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MORPHOMETRIC PHENOTYPE STRUCTURE OF THE CHEST AND NECK AS A DETERMINANT OF SEXUAL DIMORPHISM IN TURI DUCKS

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ABSTRACT

This study aims to prove the morphometric differences in the phenotype structure of the chest and neck as a determinant of sexual dimorphism. This study used a sample of DOD Turi ducks, with a total of 10 males and 10 females which were then reared for 8 weeks. Measurements were made every 2 weeks using a measuring tape with an accuracy of 0.1 cm and a digital caliper with an accuracy of 0.01 cm. Data was processed using ANOVA and repeated measures in SPSS 25. The results showed that the morphometric differences in chest circumference, chest width, and neck circumference of male Turi ducks were greater than that of female Turi ducks at 2-8 weeks of age, while morphometric differences in neck length occurred at 2-4 weeks of age. The growth pattern of the neck length of male and female Turi ducks did not differ, while the growth pattern of chest circumference, chest width and neck circumference of male Turi ducks was higher than that of female Turi ducks. The highest growth rate of chest circumference, chest width, and neck length in all sexes occurred at 4 weeks of age, while neck circumference occurred at 2 weeks of age. Differences in morphometric, pattern, and growth rate of the chest and neck between male and female Turi ducks are caused by genetic differences and the ability to utilize feed.

Key words: Turi duck, morphometric, sexual dimorphism, chest, neck

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INTRODUCTION

Livestock farming is one of the food producing sectors to improve nutritional quality in Indonesia. One of the livestock whose eggs and meat are used is ducks. Nugroho et al. (2018) stated that the Turi Duck is a local genetic resource originating from Bantul Regency, DI Yogyakarta. Egg production reaches 200 eggs/head/year (Baskoro, 2019).

The duck population in Indonesia in 2018 was 50,527,567, then in 2020 it fell to 48,587,606 (Dirjen PKH, 2020). The decline in duck population was followed by a decline in meat and egg production. Duck productivity can be increased through

improving livestock management and maintenance according to objectives (Ketaren, 2007). The three purposes of raising ducks are as laying ducks, broiler ducks, and animal husbandry. Raising laying ducks requires a population ratio of female to male ducks of 100:4 (Wakhid, 2010). Duck farming requires a population ratio of 1:10 male and female ducks to produce eggs with high fertility (Suryana, 2012).

To achieve profits in accordance with the objectives of raising ducks, it is supported by early sex determination. Sex determination can be done through cloaca examination, but this is less effective because the palus is difficult to see before sexual maturity (Odwyer et al., 2006). One way to find out the gender of a duck can be using morphometric techniques (Firdaus, 2021). Chest morphometrics have been used to differentiate sex in muscovy ducks (Yakubu, 2011), Neck morphometrics are used to determine sex in free-range chickens (Tamzil *and* Indrasih, 2020), Morphometrics of neck length and chest circumference are used as determinants of sexual dimorphism in Magelang ducks (Rahayu et al., 2019). This is the basis for the author to conduct morphometric research on the phenotypic structure of the chest and neck as a determinant of sexual dimorphism in Turi ducks.

MATERIALS AND METHODS

This research is observational with a Randomized Block Design (RAK) based on gender.

Research Tools and Materials

The equipment used is a DOD cage, cage bedding, 5 watt light bulb, cage for ducks aged 2-8 weeks, pond, place for food and drink, calipers Sketmat accuracy of 0.01 cm, measuring tape Deli accuracy of 0.1 cm, cloth tape, gloves, mask and

stationery. The research materials are water and feed (PB−1 *crumble* Japfa, rice bran and aking rice in a ratio of 1:2:2) *ad libitum* and 1 kg of snails every day for ducks aged 2-8 weeks.

Sample Preparation

The samples were DOD Turi ducks (10 males and 10 females). Determination of gender by breeders is based on observations of the duck's feathers, beak and voice.

Maintenance

Samples were kept for 8 weeks with the same food, drink and cage. Each sample has a different colored cloth ribbon attached to the wings as a mark.

Measurement

Measurements were carried out on DOD, aged 2, 4, 6 and 8 weeks. Chest circumference is measured around the chest through under the wings (Yakubu, 2011). Neck circumference is measured around the base of the neck (Yakubu *and* Ari, 2018). Chest width is measured from the front of the chest, from right to left (Tamzil and Indarsih, 2020). Neck length is measured from cervical vertebrae 1 to 14 (Onk et al., 2018).

