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**Some biological characteristics and productivity of the sea ducks 15 –
Dai Xuyen reared in fresh and saline water condition**

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PUBLISHED PAPERS RELATED TO THE THESIS

- 1. Vương Thị Lan Anh, Nguyễn Văn Duy, Hoàng Văn Tiệu, Nguyễn Thị Minh Phương, Nguyễn Bá Tiếp.** 2018. *Some morphological characteristics and microscopic structure of saline glands of the 15 Dai Xuyen sea ducks.* Vietnam Journal of Agricultural Science No. 16 (12) in 2018. Pages 1059 - 1067
- 2. Vương Thị Lan Anh, Nguyễn Văn Duy, Nguyễn Văn Tuấn, Nguyễn Bá Tiếp, Hoàng Văn Tiệu.** 2019. *Determine some blood physiological and biochemical indicators of Sea ducks 15 - Dai Xuyen reared in fresh and saline water condition.* Journal of Animal Science and Technology No. 99, May 2019. Pages 69 – 76.
- 3. Vương Thị Lan Anh, Nguyễn Văn Duy, Mai Hương Thu, Nguyễn Văn Tuấn, Hoàng Văn Tiệu.** 2019. *Productivity of commercial sea ducks 15 - Dai Xuyen reared in fresh and salt water condition.* Journal of Animal Science and Technology No. 103, September 2019. Pages 21-34.

Chapter 1. INTRODUCTION

1.1. Rationable

Over the past few years, Vietnam's waterfowl has been growing rapidly, in October 2017, the waterfowl population was 90,247 million and reached over 92,054 million in October 2018 reached (GSO 1/2019). Along with the current tendency for developing waterfowl industry, there are possibilities to complete the projects on restructuring animal industry following value increasing and sustainable development with the waterfowl population reached 100 millions by 2020.

The above results shown that waterfowl industry has been really effective for farmers. The advanced technologies have been newly applied in waterfowl industry which have gradually been transformed into commodity farming, industrialized and modernized step by step. Meanwhile, many farms and livestock farms towards industrial orientation were established.

Especially recently, due to the impact of the African swine fever virus and the pig price fluctuation, so the tendency of households are to develop waterfowl industry with both quantity and quality of breeding.

Vietnam is located in Southeast Asia, there is a coastline of 3,444 km, equivalent to an area of 4,200 km², including 2,800 islands and 28 provinces with sea. Beside, the advantages of fishery development, our country deals with the ongoing problem of climate change and saline water intrusion. Vietnam is one of the countries heavily affected by global climate change.

Climate change is considered an important issue influencing all policies, plans and activities of our country in the coming years. 70% population living near the coast are currently facing with unforeseen threats from rising sea levels and other natural disasters.

Climate change and rising sea levels can increase flooded areas, obstruct drainage systems, increase erosion in coastal and salinity areas, make it difficult for agricultural production. industrial and domestic water supply. According to a report by the World Bank (WB) and the Intergovernmental Panel on Climate Change (IPCC), a sea level is risen at 1m that will likely cause an "ecological crisis", affecting nearly 12 % area and 11% Vietnam's population. Dao Xuan Hoc (2010) reported that in the dry season there will be over 70% out of the Mekong Delta will be saline intrusion with a salt concentration higher than 4g / l. In that status, the 15 Dai Xuyen sea duck breed is considered a soft solution, a waterfowl breed

adapted to climate change and saline water intrusion.

The 15 - Dai Xuyen sea duck is a salt-tolerant breed that have been reared at Dai Xuyen Duck Research Center and Dong Rui commune - Tien Yen district - Quang Ninh from 2012 to 2014. The results show that The 15 - Dai Xuyen sea duck is appropriate to rearing in saline, brackish and freshwater conditions, contributing to creating job and obtaining economy through model building and develop into market. From above issues, it contributes to economic development, political security and sovereignty in coastal and island regions. However, the 15 - Dai Xuyen sea duck has not yet been comprehensive studied to explain the mechanism of why the sea ducks 15 - Dai Xuyen can adapt to saline water conditions? Will physiological and biochemical parameters of this duck breed if they are raised in fresh and saline water?

And more than ever, the the sea ducks 15 - Dai Xuyen was reared in some provinces with different saline water condition, how to develop? On that basis, the most appropriate breeding procedure for this duck breed is proposed. In order to solve the above-mentioned research questions, it is necessary to conduct research on the topic: "Some biological characteristics and productivity of the sea ducks 15 - Dai Xuyen reared in fresh and saline water environment"

1.2. OBJECTIVES OF STUDY

1.2.1 Overall objective

Evaluate the adaptability of the sea ducks 15 - Dai Xuyen and give the most appropriate breeding process for this ducks

1.2.2 Specific objectives

- Defined some conformations, biological characteristics, growing rate and reproductive performance of the sea ducks 15 - Dai Xuyen reared in fresh and saline water

- Defined anatomical characteristics of salt glands and salinity tolerance mechanism of the sea ducks 15 - Dai Xuyen reared in saline water condition

- Evaluated the impact of fresh and saline water conditions on meat performance and quality of the sea ducks 15 - Dai Xuyen

- Established a scientific and practical basis to complete the breeding process of the sea ducks 15 - Dai Xuyen in fresh and saline water conditions

1.3. SCIENTIFIC VALUE OF STUDY

- This is the first project in Vietnam to study anatomic and microscopic salt gland to explain why the sea ducks 15 - Dai Xuyen can adapt to saline water rearing conditions.

- The thesis has clarified the salinity tolerance mechanism of the sea ducks 15 - Dai Xuyen through salt gland.

- Research results of author are valuable scientific value and references for scientific research and teaching at scientific and training institutes.

1.4. PRACTICAL VALUE OF THESIS

- The sea ducks 15 - Dai Xuyen is considered a soft solution in livestock to adapt to climate change and saline water intrusion in Vietnam

- Determined the slaughtering period for the most effective rearing of the 15 – Dai Xuyen sea duck in fresh water and saline water conditions

1.5. NEW CONTRIBUTIONS OF THESIS

- This is a first work to systematically research on conformation, physiological and biochemical indicators of blood, growth rate and reproductive performance, the topic of thesis provided an important practical basis for researching and breeding the sea ducks 15 - Dai Xuyen in different ecological conditions.

CHAPTER 2. LITERATURE REVIEW

The salt concentration of seawater is about 3% while the body fluids in vertebrates about 1% (Schmidt-Nielsen, 1960), so marine animals must have mechanisms against leaching (discharge). Excess salt is pumped by gills in saline water fish; concentrate). The kidneys of some mammals (seals, whales) are capable of producing urine with a high salt concentration, so they adapt to live in saline water (Hughies et al., 1983). The kidneys of birds have no ability to concentrate urine. For this reason, birds living in the sea can not rely on their kidneys to regulate osmotic pressure, so they must adapt with other salt secretion mechanisms.

Some birds using invertebrates as feed have osmotic pressure balanced with seawater (Bennet, 2003) and gland at the head capable of exuding high salt concentrations along the drain of the duct. top of the mine. The surgeons considered it the nasal gland (glandula nasalis), later known as the salt gland, developed in saline water birds (Bennet et al., 2000). Thus, the structure and function of this route certainly plays a significant role in adapting to different water conditions (brackish or saline water).

