over three generations

3.1.1.1. Some conformation of the Sin Chéng duck reared over three generations

Sin Chéng duck at the first day has a long black hair streak starting from the nose running across the end of the eye, cutting the main black longitudinal streak running from head to tail, reaching 100% of the number of ducks observed by generations dark black with yellow hair on abdomen, lead-gray bill with gold-tinge, pale yellow legs

At 22 weeks of age, Sin Chéng duck has the main conformation of male ducks, which are stone gray and white belly, the female duck is the color of the sparrow mixed with lilac and has a dark purple-green diamond-shaped cavity at the end of the feathers; Both males and females have yellow and gray bill and feet. Male ducks also have a gender specificity: the large head has dark blue feathers. The female Sin Chéng has a long black hairline starting from the bridge of her nose and running across the end of her eye.

3.1.1.2. *Sizes of dimensions for the Sin Chéng duck reared over three generations*

Sin Chéng Duck at 10 weeks age, males have a body length of 31.25 - 31.33 cm; breast meat length is 13.48 - 13.58 cm; Leg height is 6.50 - 6.53 cm and the female duck has a body length of 28.20 - 28.44cm; breast length is 12.03 - 12.05 cm; 6.15 - 6.18 cm high length

Table 3.1. ***Sizes of dimensions for the Sin Chéng duck reared over three generations***

(unit: cm)

Indicators		INITIAL Gn		First Gn		Second Gn	
		Male (n = 70)	***Female (n = 70)***	***Male (n = 70)***	***Female (n = 70)***	***Male (n = 70)***	***Female (n = 70)***
Body length	$\bar{X}$ ±SE	31.25[a] ±0.24	28.20[a] ±0.11	31.28[a] ±0.30	28.36[a] ±0.14	31.33[a] ±0.33	28.44[a] ±0.16
Chest circle	$\bar{X}$ ±SE	32.04[a] ±0.22	30.00[a] ±0.10	32.66[a] ±0.26	30.03[a] ±0.13	32.72[a] ±0.36	30.10[a] ±0.13
Breast length	$\bar{X}$ ±SE	13.48[a] ±0.18	12.03[a] ±0.10	13.55[a] ±0.28	12.05[a] ±0.10	13.58[a] ±0.24	12.05[a] ±0.12
Leg heigth	$\bar{X}$ ±SE	6.50 ±0.05	6.15 ±0.02	6.53 ±0.06	6.17 ±0.03	6.53 ±0.06	6.18 ±0.02
Wing feather length	$\bar{X}$ ±SE	18.15 ±0.27	17.53 ±0.30	18.16 ±0.30	17.54 ±0.27	18.16 ±0.33	17.54 ±0.29
Chest circle / Body length		1.02[a]	1.06[a]	1.04[a]	1.05[a]	1.04[a]	1.05[a]

3.1.1.3. Feather speed of Sin Chéng duck

Sin Chéng male duck at 6-7 weeks age, the wing feathers have grown to half of its back and at 7-8 weeks age, the feathers of Sin Chéng duck have grown to the tail. With these same criteria, the female duck has faster hair growth rate than male duck from 1-2 weeks age

Table 3.2. Feather speed of Sin Chéng duck

TT	Indicators	Male		Female	
		Age of week	***Discription***	***Age of week***	***Discription***
1	Shredded	1-2	Newly hatched feathers fall, first fluff.		

2	Ripple	2-3	Flank-like hairs appear on the side.		
3	Bristles	3-4	The hairy legs grow in the armpits and on the shoulders.		
4	Comb	4-6	The ingrown wing feathers look like comb.		
5	Paddle swimming (half back)	6-7	The wing feathers have grown to half of the back.		
6	Staging (depreciation)	8-9	Wing feathers grown to the tail.	7-8	Wing feathers grown to the tail
7	Cross the wings	9-10	Wing feathers grow long, the wings cross each other.	8-9	Wing feathers grow long, the wings cross each other

3.1.2. Growing rate and results of selective Sin Cheng ducks reared over three generations

3.1.2.1. Survival rate over generations

From 1 day to 8 weeks of age, the survival rate was from 96.75% to 97.53%. From 9 weeks of age to the end of the heifer period, the survival rate of males was 95.37% - 97.09% and females was 95.20% - 96.32%.