Gender Proof Action

Gender was proven based on observations of the presence or absence of palus in the cloaca of Turi ducks. Palus is found in male Turi ducks.

Data analysis

Research data is analyzed using an application SPSS 25 for Windows (Statistical Package for Social Sciences). Data processing used ANOVA to determine morphometric differences in each variable relative to age (Anggraeni et al., 2021). Repeated Measure analysis to determine differences in the pattern and rate of growth of the chest and neck of ducks between different sexes during the rearing period (Ding et al., 2022)

RESULTS AND DISCUSSION

Morphometric Differences in Chest Circumference, Chest Width, Neck Circumference and Neck Length in Male and Female Turi Ducks.

Table 1. Morphometric differences in chest circumference, chest width, neck circumference and neck length in male and female turi ducks.

Variable	Gender	DOD	2 weeks	4 weeks	6 weeks	8 weeks
Chest Circumference	Male	6,51±0,20^{a}	12,17±0,43^{c}	18,72±0,73^{e}	21,31±0,71^{f}	23,33±0,35^{g}
	Female	6,31±0,27^{a}	11,40±0,60^{b}	16,77±0,89^{d}	19,17±1,17^{e}	21,60±0,86^{f}
Chest Width	Male	2,18±0,16^{a}	3,84±0,16^{c}	6,10±0,15^{e}	7,12±0,21^{g}	7,54±0,36^{h}
	Female	2,12±0,16^{a}	3,53±0,12^{b}	5,19±0,37^{d}	6,50±0,29^{f}	7,10±0,32^{g}
Neck Circumference	Male	4,44±0,20^{a}	8,48±0,39^{c}	11,07±0,71^{e}	11,77±0,43^{f}	12,51±0,45^{g}
	Female	4,33±0,38^{a}	7,58±0,56^{b}	10,03±0,46^{d}	10,88±0,52^{e}	11,58±0,70^{f}
Neck Length	Male	4,59±0,48^{a}	8,80±0,36^{c}	12,97±1,12^{e}	14,61±0,62^{f}	17,77±0,91^{g}
	Female	4,24±0,29^{a}	8,01±0,53^{b}	11,99±0,86^{d}	14,07±0,90^{f}	17,22±1,66^{g}

Note: |a-h Different superscripts on the same variable indicate a real difference ($p<0,05$)

Chest Morphometrics

The morphometrics of duck body parts are influenced by the phenotypic structure. Phenotypic diversity is influenced by genetic factors, food and environmental factors. If the influence of food and environment is uniform, the phenotype that appears is the genetic factor (Yuwanta et al., 2000).

Chest morphometrics are influenced by *os sternum* and *pectoralis muscles* (Li et al., 2021). The results showed that the morphometric circumference and chest width of male Turi ducks were significantly greater ($p<0.05$) compared to female ducks at the age of 2-8 weeks. In line with research conducted by Tarigan., et al. (2015) in adult Bali ducks, the result is that the circumference and chest width of male ducks are larger than those of female ducks (30,45 cm > 28,36 cm and 10,38 cm > 9,41 cm). Same with research Arlina el al. (2021) that the chest circumference of male Kamang ducks is larger than that of female ducks (28,06 cm > 27,41 cm).

Neck Morphometrics

The neck bones in birds are S-shaped which connects the head to the body, to balance the body and to make it easier to find food (Widodo et al., 2012). The bones that make up a duck's neck are *os vertebrae cervicales* totaling 14 parts (Handayani and Endrakasih, 2018).

The results of the morphometric research showed that the neck circumference of male ducks was significantly greater ($p<0.05$) compared to female ducks at the age of 2-8 weeks. The same as the results of research by Yakubu and Ari (2018) on Nigerian chickens, namely that the neck circumference was significantly different ($p<0.05$) starting at 2 weeks of age. Morphometric neck length of male Turi ducks was significantly greater ($p<0.05$) compared to female ducks at 2 and 4 weeks of age, the same as research by Onk et al. (2018) the neck length of male and female Turkish ducks differed significantly ($p<0.05$) starting at 2 weeks of age.

Differences in Growth Patterns and Rates of Chest Circumference, Chest Width, Neck Circumference and Neck Length in Male and Female Turi Ducks.