The question given is how sea birds excrete salt in the case of food and water are high in salt and the kidneys are not as optimal as animals living

in land? The discovered salt gland have been answered for this question (Peaker and Linzell, 1975). Interestingly, the size of the gland is not only large in seabirds but also varies depending on NaCl concentration in the aquatic condition. Before long time, Schildmacher showed that ducks were transferred to water condition with a 3% salt concentration, which enlarged the gland. However, the author later suggested that the gland could only protect the nasal sinuses from the stimulation of saline water (Schnidt Nielsen, 1960). It is assumed that the change in size of the gland due to increasing salt concentration in water. However, the inference that the gland enlarges if needed and shrinking if not needed does not mean that terrestrial birds need to develop salt glands from their sinuses and it does not mean that birds have a calendar. The evolutionary history of marine life has a linear route with the size and capacity of the NaCl solution. (Schnidt Nielsen, 1960). The debate about the influence of salt concentration in water on salt gland size is still going on. This study suggests that high salt concentrations may not affect size but change the volume of salt gland. This could be the premise for the study of cell density, cell size in each type of gland tissue and even changes in sinus size, ducts in different water conditions.

the sea ducks 15 - Dai Xuyen have first raised for good results in Dong Rui - Tien Yen - Quang Ninh since 2012.

After two years of rearing, the sea ducks 15 - Dai Xuyen was recognized by the Ministry of Agriculture and Rural Development as livestock breeds permitted to be produced under 18/2014 / TT-BNNPTNT Circular of June 23, 2014. The sea ducks 15 - Dai Xuyen is capable of adapting to fresh, brackish and saline water condition. This is the first duck breed having proper adapting ti the marine condition in Vietnam. It can be said that the sea ducks 15 - Dai Xuyen is a dual-use duck with the highest egg yield, meat yield in Vietnam, it can be nearly 1.5 times higher than other native dual-use ducks like Bau Ben and Dom, Co Lung, Ky Lua ...

Vietnam is a country with agriculture development, so animal industry plays an important role in the country's economy. On the other hand, Vietnam has 28 provinces with the sea so the potential for developing this breed of Sea duck is high. On the other hand, our country is one of 6 countries heavily affected by global climate change. So the sea ducks 15 - Dai Xuyen is considered a soft solution, is the object of livestock to adapt to climate change and saline water intrusion. Therefore, with the policy of the Ministry of Agriculture and Rural Development, right from the early years after recognizing livestock breeds, there have been many programs

of transferring Sea Duck breeds to breeding provinces and brought high economic efficiency for farmers. The sea ducks 15 - Dai Xuyen has been widely developed, expanded into breeding models. Nguyen Van Duy et al. (2018) studied on the appropriate Protein level for the sea ducks 15 - Dai Xuyen reported that the sea ducks 15 - Dai Xuyen was reared for meat using food with protein level of 21%, ME 2950 Kcal / kg in the period of 1 - 28 days age and feed with protein level of 18%, ME 3250 Kcal / kg for the period of 29-70 days age for the highest efficiency.

Le Thi Mai Hoa et al. (2018) reportet that the model of the sea ducks 15 - Dai Xuyen for commercial farming in Quang Ninh, Hai Phong, Ninh Binh provinces brough economic efficiency for farmers, the criteria for the growth rate of sea ducks was properly achieved. Survival rate in spring-summer crop was over 98.5%, autumn-winter crop was over 98%; The average body weight gain at 10 weeks age in the summer-spring and autumn-winter crop in the three provinces was ranged from 2605 to 2657 g/duck, feed consumption/kg body weight gain was from 2.70 - 2.78 kg.

CHAPTER 3, MATERIALS, CONTENTS AND METHODS

3.1. MATERIALS

- 15 -Dai Xuyen sea duck rearing for reproduction
- 15 -Dai Xuyen sea duck rearing for commercial meat

3.2. CONTENTS

3.2.1. Contents of study

Content 1: Some biological characteristicis of the 15 – Dai Xuyen sea duck

Content 2: Reproductive performance of the 15 – Dai Xuyen sea duck

- Reproductive performance of the 15 – Dai Xuyen sea duck reared in fresh water condition at Dai Xuyen Duck Research Center through 3 generations equivalent to the laying years of 2015 - 2016; 2016 - 2107; 2017 - 2018

- Reproductive performance of the 15 – Dai Xuyen sea duck reared in water condition with different salinity levels

Content 3: Capacity of meat producing and meat quality of the sea ducks 15 - Dai Xuyen in both freshwater and saline water conditions

3.3. METHODS OF STUDY

3.3.1. Content 1: Some biological characteristics of the sea ducks 15 - Dai Xuyen

- Anatomical salt gland of the 15 – Dai Xuyen sea duck. On that basis aimed was to determine the macroscopic, microscopic structure of the salt

gland. Explain the action mechanism of the salt gland.

- Analyse some physiological and biochemical blood indicators of the 15 – Dai Xuyen sea duck raising for meat at 9-10 weeks in fresh and saline water conditions.

3.3.2 Content 2: Reproductive performance of the sea ducks 15 - Dai Xuyen rearing for reproduction

Evaluate reproductive performance of the sea ducks 15 - Dai Xuyen according to the guidance of Bui Huu Doan et al. (2011).

3.3.3. Content 3: Meat producing capacity and meat quality of the sea ducks 15 - Dai Xuyen

Evaluate meat producing capacity and meat quality of the sea ducks 15 - Dai Xuyen according to the guidance of Bui Huu Doan et al. (2011)

3.3.4. Data analysis

The data obtained was processed by the following calculation methods:

- Entered data and used some calculations using Excel 2007 software
- For all considered indicators, calculated the statistical parameters (sample size, mean, standard errors, coefficient of variation) using Excel 2007 or 9.1 Sas software.

- Evaluated effects of different conditions on the considering indicators by analyzing variance with 1 factor, 2 factors, 3 factors

- Compared the mean values with Duncan using SAS version 9.1 software

- Determined the growth functions by Statgraphics software. Centerion XV version 15.1.02

CHAPTER 4. RESULTS AND DISCUSSION

4.1. SOMEBIOLOGICAL CHARACTERISTICS OF THE 15 – DAI XUYEN SEA DUCK

4.1.1. Some typical conformations of the sea ducks 15 - Dai Xuyen

The adult the sea ducks 15 - Dai Xuyen was selected for stable color coat. Ducklings have light yellow fur and black spots on the head, the tail. The small portion remains have black and yellow fur. Adult duck has a dark colored winged duck, very few have black and white fur. The male has a head and neck, the wings are dark blue, and the tail has crooked feathers.

Body: The body of 15 - Adult Dai Xuyen sea duck is firm, deep chest, meat-specialized ducks. There is a big difference in appearance between males and females, the body of male is larger than female and coat color

is darker.

Thus, the conformation and color of the sea ducks 15 - Dai Xuyen is similar that of PT ducks (sparrow wings, Nguyen Duc Trong et al., 2011 d). And is typical conformation of dual-purpose duck

Dimension of body measurements of the sea ducks 15 - Dai Xuyen

At 8 weeks of age, the body length measurement of the 15-Dai Xuyen sea ducks was 23.41 cm for male and 23.19 cm for female, this size was increased at 38 weeks of age reaching 27.10 cm for male; and 26.36 cm for female



Photo 4.1. The 15 – Dai Xuyen sea duck at 1 day age and adult

Breast circle of the sea ducks 15 - Dai Xuyen at 8 weeks age was 28.96 in males and 27.89 cm in females. This size was increased at 38 weeks of age and reached 33.50 cm for males, 32.06 cm for females

Các chiều đo về kích thước của vịt Biển 15 - Đại Xuyên khi trưởng thành có dài lườn đạt 13,52 - 14,64 cm; độ dài lông cánh đạt 16,39 - 17,46 cm.