3.1.2.2. Body weigth of Sín Chéng duck over 3 generations.

Table 3.3. Body weigth of Sín Chéng duck over 3 generations

(unit: g/duck)

Week of age	**INITIAL Gn**		**First Gn**		**Second Gn**	
	$\overline{X}$ ± SE		$\overline{X}$ ± SE		$\overline{X}$ ± SE	
1 NT	***(n=90)***		***(n=90)***		***(n=90)***	
	48.20 ± 0.61		49.25 ± 0.66		49.20 ± 3.24	
22	***(n=96)***	***(n=477)***	***(n=103)***	***(n=516)***	***(n=100)***	***(n=498)***
	2273.25 ± 18.50	2164.29 ± 34.10	2293.15 ± 17.94	2234.19 ± 33.89	2350.62 ± 25.34	2250.75 ± 25.34

At 8 weeks of age, the body weigth of Sín Chéng duck was from 1772.10g to and 1795.26g/duck for male and from 1684.71g to 1698.29g/duck for female. At 22 weeks of age, the body weigth was from 2273.25g to 2350.62g/duck for male and from 2164.29g to 2250.75g/duck for female.

3.1.2.3. Results of the selection on the body weigth traits of the nuclear Sin Cheng duck over three generations.

At 8 weeks of age, the selective herd for the body weight of male duck was 1937.17g /duck (higher than the initial generation was 66.87g/duck) and the female duck was 1798.30g/duck (60.67g higher than the initial generation). At 22 weeks age, the result of selective second generation for body weight of male duck was 2351.29g/duck and female duck was 2251.44 g/duck.

Table 3.4. Results of the selection on the body weigth traits of the nuclear Sin Cheng duck over three generations

Indicators		**INITIAL Gn**		**First Gn**		**Second Gn**	
		Male	***Female***	***Male***	***Female***	***Male***	***Female***
8 weeks age							
Population	number (duck)	965	970	990	992	986	994
	BW(g)	1772.10	1684.71	1792.03	1694.91	1795.26	1698.29
Selective herd	number (duck)	100	500	108	542	103	517
	BW(g)	1870.30	1737.63	1893.33	1772.03	1937.17	1798.30
	Selection pressure (%)	10.36	51.54	10.83	54.30	10.44	52.01

	Selection Differential (g)	98.2	52.92	101.3	77.13	141.91	100.01
22 weeks age							
Selective herd	number (duck)	50	300	63	378	58	350
	BW(g)	2274.11	2165.20	2294.52	2235.16	2351.29	2251.44

3.1.2.4. Feed consumption of Sin Chéng duck in the the period from 01 day to 22 weeks age over three generations

Kết thúc toàn bộ quá trình nuôi vịt từ 01 ngày tuổi đến 22 tuần tuổi vịt Sín Chéng tiêu tốn hết 16.013 g/con ở thế hệ xuất phát và 16.155 g/con ở thế hệ hai.

Finishing the whole process of rearing ducks from 1 day to 22 weeks of age, the feed consumption of Sin Chéng ducks was 16,013g/duck in the initial generation and 16,155g/duck in the second generation.

Table 3.5. Feed consumption of Sin Chéng duck in the the period from 01 day to 22 weeks age over three generations

(unit: g/duck)

Period (weeks age)	INITIAL Gn	First Gn	Second Gn
01 day - 4	1.348	1.356	1.356
01day - 22	***16.013***	***16.141***	***16.155***

3.1.3. Reproduction capacity of Sin Chéng ducks over three generations

3.1.3.1. First laying age, 5%, 50% and peak laying of Sin Chéng duck over three generations

The first laying age of Sin Chéng ducks in the initial generation was 149 days. The age of 5% laying was 161 days and 50% laying was 192 days and peak laying was 223 days. That of the second generation was 148; 161; 190 and 218 days.

3.1.3.2. The egg weight at 5%, 30%, 50%, peak and 38 laying weeks of Sin Cheng ducks over three generations

At the stage of 5% laying, egg weight was from 62.88 to 63.93 g/egg. The egg weight at 30% laying was 68.72 to 69.00g/egg, at 50% laying was from 74.65 to 74.87g/egg and the peak laying was from 75.47 to 75.61g/egg.

3.1.3.3. Laying rate and egg performance of Sin Chéng duck over three generations

The average laying rate at 22 - 73 weeks was from 42.24% to 45.07%. Egg performance/female/73 weeks were from 153.75 to 164.05 eggs.

Table 3.6. Laying rate and egg performance of Sin Chéng duck over three generations

Weeks	INITIAL Gn (n=300 females)		First Gn (n=378 females)		Second (n=350 females)	
	Laying rate (%)	Egg performance (egg)	Laying rate (%)	Egg performance (egg)	Laying rate (%)	Egg performance (egg)
22	1.14	0.08	1.43	0.10	1.51	0.11
38	64.29	4.50	75.00	5.25	75.62	5.29
22-38		**57.19**		**63.86**		**64.13**
44	55.43	3.88	59.93	4.20	60.29	4.22
22-44		**82.33**		**91.96**		**92.30**
73	21.57	1.51	20.86	1.46	20.88	1.46
Total		**153.75**		**162.60**		**164.05**
Average	**42.24**		**44.67**		**45.07**	

3.1.3.4. Feed consumption/10 eggs of Sin Chéng duck over three generations

The average feed consumption/10 eggs of Sin Chéng duck over the three generations of 22-73 weeks was 4.94 kg in the initial

generation. 4.63 kg for in first generation and 4.58 kg in second generation

3.1.3.5. Embryonic egg rate and hatching rate of Sin Chéng ducks over three generations

The results showed that the average embryonic egg rate to the total hatched eggs was from 94.37% to 95.52%, hatched rate/egg with embryo was from 92.38% to 94.11%. Type 1 duck rate/total hatcing eggs was from 84.16 to 84.71%

3.2. Reproduction performance and growth rate, meat production and meat quality of Sin Chéng duck in two rearing methods

3.2.1. Reproduction performance of Sin Chéng duck in two rearing methods

3.2.1.1. Survival rate in the period from 01 day to 22 weeks of age of Sin Chéng duck in the two rearing methods

At 8 weeks of age, the survival rate of captive ducks was higher than semi-grazing ducks. On average, in this period, semi-grazing ducks were 96.11% and captive ducks were 96.67%. End of heifer (22 weeks age), the survival rate of semi-grazing ducks was 93.10 in male and 94.44% in female; the survival rate of captive ducks was 96.55% in male and 95.17% in female.

3.2.1.2. Body weight in the period from 01 day to 22 weeks age of Sin Chéng ducks for reproduction in two rearing methods.

At 8 weeks age, the body weight of male and female ducks in semi-grazing plot was 1608.70g and 1504.29g/duck, respectively; The body weigth of male in captivity was 1677.63g and the female was 1562.58g/duck. At the time of 12 weeks of age, the body weight of males in semi-grazing was 2020.37g/duck and the body weight of females was 1929.71g/duck; In captivity, the body weight of male duck was 2026.19g and female was 1934.60g/duck. At the end of heifer period (22 weeks age), the body weight of semi-grazing male and female was 2329.68g and 2227.19g/duck, respectively; The body

weight of captive rearing slot was 2340.81 g and 2235.30g/duck in male and female duck.

3.2.1.3. Laying rate and egg performance of Sin Chéng duck in two rearing methods

The average laying rate of Sin Chéng duck at 23 weeks age was 57.02% in semi-grazing and 54.70% in captive mothod. In 23 weeks of laying, the egg performance/female of semi-grazing was 91.80 eggs, 3.73 eggs higher than that of the captive method, 88.07 eggs corresponding to the semi-grazing method with egg performance iat 23 weeks of laying, 4.24% higher than the captive method.

3.2.1.4. Feed consumption/10 eggs of Sin Chéng duck in two rearing methods

The average feed consumption per 10 eggs at 23 weeks laying of Sin Chie ducks in the semi-grazing method was 3.94kg and 4.26kg in the captive method.

3.2.1.5. Embyonic egg rate, hatched rate and number of ducklings/female of Sin Cheng ducks in two rearng methods

The embyonic egg rate of captive ducks was 95.16%, 94.33% hatching rate / embyonic egg rate was 89.77% and the type I duck / total hatched eggs was 85.18%. These indicators were lower on semi-grazing ducks witth 95.44%, 94.57%, 89.84% and 85.34% respectively.

3.2.1.6. The egg quality of Sin Chéng ducks in two rearng methods

The average egg weight of Sín Chéng duck was 75.31 - 75.66g/egg; The egg morphology index of Sin Chéng duck was 1.36 - 1.37; the yolk rate accounted for 32.34 - 34.87%; The yolk color was 9.73 - 9.82; Haugh unit was 80.26 - 81.25.