The ratio between body length and chest circle of the sea ducks 15 - Dai Xuyen at 8 weeks of age was 1.24 for male and 1.20 for female; 13.16 cm, wing length was 12.10 cm for males and 11.64 cm for females. The ratio between body length and chest circle at 38 weeks of age was 1.23 for males and 1.21 for females.

The size dimensions of the sea ducks 15 - Dai Xuyen at adult stage was 13.52 - 14.64 cm in breast length; 16.39 - 17.46 cm in wing length.

4.1.2. Anatomy of salt gland of the sea duck 15 – Dai Xuyen.

4.1.2.1. Size and weight of salt glands

The salt gland length of the sea ducks 15 - Dai Xuyen at 6 weeks of age was increased by 2.65 times compared to 1 day age, while the width

of this gland was increased by 2.68 times and the weight was increased by 2.27 times. Thus, in the first weeks, the growth rate of length and width was equal and faster than that of the gland weight. In other words, size was increase faster than weighth

This feature may be related to changes in the microscopic structure of the gland, such as glandular cell density, cell composition or sinuses size in the gland. Compare to these indicators of ducks from 6 to 22 weeks of age, the length and weight indicators was increased by about 25%, width was increased by about 33%. Thus, it can see that the growth rate of size and the weight of salt glands in the adult stage were slower than that in the duckling stage (from 1 day age to 6 weeks age)

Table 4.1. Size and weight of salt glands of the sea ducks 15 - Dai Xuyen in fresh water condition

Indicators	01 day age (n = 6)	6 weeks age (n = 6)	22 weeks age (n = 6)
	Mean ± SD	Mean ± SD	Mean ± SD
Gland length (mm)	4.60 ^a ± 0.57	12.20 ^b ± 0.54	15.10 ^c ± 0.82
Gland width (mm)	0.26 ^a ± 0.05	2.30 ^b ± 0.44	3.40 ^c ± 0.55
Gland weigh (mg)	1.10 ^a ± 0.21	2.50 ^b ± 0.35	3.20 ^c ± 0.53

Note: the mean values in the same column with different superscripts were statistically different (P<0.05).

4.1.2.2. Effect of water condition (salinity) on the salt gland

The length and width of the salt gland of the sea ducks 15 - Dai Xuyen reared in saline water (VB15 NM) were 16.8 mm and 3.9 mm, higher than the corresponding sizes of the sea ducks 15 - Dai Xuyen reared in fresh (VB15NN) (15.10 mm and 3.4 mm). However, these differences were not statistically significant

Table 4.2. Size and weight of salt glands of the sea ducks 15 - Dai Xuyen reared in fresh and saline water

Indicators	Reared in fresh water (n = 6)	Reared in saline water (n = 6)
	Mean ± SD	Mean ± SD
Gland length (mm)	15.10 ± 0.82	16.80 ± 0.63
Gland width (mm)	3.40 ± 0.55	3.90 ± 0.7
Gland weigh (mg)	3.20 ^b ± 0.53	4.40 ^a ± 0.3

Note: the mean values in the same column with different superscripts were statistically different (P<0.05).

The salt gland weight of the duck group reared in saline water condition was 4.40 mg higher than that of the duck group reared in fresh water condition (reached 3.2 mg). This difference was significant with $P < 0.05$. It can be concluded that the saline water condition tended to increase the size of the salt gland and particularly had a significant influence on the weight of this gland.

4.1.2.3. Microstructure of the salt gland of the sea ducks 15 - Dai Xuyen

The microscopic structure of salt glands of the sea ducks 15 - Dai Xuyen was observed at the age of 22 weeks shown typical characteristics of an exocrine gland. The gland was surrounded by connective tissue, this layer was connected the gland with the concave bone of the frontal bone

In the connective tissue layer was the smooth muscle layer (sphincter) with the rhomboid cell nuclei. Inside the gland were polygonal lobes. The space between the lobes was rich vascular connective tissue. Gland cells in each lobe were arranged in rafts (or columns) of different lengths due to microscopic template slices. From each lobe, there was a secretory duct that flowed into the central duct. The central tube was drained into the main secretion duct. The lumen of the tubes was paved by a single cylindrical epithelial cell layer (Figure 4.5 a to 4.5 h).

The crossed section shown the image of tubes was arranged in ray-like radiated from the central channel. At the gland was distance from the central tube, the branches and the glands were a more uniform structure throughout the length of the gland. The tubular structure indicated that this was a secretory gland, not the kidney filtration. The microscopic image in this study was similar to the conclusions of previous studies on the salt glands of seabirds (Ernst and Elli, 1960; Woodin and Michot 2002; Hughes, 2003).

Previous studies suggested that the fecal artery was reached to the salt gland from the inner eye artery to form lobed artery arteries, continue to divide into lobular arteries, into the central duct, and then created capillaries that run parallel to the glandular formed led to the periphery of the gland and ends up created capillaries scattered between the glands, as much as in the papillae of the kidney.

Thus, the circuit was distributed in parallel but in the opposite direction with the glandular form but in the opposite direction with the secretory flow (Holmes and Phillips, 1985). The microscopic image in this study shown the presence of blood vessels in the lobes of the gland and in connective tissue as well as the intervals of the lobes partly proving that

the salt gland structure of Sea ducks 15 - Dai Xuyen was similar to salt gland structure of other birds.

4.1.3. Some blood physio-biochemical indicators of the 15 – Dai Xuyen sea duck reared in fresh and saline water conditions

4.1.3.1. Indicators of erythrocyte system, hemoglobin (Hb), platelets and leukocyte system

The results of Table 4.2 show that the erythrocyte content of the sea ducks 15 - Dai Xuyen reared in fresh water was 2.49 million / mm³ for male and 2.38 million/mm³ for female, reared in saline water was 2.51 million/mm³ for duck and 2.33 million/mm³ for female, there was no statistically significant difference in the erythrocyte number of the sea ducks 15 - Dai Xuyen reared in fresh and saline water conditions (P> 0.05).

Hàm lượng hemoglobin (Hb) của vịt Biển 15 - Đại Xuyên nuôi trong nước ngọt có hàm lượng Hb đạt 11,10 g% đối với con trống và 10,91 g% đối với con mái, nuôi trong nước mặn con trống đạt 12,84g %, con mái đạt 11,85 g%. The hemoglobin (Hb) content of the sea ducks 15 - Dai Xuyen reared in fresh water was 11.10 g% for males and 10.91 g% for females, reared in saline water males was 12 , 84g%, the female was 11.85 g%.