The egg protein in the white was 10.95 - 11.13%, 17.72 - 17.75% in the yolk; Lipid in the yolks was 31.72 - 31.80%; Total

mineral in the white was 0.61 - 0.71; and in the yolk was 1.81 - 2.21%.

3.2.1.7. Evaluate consumers' preference with Sin Chéng duck eggs

The egg product of Sin Cheng duck reared in the two *rearing methods wa*s favored by customers and egg product 1 had an accumulation frequency of 53.60% on consumer rating with an accumulation frequency of 92.78%. "Higher than egg product 2 also at score 8 was 74.22% with cumulative frequency of 91.75%".

3.2.2. Growth rate, meat production and meat quality of Sin Chéng duck in two rearing methods

3.2.2.1. Survival rate of Sin Cheng duck meat in two rearing methods

In the period from 1 day to 4 weeks age, the survival rate of semi-grazing ducks was 96.67% and captive duck was 96.67 - 97.78%. At 12 weeks of age, semi-grazing duck was 95.56 - 96.67% and captivity was 96.67 - 97.78%; The survival rate at 12 weeks age of captive ducks (96.67 - 97.78%) was higher than that of semi-grazing ducks (95.56 - 96.67%). On average, the survival rate at 12 weeks of captive ducks was 97.22% higher than that of semi-grazing ducks (96.11%).

3.2.2.2. Cumulative growth of Sin Chéng duck in two rearing methods

At 12 weeks of age, in semi-grazing ducks, the weight was 2345.17g/duck in male and 2001.79g/duck in female, in captive ducks keeping, weight of duck was 2435.00g in male and 2130.40gin female. On average, the weight of male and female in semi-grazing method was 2173.48g/duck (100%), and in captive method was 2282.70g/duck (105.03%)

3.2.2.3. Absolute growth of Sin Chéng duck in two rearing methods

Absolute growth of Sin Chéng duck was divided into two stages: absolute growth was increased gradually from the first week of age and peaks at 5-6 weeks of age in both methods. On average,

the growth rate (g/duck/day) during the period from 01 day to 12 weeks age Sin Cheng in captivity was higher than that of semi-grazing ducks (23.23g/duck/day for semi-grazing ducks per day in female ducks, 27.32g/duck/day in male ducks; captive ducks was 28.39g/duck/day in female ducks, 24.77g/duck /day in male ducks

3.2.2.4. Relative growth of Sin Chéng duck in two rearing methods

The relative growth of Sin Chéng ducks rearsed for meat had achieved a high mean value continuously for the first 3 weeks in both male and female ducks of the two rearing methods and then stabilized in the next 2 weeks at 31.40 - 40.89 % in the group of semi-grazing ducks and 31.11 - 41.35% in the group of captive ducks, by the 7th week the relative growth of ducks was gradually decreased, which was consistent with the rule of growth rate for the breeds. The relative growth mean of semi-grazing ducks was 29.72 - 30.76% and lower than that of captive ducks.

3.2.2.5. Feed consumption/ kg body weight gain of the Sin Chie duck in the two rearing methods

Feed consumption/kg body weight gain in both methods was increased gradually over the weeks of age and feed consumption in captive method was always higher than in semi-grazing method. At 8 weeks of age, feed consumption/kg body weight gain was 2.91 kg in semi-grazing method and 2.99 kg in captive mothod. At 12 weeks of age, feed consumption/kg body weight gain was 4.49 kg in semi-grazing method and 4.60 kg in captive method.

3.2.2.6. Meat performance and meat quality of Sin Chéng duck in two rearing methods

* Meat performance of Sin Chéng duck in two rearing methods

The carcass rate of male ducks at 12 weeks old was accounted for 68.10 - 68.77% in both rearing methods; the thigh meat rate was from 12.66 to 13.29%; the breast meat was accounted for 14.55% to 14.81%. In females, the carcass rate was accounted for 68.24 to

68.33%, the thigh meat rate was accounted for from 12.37 to 13.19%. The breast meat rate was 14.26 - 14.76%; the fat rate of male duck was from 0.56 - 1.70% and female duck was from 0.63 - 1.84% in female duck.

* *Meat quality of Sin Chéng duck in two rearing methods*

The pH value of Sin Chéng duck meat was measured in 15 minutes and 24 hours after slaughter at 12 weeks of age on breast meat and thigh meat were 5.94 - 5.73 and 5.96 - 5.77 for semi-grazing and 5.96 - 5.76 and 6.00 - 5.80 in captive methods.

Light color (L *) of Sin Chéng duck meat reared by semi-grazing was 42.38 - 42.53; captive method was 40.17 - 40.57 on breast meat and similarly on thigh meat with 45.25 - 45.56 and 42.88 - 43.18. The toughness of Sin Chéng duck reared by free-grazing method was higher than that of captivity

* Chemical composition of Sin Chéng duck meat in two rearing methods

The dry matter content of breast and thigh meat was almost similar in both methods and ranged from 24.08 to 25.23%. Protein porpotion between the two rearing methods was similar. Specifically, semi-grazing ducks was ranged from 21.16 - 21.77% and in captive duck was ranged from 21.32 - 21.92%. The lipid rate of semi-grazing ducks was ranged from 1.46 to 3.02%, lower than that of captive ducks, ranged from 4.55 to 5.62% and the mineral rate of semi-grazing ducks was ranged from 1.14 to 1.26% higher than that of captive ducks with from 0.91 - 1.05% only.

3.2.2.7. Economic efficiency of commercial Sin Chéng duck was reared by two farming methods

100 ducks reared by two methods and slaughtered together at 12 weeks of age in a semi-grazing plot was a total cost of 23,592.30 thousand dong, total imcome was 28,202.04 thousand VND, the income per 100 ducks was 2,560.97 thousands dong; In captivity, the

total cost was 25,032.46 thousand VND, the total income was 29,162.33 thousand dong, the income per 100 ducks was 2,294.37 thousands dong. Efficiency of semi-grazing method was higher than in captivity.

Table 3.7. Economic efficiency of commercial Sin Chéng duck was reared by two farming methods

(unit: 1000 dong)

Category	Semi-grazing method	Captive method
Breed	2.700.00	2.700.00
Feed	16.627.04	18.067.20
Veterinary medicine	630.00	630.00
Electricity and water, VR...	558.00	558.00
Total	20.515.04	21.955.20
Other expense 15%	3.077.26	3.077.26
Total expense	23.592.30	25.032.46
Selling cost	75.00	73.00
Total revenue	28.202.04	29.162.33
Income - expenditure	4.609.75	4.129.87
Income/100 ducks	2.560.97	2.294.37

3.2.2.8. Consumer evaluation on meat products of Sin Chéng duck in two rearing methods

For type 1 breast meat, the number of customers was favored with a cumulative frequency of 99.05%. For type 2 breast meat product, the number of customers was favored with a cumulative frequency of 98.10%. Both breast products (breast 1 and breast 2) of Sin Cheng duck reared in two mothod (captivity and semi-grazing) were favored by the customer and type 1 breast meat product gave a cumulative frequency of consumers were higher than that ofo type 2 breast meat products.

The type 1 thigh product was favoured by some customers with a cumulative frequency of 97.70%. For type 2 was favored customer with a cumulative frequency of 95.40%. Both thigh meat products (thigh meat 1 and thigh meat 2) of Sin Chéng duck were favored by customers and meat product thigh 1 with a higher cumulative frequency of consumer was higher than thigh meat product 2.

3.3. Genetic difference of Sin Chie duck with Minh Huong duck, Muong Khieng duck and Bau Ben duck

3.3.1. Genetic diversity in four duck population

Using 15 microsatellite indicators to analyze 4 genetic resources of ducks Sin Chéng, Minh Huong, Muong Khieng and Bau Ben, a total of 195 alleles/ locus were obtained. In Ben (4.47), the average population was Minh Huong (7.00) and Muong Khieng (6.67), the highest was Sin Chieng (9.80).

He and Ho frequencies of Sin Chéng duck population were highest (0.69 and 0.60) and lowest were Bau Ben ducks (0.48 and 0.41). Inbreeding coefficient was highest in Bau Ben duck population (0.16), average in Sin Chie duck population (0.13) and lowest in Minh Huong and Muong Khieng population (0.12).