Table 4.3. Erythrocyte, hemoglobin (Hb), platelets and leukocyte indicators of the sea ducks 15 - Dai Xuyen reared

Indicators	Reared in fresh water		Reared in saline water	
	Male (n = 30)	Female (n=30)	Male (n = 30)	Female (n =30)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Erythrocyte (10 ⁶ /mm ³)	2.49 ± 0.31	2.38 ± 0.27	2.51 ± 0.54	2.33 ± 0.43
Erythrocyte volume (hematocrit %)	55.03 ^a ± 5.09	44.77 ^b ± 6.14	44.43 ^b ± 7.64	42.17 ^b ± 3.84
Hemoglobin (g%)	11.10 ± 0.63	10.91 ± 0.56	12.84 ± 0.94	11.85 ± 0.46
Platelet (10 ³ /mm ³)	20.87 ± 1.85	22.96 ± 5.54	22.05 ± 3.75	21.98 ± 3.58
Leukocyte (10 ³ /mm ³)	22.19 ^a ± 3.95	23.11 ^a ± 2.99	31.46 ^b ± 3.5	32.81 ^b ± 3.47
Neutrophil (%)	23.76 ± 5.27	24.97 ± 3.49	24.54 ± 6.17	25.91 ± 5.06
Leukemia (%)	56.37 ± 5.46	55.23 ± 3.62	54.40 ± 7.47	53.67 ± 5.82
Mononuclear (%)	11.55 ± 3.36	10.72 ± 2.38	11.52 ± 2.62	10.82 ± 2.51
Eosinophil (%)	6.45 ± 1.66	6.48 ± 1.29	7.31 ± 1.78	7.27 ± 1.95
Alkaliniaffinity leukocyte (%)	1.91 ± 1.01	2.64 ± 1.48	2.27 ± 1.05	2.37 ± 1.52

Note: the mean values in the same column with different superscripts were

statistically different ($P < 0.05$).

The Hb content of newly hatched Co duck was 9.52 g%. at 70 days age was 11.29 g% and at peek laying stage was 11.60 g% (Nguyen Thi Minh. 2001). Hb content of Dom duck was 12.40 g% (Dang Vu Hoa. 2015); Black ducks in Australia had a Hb content: 12.96 g% (Mulley. 1979). Research results of Hb content in blood of the sea ducks 15 - Dai Xuyen was equivalent to the study of other duck breeds of the above authors.

The average leukocyte number of 4 sea Ducks 15 - Dai Xuyen groups was 27.39 thousand/mm³ higher than that of native Nigerian duck (24.53 thousand/mm³) and Iranian duck (17.65 thousand/mm³) (According to the studies of Okeudo et al.. 2003; Tadjalli et al.. 1996).

4.1.3.2. Protein content and protein fractions

The protein content of female duck reared in fresh water and saline water was higher than that of male duck reared in the same conditions. The results of Table 4.4 show that the total protein content of ducks in fresh water (39.98 g/l) was higher than that of ducks reared in saline water (35.82 g/l). The albumin content indicator was similarly different (Table 4.4). These differences in protein indicator may be due to better conditions of rearing with freshwater ducks than those reared in saline water conditions.

Table 4.4. Plasma protein indicator of Sea Duck 15 - Dai Xuyen (g/l)

Indicators	Reared in fresh water		Reared in saline water	
	Male (n = 30)	Female (n =30)	Male (n = 30)	Female (n = 30)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Protein	36.31 ^a ± 2.37	41.65 ^b ± 1.95	34.87 ^a ± 3.10	38.67 ^b ± 3.29
Albumin	19.23 ^a ± 0.90	21.97 ^b ± 1.55	18.11 ^a ± 0.62	22.74 ^b ± 1.51
α 1-globulin	3.96 ± 0.64	3.46 ± 0.80	3.47 ± 0.55	3.92 ± 0.54
α2-globulin	7.75 ± 0.73	7.79 ± 0.68	7.86 ± 0.65	6.10 ± 0.60
β-globulin	5.24 ± 0.78	5.80 ± 0.97	4.05 ± 0.37	4.62 ± 0.66
γ-globulin	1.08 ± 0.27	1.43 ± 0.54	1.12 ± 0.08	1.23 ± 0.18

Note: the mean values in the same column with different superscripts were statistically different ($P < 0.05$).

Most duck blood chemical studies have determined serum proteins. In poultry, as well as cattle, plasma protein determination was the basis for assessing the amount of protein reserves for the body and also the basis for assessing nutritional status and liver function of animal (Jerabek et al.. 2018). Therefore, it can be seen that the Sea Duck 15 - Dai Xuyen groups reared at the Dai Xuyen Duck Research Center had better nutrition status

than the duck groups reared in saline water environment.

4.1.3.3. Concentration of some electrolytes in the blood

The serum ion concentration of sea ducks 15 - Dai Xuyen for Na + ions, males and females was 141.19; 144.43 mmol when reared in fresh water was 139.64; and 140.21 mmol reared in saline water. K + Ion was 4.69 mmol for male and 4.09 mmol for female reared in saline water. Cl- Ion were 117.68; 115.76 mmol for male and female reared in fresh water, respectively and reached 123.78; 126.51 mmol reared in saline water. The results showed that the concentration of Na +, K + and Cl- ions in female duck serum was similar to that of male in both water conditions. Meanwhile, there was no difference in the concentration of ions between the duck group reared in fresh water and in saline water (Table 4.5).

The results of this study showed that Ca²⁺ concentration in the serum of Sea Ducks 15 - Dai Xuyen reared in saline water (3.75 mmol for males and 3.24 mmol for females) was higher than that of those reared at Dai Xuyen duck research center (3.15 mmol for the male and 2.88 mmol for the female) was statistically different between the male reared in saline water and the remaining duck groups (P < 0.05). At the center, males with a higher Ca²⁺ concentration of female ducks were freely searched food in saline water, which increased the calcium-rich food of Ducks 15 - Dai Xuyen, leading to this difference.

Table 4.5. Concentration of some ions in serum of the sea duck 15 - Dai Xuyen (mmol)

Indicators	Reared in fresh water		Reared in saline water	
	Male (n = 30)	Female (n=30)	Male (n = 30)	Female (n = 30)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Na ⁺	141.19 ± 5.24	144.43 ± 3.32	139.64 ± 6.04	140.21 ± 4.23
K ⁺	4.69 ± 0.27	4.09 ± 0.57	4.24 ± 0.37	3.95 ± 0.52
Cl ⁻	117.68 ± 3.95	115.76 ± 6.43	123.78 ± 4.37	126.51 ± 6.21
Ca ²⁺	3.15 ^b ± 0.34	2.88 ^b ± 0.24	3.75 ^a ± 0.43	3.24 ^b ± 0.11

Note: the mean values in the same column with different superscripts were statistically different (P<0.05).

4.2. PRODUCTIVITY OF THE SEA DUCK 15 – DAI XUYEN REARED AT DAI XUYEN DUCK RESEARCH CENTER

4.2.1. Growth rate of Sea Duck 15 - Dai Xuyen reared at Dai Xuyen Duck Research Center

4.2.1.1. Survival

Survival rate of the sea ducks - 15 Dai Xuyen was high over the years

of laying (2015 to 2018). in the period of 0 - 8 weeks; 96.00% in 2015-2016; 96.80% in 2016 - 2017 and 97.20% in 2017 - 2018. The period of duckling and heifer (1 day age - 20 weeks age) was 94.40 years; 95.20; 95.60%. The survival rate of Sea ducks 15 - Dai Xuyen was increased gradually through the year of laying and was the highest in 2017 - 2018.

4.2.1.2. Body weight of sea ducks 15 - Dai Xuyen over the age of weeks

Body weight of Sea ducks 15 - Dai Xuyen at 8 weeks ahe in 2015-2016 was 1829.73g/duck in male and 1780.03g/duck in female. In the year of 2016 - 2017. it was 1825.00g/duck in male; 1776.93g/duck in female. Similarly. in 2017-2018. the body weight of male and female was 1835.43 and 1762.42 g/duck. respectively. The body weight at 20 weeks of age in laying year of 2015 - 2016 was 2624.83g/duck for male. and 2522.40g/duck for female. In the laying year of 2016 - 2017. the body weight of male and female was 2603.63; 2505.70g/duck similar to the laying year of 2017 - 2018 with 2612.23; 2501.67g/ducj. Body weight of Sea ducks 15 - Dai Xuyen at 8 weeks of age over 3 generations was not significant different between males and females ($P > 0.05$). However. at 20 weeks of age. although there was no statistically significant difference in body weight among the three generations. body weight between males and females in each generation was significantly different statistics ($P < 0.05$).