Table 3.8. Number of alleles, heterozygous frequency and inbreeding coefficient of 4 duck populations

Population	Number of allen	Average number of allele / locus	He±SE	Ho±SE	Fis
Sn Chéng	147	9.80±8.50	0.69±0.23	0.60±0.23	0.13
Minh Huong	105	7.00±5.59	0.56±0.27	0.50±0.24	0.12
Muong Khieng	100	6.67±5.56	0.56±0.26	0.50±0.30	0.12
Bau Ben	67	4.47±3.09	0.48±0.24	0.41±0.26	0.16
Total	195				
Average		13±2.21	0.57±0.08	0.50±0.07	0.13

3.3.2. Genetic distance and phylogenetic tree between Sin Cheng duck and Minh Huong duck, Muong Khieng duck and Bau Ben duck

Genetic distances among populations were varied from 0.16 to 0.40. Genetic distance between SinChéng duck and Bau Ben duck was 0.40; followed by SinChéng duck with Minh Huong duck and Muong Khieng duck was 0.23 and 0.24 respectively; the Minh Huong - Muong Khieng duck group with the closest genetic distance was equal to 0.16.

Table 3.9. Genetic distance matrix among 4 duck populations

Duck population	Sin Chéng	Minh Huong	Muong khieng	Bau ben
Sin Chéng	0	0.23	0.24	0.40
Minh Huong	*	0	0.16	0.34
Muong khieng	*	*	0	0.22
Bau ben	*	*	*	0

*Note: *: Differences between breeds with P <0.05*

Genetic distances among duck population were analyzed following a different approach using the Principle Coordinates Analysis (PCA) method (figure 3.1).

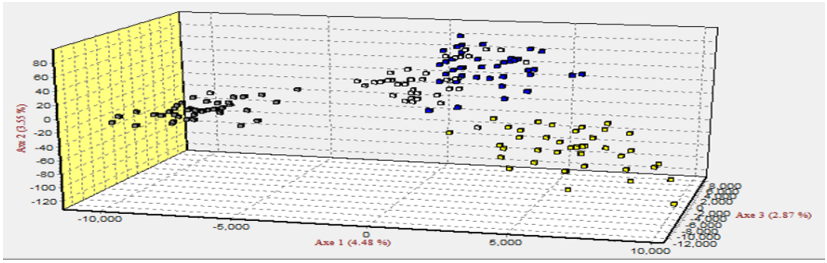

Figure 3.1. PCA results for 4 duck populations

The genetic distance among the four indigenous duck populations was more clearly illustrated in phylogenetic plants. (figure 3.2)

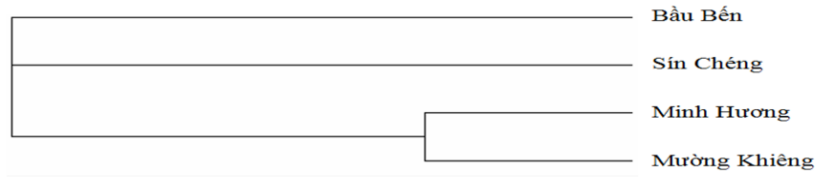

Figure 3.2. Phylogenetic plants show genetic relationships of 4 duck populations based on 15 microsatellite indicators according to Nei (1972).

3.3.3. Genetic structure between Sin Chéng duck and Minh Huong duck, Muong Khieng duck and Bau Ben duck

Figures 3.3 and 3.4 show that in the range of K values from 2 to 4, the BIC value did not change much and the smallest BIC value was K = 3. In 4 populations, 3 genetic structures were existed (clusters).