4.2.1.3 Reproductive performance of the sea duck 15 – Dai Xuyen

Table 4.6. Reproductive performance of the sea duck 15 – Dai Xuyen

Indicators	Units	Year 2015 – 2016 (n = 3)	Year 2016 – 2017 (n = 3)	Year 2017 – 2018 (n = 3)
		Mean ± SE	Mean ± SE	Mean ± SE
Laying age	Week	22	22	22
Laying aget at 50%	Week	26	26	26
Body weight of female at laying	g/duck	2611.21 ± 22.45	2593.13 ± 25.23	2579.16 ± 19.41
Laying percentage/52 weeks laying	%	66.58 ± 1.42	67.10 ± 1.90	67.32 ± 1.93
Egg yield/52 weeks laying	Egg	242.48 ± 1.52	243.23 ± 1.80	245.31 ± 1.75
Feed consumption/10 eggs	kg	3.51 ± 0.05	3.49 ± 0.07	3.47 ± 0.06
Egg weight	g/egg	82.60 ± 0.89	82.79 ± 0.90	82.76 ± 0.82
Shape index	-	1.42 ± 0.01	1.42 ± 0.01	1.41 ± 0.01
Yolk percentage	%	34.08 ± 0.12	34.57 ± 0.11	34.61 ± 0.15
Embryonated egg percentage	%	92.34 ± 0.56	93.65 ± 0.63	94.23 ± 0.47
Hatching rate / embryonated egg	%	86.73 ± 0.45	86.81 ± 0.52	86.32 ± 0.39

The laying egg of sea duck 15 - Dai Xuyen was 22 weeks age over 3 generations. The body weight at laying of sea ducks 15 - Dai Xuyen was 2611.21g/duck in 2015 - 2016. 2593.13g/duck in 2016 - 2017 and reached 2579.16g/duck in 2017 - 2018.

The average laying percentahe/52 weeks of laying of sea ducks 15 - Dai Xuyen in the first generation was 66.58%. the second generation was 67.10% and the third generation was 67.32%. The average laying rate of ducks was increased over 3 generations. Body weight of sea ducks over three years of observation was stable and egg production was increased. Thus, with the egg yield potential of sea ducks 15 - Dai Xuyen. can be continued to selectively improve egg yield for the following years.

Over 3 generation observation of sea ducks 15 - Dai Xuyen. egg yield/female/52 weeks of laying was high. The first generation was 242.48 eggs. the second generation was 244.23 eggs and the third generation was 245.31 eggs. Egg yield over 3 generations observation was increased to 2.83 eggs.

Feed consumption/10 eggs of sea ducks 15 - Dai Xuyen of the first generation was 3.51 kg in average. the second generation was 3.49 kg and the third generation was 3.47 kg.

Egg weight was 82.60 -82.79 g/egg. Egg yolk percentage of sea duck 15 - Dai Xuyen was 34.08 - 34.61%.

The eggs with embryos percentage was 92.34 -94.23%. The egg quality index of the sea ducks 15 - Dai Xuyen was met the demand of technical requirements for breeding

4.2.2. Sea Duck 15 - Dai Xuyen reared in water condition with different salty level

4.2.2.1. Survival rate

The results showed that the survival rate in the period of 1 day age - 8 weeks age was 97.22% in Van Hai commune - Ninh Binh (0 ‰); 96.94% in Kim Hai commune - Ninh Binh (1 - 10 ‰); 97.78% in Hai Phong (11 - 20 ‰) and 94.72% in Quang Ninh (21 - 30 ‰). In the period of 1 day age - 20 weeks age. the survival rate was 94.44% in Van Hai commune - Ninh Binh (0 ‰); 93.89% in Kim Hai commune - Ninh Binh (1 - 10 ‰); 94.72% in Hai Phong (11 - 20 ‰) and 90.28% in Quang Ninh (21 - 30 ‰). Thus, Sea ducks 15 - Dai Xuyen was best adapted when raised in water with salinity of 21 - 30 ‰. Followed by a fresh water with a salinity of 0 ‰; next to water condition with salinity 1 - 10 ‰ and lowest in water conditions with high salinity 21 - 30 ‰.

4.2.2.2 Body weight

Body weight of sea ducks 15 - Dai Xuyen at 8 weeks of age was the highest in Kim Hai commune - Ninh Binh (1 - 10 ‰) with males was 1898.17 g. females was 1803.43 g. In Hai Phong (11 - 20 ‰), the weight of male was 1872.73 g and female was 1796.60 g. In Van Hai commune - Ninh Binh (0 - 10 ‰), the body weight of male was 1818.10 g. female was 1781.73 g. The lowest body weight was found in Quang Ninh (21-30 ‰) with the duck was 1803.67; female was 1775.57 g. At 20 weeks of age, the body weight of Sea ducks 15 - Dai Xuyen was the highest when reared in Kim Hai commune - Ninh Binh (1 - 10 ‰) with male ducks was 2661.77 g. female was 2548.13 g. The lowest in Quang Ninh (21-30 ‰) with male duck was 2594.10 g and female was 2497.30 g.

4.2.2.3. Some reproductive indicators of the sea ducks 15 - Dai Xuyen were reared in saline water condition

The laying age of sea Ducks 15 - Dai Xuyen was 22 - 23 weeks. In Van Hai - Ninh Binh, Kim Hai - Ninh Binh and Hai Phong, the laying age of duck was 22 weeks. In Quang Ninh, ducks had a laying age of 23 weeks. The body weight of female at laying at Van Hai - Ninh Binh, Kim Hai - Ninh Binh, Hai Phong and Quang Ninh was 2579.12; 2600.11; 2590.31 and 2537.35 g/duck.

Table 4.7. Reproductive performance of the sea ducks 15 - Dai Xuyen reared in saline water condition

Indicators	Units	Van Hai - Ninh Binh (0 ‰)	Kim Hai - Ninh Binh (1 - 10 ‰)	Hai Phong (11 - 21 ‰)	Quang Ninh (21 - 30 ‰)
		22	22	22	23
Laying age	Week	2579.12	2600.11	2590.31	2537.35
Laying aget at 50%	Week	26	27	26	27
Body weight of female at laying	g/duck	33	32	33	34
Laying percentage/52 weeks laying	%	66.77	67.65	68.25	65.67
Egg yield/52 weeks laying	Egg	243.45	246.54	248.63	239.67
Feed consumption/10 eggs	kg	3.50	3.46	3.37	3.60
Egg weight	g/egg	82.86	82.91	82.60	82.51
Shape index	-	1.42	1.43	1.42	1.41
Yolk percentage	%	34.48	34.62	34.65	34.41
Embryonated egg percentage	%	93.25	95.25	94.01	92.48
Hatching rate / embryonated egg	%	87.66	87.40	88.99	88.21

The average annual laying percentage of sea Ducks 15 - Dai Xuyen was the highest when reared in Hai Phong (11 - 20 ‰) 68.25%. followed by Kim Hai - Ninh Binh (1 - 10 ‰) was 67.65%; in Van Hai - Ninh Binh reached 66.77% and the lowest in Quang Ninh (21 - 30 ‰) was 65.67%.

Egg yield of Sea ducks 15 - Dai Xuyen/female/52 weeks reared in different saline water in Van Hai - Ninh Binh was 234.45 eggs; in Kim Hai - Ninh Binh was 246.54 eggs; the highest in Hai Phong was 248.63 eggs. the lowest in Quang Ninh was 239.67 eggs. Egg yield of sea ducks 15 - Dai Xuyen was different when the water conditions were different salinity levels. It can be seen that the egg yield of ducks reared in Hai Phong with a salinity of 11 - 20 ‰ was the highest. followed by the water with a salinity of 1 - 10 ‰. fresh water conditions and the egg yield of ducks reared in water with salinity of 21 - 30 ‰ was the lowest. Thus. the sea ducks 15 - Dai Xuyen was a duck breed suitable for rearing in saline water condition. especially most suitable in water condition with salinity \leq 20 ‰.

The feed consumption/10 eggs of the sea ducks 15 - Dai Xuyen reared in Van Hai - Ninh Binh (0 ‰) was 3.50 kg. reared in Kim Hai - Ninh Binh (1 - 10 ‰) was 3.46 kg. reared in Hai Phong (11 - 20 ‰) was 3.37 kg and reared in Quang Ninh (21 - 30 ‰) was 3.60 kg. Feed consumption/10 eggs was the lowest in Hai Phong and highest in Quang Ninh.

The egg weight of sea duck 15 - Dai Xuyen was 82.51 - 82.91g/egg. The yolk percentage was 34.41 -34.65%. Embryonated egg percentage was 92.48 - 95.25%. Hatching rate/embryonated egg was 87.40 -88.99%. The indicators of egg quality met the demand of technical requirements for breeding and hatching rate was high.

4.3. MEAT PERFORMANCE AND QUALITY OF SEA DUCK 15 – DAI XUYEN REARED COMMERCIALY

4.3.1. Meat performance

4.3.1.1. Survival rate

The survival rate of Sea ducks 15 - Dai Xuyen in saline and fresh water conditions was high. In the period of 1 day age - 10 weeks of age in freshwater condition. the survival rate of males and females was 96.67%. The saline water condition for males and females was 93.33%.

4.3.1.2. Body weight

The body weight of sea duck 15 - Dai Xuyen at 8 weeks of age was 2621.88 g/duck for males. and 2463.55 g/duck for females when reared in fresh water conditions. In saline conditions. male was 2448.20 g /duck;

female was 2357.23 g /duck. The body weight of sea ducks 15 - Dai Xuyen at 9 weeks of age reared in fresh water conditions. male and female was 2715.18; 2577.25 g /duck. respectively; in saline water conditions. the body weight of male and female was 2536.08; 2467.00 g/duck. respectively; Body weight at 10 weeks of age of ducks reared in fresh water was 2792.92g for male; 2639.75g for female. Rearing n saline conditions was 2619.14; 2540.46 g /duck

Table 4.8. Body weight of sea duck 15 – Dai Xuyen reared commercially(g/duck)

Weeks of age	In fresh water condition		In saline water condition	
	Male (n = 60)	Female (n = 60)	Male (n = 60)	Female (n = 60)
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
1 day ege	52.10 ± 0.21	52.02 ± 0.25	52.12 ± 0.23	52.07 ± 0.22
1	182.55 ^a ± 1.93	162.62 ^b ± 1.36	166.80 ^b ± 1.89	154.43 ^c ± 1.91
2	429.10 ^a ± 5.93	375.08 ^b ± 2.95	376.35 ^b ± 4.81	340.61 ^c ± 4.07
3	773.45 ^a ± 7.87	724.45 ^b ± 5.30	711.21 ^b ± 6.12	655.86 ^c ± 7.72
4	1131.53 ^a ± 10.60	1082.55 ^b ± 8.18	1067.04 ^b ± 7.59	1005.96 ^c ± 9.21
5	1506.97 ^a ± 13.81	1450.91 ^b ± 9.82	1425.50 ^b ± 10.80	1373.96 ^c ± 9.85
6	1923.45 ^a ± 17.67	1834.00 ^b ± 11.51	1803.18 ^b ± 11.04	1750.86 ^c ± 13.27
7	2279.98 ^a ± 19.04	2169.09 ^b ± 16.26	2159.41 ^b ± 14.53	2086.04 ^c ± 16.16
8	2621.88 ^a ± 16.36	2463.55 ^b ± 12.48	2448.20 ^b ± 12.53	2357.25 ^c ± 10.96
9	2715.18 ^a ± 15.20	2577.25 ^b ± 12.17	2536.08 ^c ± 12.03	2467.00 ^d ± 11.22
10	2792.92 ^a ± 14.80	2639.75 ^b ± 12.79	2619.14 ^b ± 13.06	2540.46 ^c ± 11.77

Note: the mean values in the same column with different superscripts were statistically different (P<0.05).

4.3.1.3. Growth functions

For both Sea ducks 15 - Dai Xuyen as well as two different types of calculation. the coefficient R² represented the accuracy of the data estimated from the functions compared to the actual data. The results show that this coefficient was very high. proved that the experimental layout was highly reliable.

Table 4.9. Parameters of the Richards and Gompertz functions

Conditions	Sex	Functions	a		b		k		n	R ²
			Est	± SE	Est	± SE	Est	± SE	Est	
Fresh water	Male	Richards	3252.63	51.06	0.011	0.02	0.35	0.02	-	98.86
		Gompertz	3252.53	28.00	4.198	0.072	0.35	0.006	0.0026	98.86
	Female	Richards	3044.72	32.24	0.075	3.93	0.35	0.13	-0.018	99.26
		Gompertz	3034.57	19.76	4.266	0.06	0.36	0.005		99.27
Sanility water	Male	Richards	3026.24	36.30	0.024	0.35	0.36	0.015	-0.0057	99.27
		Gompertz	3023.66	20.34	4.29	0.06	0.36	0.005		99.28
	Female	Richards	2925.02	29.80	0.082	6.20	0.36	0.01	-0.019	99.23
		Gompertz	2914.54	19.81	4.35	0.06	0.36	0.005		99.24

The R2 coefficient of Richards and Gompertz functions rearing in fresh water was 98.86 for male; 99.26; 99.27% for female. In saline water condition. It was 99.27; 99.28% for males. 99.23; 99.24% for females. . respectively. The a parameters (asymptotic body weight) of Sea ducks 15 - Dai Xuyen in fresh water and saline water with body weight was higher than actual body weight. However the actual body weight was also likely to be achieved compared to the actual. Therefore. using the Richards and Gompertz functions was appropriate to describe the growth curve of Sea ducks 15 - Dai Xuyen in two rearing conditions.

The calculated data showed that the mature body weight of the Sea ducks 15 - Dai Uyen in Richards. Gompertz functions reared in fresh water condition was 3252.53 - 3252.63 g for the male. higher than actual body weight at 10 weeks of age. The female was 3034.57 - 3044.52g higher than the actual body weight at 10 weeks of age. Rearing in saline water condition. the estimated mature body weight of male was 3023.66 - 3026.24 g; 2914.54 - 2925.02 g. higher than the actual body weight at 10 weeks of age. Thus. it can be concluded that body weight at 10 weeks of age of Sea ducks 15 - Dai Xuyen reared in fresh water and saline water was not the highest value. However. freshwater condition was closer to the estimated value than that reared in saline water.