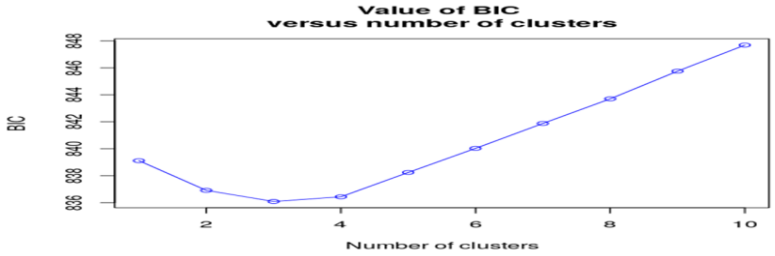

Figure 3.3. Number of experimental genetic constructs of 4 duck populations

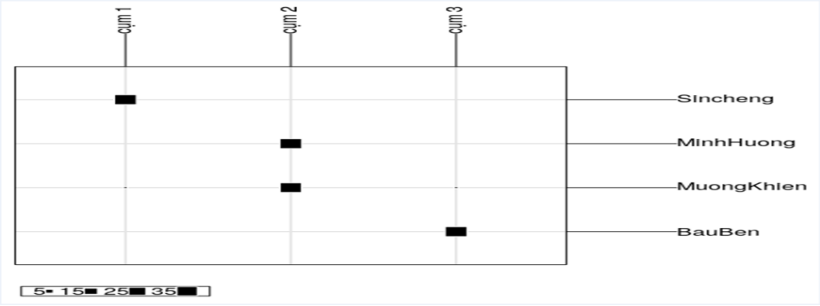

Figure 3.4. Genetic structures of 4 duck populations

CONCLUSION AND RECOMMENDATION

CONCLUSION

1. Duck had a homogeneous hair color, at 1 day of age the feathers on the back were dark black and yellow on the abdomen from head to tail. At 8 weeks of age, the female's main coat color is sparrow mixed with lilac; male duck had stone gray hair and white belly. At 22 weeks of age, the female's main color was sparrow mixed lilac and long black hairstreaks starting from the bridge of the nose running across the end of the eye, the male had a stone gray color with a white belly.

The body weight of Sin Chéng duck in second generatuon at 8 weeks of age was 1795.26g for male and 1698.29g for female. The body weights at 22 weeks of age was 2350.62g and 2250.75g for male and female. Egg performance/female/52 laying weeks was 164.05 eggs. Feed consumption per 10 eggs was 4.58 kg. The embryonic egg rate was 95.52%; type 1 duck rate/total hatched eggs was 84.71%.

2. The egg performance of Sin Cheng ducks were for reperoduction in semi-grazing method was 91.80 eggs/female/23 weeks of laying (higher than the captive method 3.73 eggs), feed consumption/10 eggs was 3.94 kg (lower than captive method 0.32 kg), the embryonic egg rate was 95.44%, hatched rate/hatching eggs was 89.84%. In captive method, the embryonic rate was 95.16%, hatched rate/hatching eggs was 89.77%. In the two rearing methods, the yolk rate was 32.34-34.87%, the protein in yolk was 17.72-17.75%, the yolk lipid was 31.72-31.80% and the total mineral in yolk was 1.81-2.21%. Duck eggs reared by semi-grazing was more appreciated by consumers than eggs in captivity

The body weight of Sin Cheng ducks reared in semi-grazing method at 12 weeks of age was 2001.79 - 2345.17g/duck, feed consumption/kg body weight gain was 4.49 kg, income/100 ducks was higher than that of captivity. Carcass rate was 68.10 - 68.24%,

fat rate was 0.56 - 0.63% (lower than semi-grazing method 1.18% in average); crude protein was 21.16 - 21.77%; lipids was 1.46 - 3.02%; Total minerals was 1.14 - 1.26%; red (a *) meatm was 18.40 - 19.55; toughness (N) was 3.02 - 3.35. The body weight of duck reared by captive method at 12 weeks of age was 2130.40 - 2435.00g/duck (higher than semi-grazing method of 109.22g in the average), feed consumption/kg body weight gain was 4.60 kg (higher than semi-grazing method 0.11 kg feed), carcass rate was 68.33 - 68.77%, fat rate was 1.70 - 1.84%, crude protein was 21.32 - 21.92%; lipids was 4.55 - 5.62%; total mineral amount was 0.91 - 1.05%; red (a *) meat was 18.15 - 19. 62; toughness (N) was 2.55 - 3.18. Duck meat reaed by semi-grazing was more appreciated by consumers than duck meat in captivity

3. Sin Ching duck had high genetic diversity with an average number of alleles/locus of 9.80 and expected heterozygous frequency (He) was 0.69, inbreeding coefficient (Fis) was 0.13. The genetic distance of Sin Chéng duck was the farthest, a separate distribution in phylogenetic tree, a homogeneous (pure) genetic structure and separate from the three native Bau Ben ducks populations, Muong Khieng and Minh Huong.

SUGGESTIONS

Continue to research, selectively improve the production capacity of the nuclear herd to provide high Sin Chéng quality duck for production and study the appropriate nutritional values to promote the strong characteristics of this breed.

Sin Chung ducks rear for meat by captivity to increase performance. However. In order to maintain the quality of meat and eggs to satisfy the favourites of consumers and not to lose the brand of Sin Cheng ducks, they must be reared by semi-grazing methods, which will give higher quality.

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