Table4. 10. Asymptotic body weight. time and body weight at the inflection point of Richards and Gompertz functions

Conditions	Sex	Function	Mature body weight (g)	Time at the inflection point (week)	Body weight at the inflection point (g)
Fresh water	Male	Richards	3252.63	4.12	1194.99
		Gompertz	3252.53	4.12	1196.54
	Female	Richards	3044.72	4.01	1109.85
		Gompertz	3034.57	4.03	1116.36
Sanility water	Male	Richards	3026.24	4.07	1110.08
		Gompertz	3026.24	4.07	1110.08
	Female	Richards	2925.02	4.05	1065.49
		Gompertz	2914.54	4.07	1072.20

Note: The formula for calculating the time of the inflection point and the body weight at the inflection point was as follows:

. In the male. the time at inflection point time of Richards and Gompertz functions was 4.12 weeks. corresponding to the body weight was 1194.99; 1196.54g. In females. the time at inflection point of Richards and Gompertz was 4.01; 4.03 weeks. corresponding to the body weight was 1109.85; 1116.36g. respectively. In saline water. in the male. the time at inflection point of Richards and Gompertz was 4.07 weeks. corresponding to the weight was 1110.08 g. In females. the time at inflection point of Richards and Gompertz was 4.05; 4.07 weeks. corresponding to the body weight was 1065.49; 1072.20 g. respectively.

From the results of the survey on the body weight of the duck groups. it can summarize the following remarks: To describe the growth curve of Sea ducks 15- Dai Xuyen in fresh and saline water. the coefficients of Richards. Gompertz functions were high and the a parameter was proved to fit the reality. So. the Richards and Gomperts functions should be used to evaluate the duck growth rate in particular and poultry growth rate in general

4.3.1.4. Feed consumption

The feed consumption of the sea ducks 15 - Dai Xuyen reared in fresh water at 1 day of age - 8 weeks of age was 2.50 kg/kg body weight gain and 2.56 kg/kg body weight gain for duck reared in saline water. In the period of 1 day of age - 9 weeks of age. the feed consumption of duck

reared in fresh water. saline water was 2.59 kg; 2.68 kg. respectively. The the period of 1 day of age - 10 weeks of age was 2.70 kg and 2.75 kg respectively. Feed consumption/kg body weight gain of Sea ducks 15 - Dai Xuyen reared in fresh water was lower than that of duck reared in saline water.

4.3.1.5. Meat performance of the sea duck 15 – Dai Xuyen reared commercially

Table 4. 11. Meat composition of the sea duck 15 – Dai Xuyen

T T	Indicators	In fresh water condition		In saline water condition	
		Male (n =3)	Female (n =3)	Male (n = 3)	Female (n =3)
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
8	Live body weight (g)	2653.33 ^a ±6.67	2473.00 ^b ±4.36	2467.33 ^b ±14.5	2369.00 ^c ±13.6
	Carcass percentage (%)	69.02 ± 1.57	67.45 ± 1.68	68.23 ± 1.32	67.46 ± 1.47
	Thigh percentage (%)	14.30 ± 0.65	14.07 ± 0.23	14.00 ± 0.43	14.23 ± 0.24
	Breast percentage (%)	13.50± 0.23	13.62 ± 0.14	13.00 ± 0.48	13.52± 0.26
	Abdominal fat percentage (%)	1.12± 0.05	1.20 ± 0.03	1.15± 0.03	1.23± 0.02
9	Live body weight (g)	2690.67 ^a ± 24.1	2583.0 ^b ± 20.6	2539.33 ^b ±7.23	2494.67 ^c ±14.0
	Carcass percentage (%)	70.65 ± 1.38	69.81 ± 1.79	69.27 ± 1.56	69.23 ± 1.47
	Thigh percentage (%)	13.98 ± 0.78	13.45± 0.75	13.87 ± 0.62	13.46 ± 0.49
	Breast percentage (%)	14.02± 0.43	14.87±0.25	14.10± 0.51	14.32 ± 0.36
	Abdominal fat percentage (%)	1.24± 0.02	1.35± 0.03	1.23 ± 0.04	1.40 ± 0.01
10	Live body weight (g)	2800.33 ^a ± 28.9	2650 ^b ± 17.3	2619.00 ^b ±3.33	2551.00 ^c ± 11.9
	Carcass percentage (%)	71.22 ± 1.23	70.86 ± 1.89	70.25 ± 1.53	70.0 ± 1.64
	Thigh percentage (%)	13.43 ± 0.98	13.26 ± 0.67	13.09 ± 0.72	13.47 ± 0.76
	Breast percentage (%)	16.65 ± 0.69	16.71 ± 0.72	16.23 ± 0.58	16.54 ± 0.64
	Abdominal fat percentage (%)	1.32 ± 0.03	1.49 ± 0.03	1.47 ± 0.02	1.52 ± 0.01

Note: the mean values in the same column with different superscripts were statistically different (P<0.05).

Body weight of Sea ducks 15 - Dai Xuyen reared in fresh water condition was higher than that of duck reared in saline water condition ($P < 0.05$). The results show that from the 8th to the 10th week, the carcass percentage of Sea ducks 15 - Dai Xuyen was 69.02 - 71.22% for male, and 67.45 - 70.86% for female reared in fresh water condition. In saline water condition, the carcass percentage was 68.23% - 70.25% for male, and 67.46 - 70.00% for female.

The sea Duck 15 - Dai Xuyen was reared in two conditions, from 8 to 10 weeks of age, the breast percentage was increased gradually, while the thigh percentage was decreased. The breast percentage of sea ducks 15 - Dai Xuyen was increased from 13.50% to 16.71% reared in fresh water condition and increased from 13.00 - 16.54% in saline water condition. The thigh percentage was decreased from 14.3% to 13.26% in fresh water condition and 14.23% to 13.09% in saline water condition. However, the carcass percentage and the thigh percentage of Sea ducks 15 - Dai Xuyen reared in the two conditions at the same time of the survey was not different significantly ($P > 0.05$). The abdominal fat percentage of Sea ducks 15 - Dai Xuyen was increased gradually at the age of 8 to 10 weeks, the abdominal fat percentage of females was higher than males in both conditions, but this difference was not statistical significance ($P > 0.05$).

4.3.2. Meat quality of the sea duck 15 – Dai Xuyen

4.3.2.1. Meat physical composition of the duck meat sea 15 - Dai Xuyen

The dehydration rate due to preservation and breast meat processing of sea ducks 15 - Dai Xuyen reared in fresh water in the period of 8 - 10 weeks of age was from 0.81 to 1.29%; 24.76 - 26.09%; lower than duck reared the saline water condition in these two indicators reaching 2.20 - 2.55% and 27.28 - 31.87%, respectively. pH of Sea duck 15 - Dai Xuyen meat was measured after 15 minutes of slaughter and 24 hours at 8 - 10 weeks of age in breast meat was from 6.2 to 6.39; 5.72 - 5.74 reared in fresh water and 5.96 - 5.7 in saline water condition, respectively. Similar to thigh meat, pH was 6.22 - 6.34; 5.8 - 5.99 in fresh water and 6.22 - 6.4; 5.72 - 5.97 in saline water condition. The difference in weeks of age was statistically significant at pH 24 ($P < 0.05$).

The light color (L^*) on breast meat of the sea duck 15 - Dai Xuyen meat reared in fresh water was 40.61 - 43.09; and 43.1 - 49.44 reared in saline water. Similarly, the light color (L^*) on thigh meat was 42.23 - 43.18 reared in fresh water, 42.86 - 46.91 reared in saline water. The light color of breast meat and thighs were statistically different in terms of environment and age ($P < 0.05$).

The red color (a *) on breast meat of the sea 15 - Dai Xuyen was 15.58 -17.4 reared in freshwater. and 15.76 -17.66 reared in saline water. On the thigh meat. this index in 2 conditions was 14.41 -16.59; 14.96 - 16.44. The difference was statistically significant for condition factors and weeks of age (P <0.05).

The yellow color (b*) on duck meat reared in saline and fresh water condition was 5.15 - 7.44; 4.73 - 7.63. respectively. on the breast muscle and thigh muscle were 5.20 - 7.69; 5.37 - 6.54. There was a difference with P <0.05 at the age of weeks.

Toughness of Sea 15 - Dai Xuyen duck meat reared in fresh water with breast meat and thigh meat index at 8 - 10 weeks of age was 25.62 - 35.97; 35.06 - 46.91. respectively. Similar to the toughness of Sea 15 - Dai Xuyen duck meat reared in saline water with breast meat. thigh meat were 27.02 - 33.60; 38.43 - 43.39. This difference was statistically significant for environmental factors and weekly factors (P <0.05).

4.3.2.2. The chemical composition of 15 - Dai Xuyen duck meat quality

Table 4.12. The chemical composition of 15 - Dai Xuyen duck meat quality (%)

Sex	Parameters	In fresh water condition		In saline water condition	
		Breast meat	Thigh meat	Breast meat	Thigh meat
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Male (n = 3)	DM	22.75 ^b ± 0.17	26.71 ^a ± 0.26	23.31 ^b ± 0.64	27.94 ^a ± 0.54
	Total mineral	1.38 ± 0.01	1.40 ± 0.06	1.36 ± 0.08	1.23 ± 0.05
	LIPID	1.89 ^b ± 0.15	5.04 ^a ± 0.2	1.90 ± 0.22	6.63 ^a ± 0.13
	PROTEIN	20.34 ± 0.21	19.26 ± 0.02	20.05 ± 0.43	19.24 ± 0.2
Female (n = 3)	DM	23.72 ^b ± 0.24	26.72 ^a ± 0.36	22.64 ^c ± 0.87	27.47 ^a ± 0.4
	Total mineral	1.41 ± 0.05	1.30 ± 0.06	1.41 ± 0.06	1.61 ± 0.09
	LIPID	1.81 ± 0.15	5.53 ^a ± 0.5	1.52 ± 0.22	5.71 ^a ± 0.46
	PROTEIN	20.92 ± 0.21	19.80 ± 0.32	20.29 ± 0.68	19.46 ± 0.29

Note: the mean values in the same column with different superscripts were statistically different (P <0.05).

Analysed the quality of breast meat. dry matter content in breast meat of ducks reared in fresh water condition was 22.75; 23.72% for male and female. Reared in saline water was 23.31; 22.64%. respectively. Total mineral content of Sea 15 - Dai Xuyen duck meat reared in fresh water was 1.38% and 1.41% for male and female. Reared in saline water was

1.36% for males. and 1.41% for females. The lipid content of male and female duck was 1.89; 1.81% reared in fresh water; 1.90; 1.52% reared in saline water. respectively. Protein content was 20.34; 20.92% for male and female reared in fresh water. 20.05; 20.29% reared in saline water. respectively.

For thigh meat quality. the dry matter content in the fresh water condition was 26.71 for male; 26.72% for female. reared in saline water was 27.94% for male. 27.47% for female. Total mineral content reared in freshwater of male and female was 1.40; 1.30% respectively. reared in salienwater was 1.23; 1.61%. Lipid content in freshwater of male and female was 5.04; 5.53%. respectively. reared in saline water reaches 6.63; 5.71%. Protein content in fresh water condition was 19.26 - 19.80%. reared in saline water condition was 19.24; 19.46%.

The results showed that the amino acid content of Sea ducks 15 - Dai Xuyen reared in fresh water was higher than that reared in saline water on breast meat and thigh meat. The essential amino acid content such as Threonin. Agrinine. Valine. Methionine. Lysine. Iso - Leucine. L - Leucine. Phenylanin of ducks reared in fresh water was higher than that reared in saline water. Valine was 0.76 - 0.85% reared in fresh water. and 0.57 - 0.68% reared in saline water. Lysine was 0.90 - 0.96% reared in fresh water. 0.91 - 0.95% reared in saline water. L - Leucine was 1.47 - 1.69% raised in fresh water. 1.32 - 1.38% raised in saline water. Phenylalanine was 0.59 - 0.72% in fresh water and 0.57 - 0.66% in saline water.

In general. the amino acid content in breast meat was higher than that of thigh meat of Sea ducks 15 - Dai Xuyen reared in fresh and saline water. This was completely reasonable

CHAPTER 5. CONCLUSIONS AND RECOMMENDATIONS

5.1. CONCLUSIONS

Based on the results obtained. several conclusions are given as follows:

1/Sea Ducks 15 - Dai Xuyen was characterized by stable color of feathers. females with dark spike wings. males with light blue neck. with 2-3 curved hairs on the tail. Duck was specific for a dual-use duck and with the breast/body length index of 1.21 - 1.23 ducks with a tendency to specialize in ducks. The salt gland of Sea ducks 15 - Dai Xuyen was increased followed week of age. this is an exocrine gland with function to concentrate salt and excreted out of the body. In the first weeks of age. ducks should be provided fresh water for drinking. especially the first week of age. Physiological and biochemical indicators in blood Sea 15 -

Dai Xuyen ducks reared in fresh water and saline water was almost stable. this is due to the role of the saline gland in the excretion of ions out of the body and the adaptability of saline water condition.

2/ Productivity of Sea ducks 15 - Dai Xuyen

The survival rate of Sea ducks 15 - Dai Xuyen reared over 3 generations at the Dai Xuyen Duck Research Center was high. In generation 3. body weight at 8 weeks of age was 1835.43 g/duck for male and 1762.43 g/duck for female. egg yield reached 245.31 eggs /female /52 weeks of laying. Feed consumption was 3.47 kg/10 eggs. The egg quality and hatching indexes were high.

Sea duck 15 - Dai Xuyen reared in water environment with different salinity. Ducks had a high survival rate. the highest egg yield reared in saline water of 11-20 ‰ was 248.63 eggs /femal /52 weeks of laying. The egg quality paramatter in different salinity standards were breeding eggs. hatching rate was high. This is a valuable genetic resource for both rapid weight gain and high egg yield

3/ Performance and meat quality of Sea duck 15 - Dai Xuyen reared commercially in fresh and saline water condition.

The survival rate of Sea duck 15 - Dai Xuyen was commercially reared in fresh and saline water condition was high. The body weight of Sea ducks 15 - Dai Xuyen rearedd in fresh water through the weeks of age was higher than that reared in saline water (30 ‰). The body weight at 10 weeks of age for ducks reared in fresh water was 2792.92; 2639.75 g/duck. Reared in saline water was 2619.14; 2540.46 g/duck. The highest growth rate of Sea ducks 15 - Dai Xuyen in two conditios at 4-6 weeks of age was decreased according to the general rule. Feed consumption/body weight gain at 1 day of age - 10 weeks of age was 2.70 in fresh water and 2.75 kg in salibe water. Sea 15 - Dai Xuyen duck meat was full of amino acids. especially essential amino acids. Slaughter age was suitable for 15 - Dai Xuyen Sea ducks at 8 weeks of age.

5.2. SUGGESTIONS

1. Continue to study the concentration of ions in the excretory fluid of Sea salt duck 15 - Dai Xuyen line
2. Study and compare saline gland of some other duck breeds with those of Sea 15 - Dai Xuyen ducks under the same saline conditions.