The growth process begins with bone growth, followed by muscle growth, then fat. Bone growth is achieved before ducks become sexually mature, almost all the bones in the bird's body experience growth of more than 50% at the age of 1-3 weeks (Rahayu et al., 2019). Peak growth occurs around 6-7 weeks of age, that is, 80% of the duck's body skeleton has reached its final dimensions (Wiradimadja et al., 2018).

Adlan et al., (2012) stated that bone growth is caused by the development of cell size (hypertrophy), which is regulated by growth hormone and calcium. Growth hormone plays a role in regulating the increase in the number and size of osteoblast and osteoclast cells involved in

the ossification process. Osteoblasts trigger bone growth while osteoclasts control bone growth so that bone shape remains proportional. Calcium has an important role in the deposition process in bones to support the ossification process (Fauzi et al., 2019). Ningrum (2015) stated that calcium is used as a material for forming egg shells in the oviduct during egg production in female ducks. Increased levels of the hormones estrogen and progesterone will encourage parathyroid hormone to dissolve calcium from the ends of the cartilage or epiphyses of long bones.

Duck muscle growth peaks at 9−13 weeks of age (Yin et al., 2021). Fat tissue grows slowly at the beginning of growth, but after reaching sexual maturity it grows faster than the speed of bone and muscle growth. Body fat is stored under the skin (subcutaneous), between muscles (intermuscular) and inside muscles (intramuscular or marbling) (Fauzi et al., 2019).

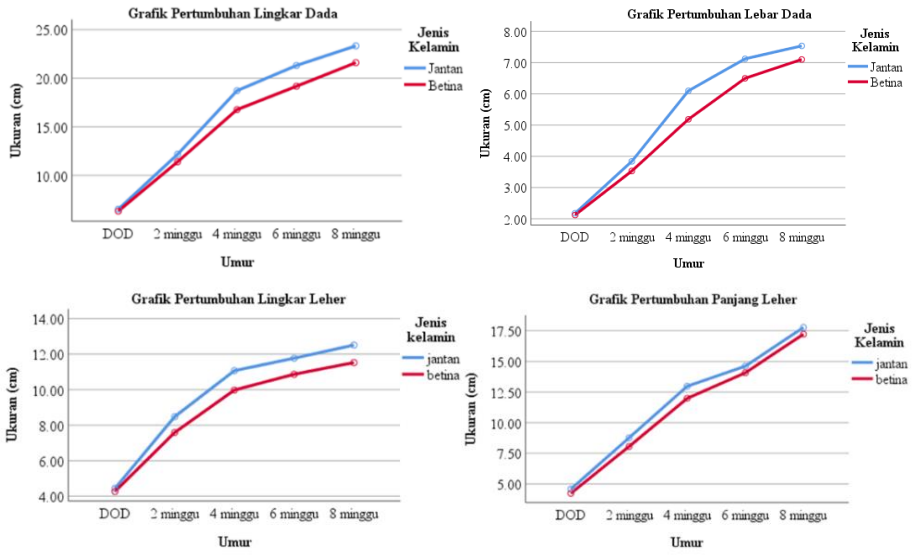

Figure 1. Graph of Growth Patterns of Chest Circumference, Chest Width, Neck Circumference and Neck Length in Male and Female Turi Ducks.

In Figure 1, a comparison of the growth patterns of chest circumference, chest width and neck circumference shows that male ducks have a higher growth pattern compared to female ducks during the rearing period from DOD to 8 weeks of age.

The pattern of growth in neck length shows that the pattern of growth in neck length between males and females from DOD to 8 weeks of age is not significantly different. This is different from research conducted by Lapik et al. (2016) in Bali ducks with results of significant differences in neck length growth patterns between males and females when DOD until 6 weeks of age. The coefficient of variation in duck neck length is thought to be due to genetic and environmental influences such as feed, temperature and rearing management.

The growth rate of ducks begins to increase at the age of 14 days and continues to increase at the age of 35 days. This is due to increasing levels of growth hormone at the age of 21 days to 35 days (Putri, 2021). Arifah et al. (2013) in their research stated that the inflection point in ducks occurs around 4-6 weeks of age.

The results of the research showed that the chest growth rate from DOD to 6 weeks of age in male Turi ducks was higher than that of female Turi ducks, then at 6 to 8 weeks of age the growth rate of female ducks was actually higher than male ducks.

Sari et al. (2012) stated that the difference in growth between male and female Gotu Kola ducks was caused by the testosterone hormone levels in male ducks being higher than in female ducks. The difference in posture between male and female ducks is also caused by the ability to utilize food and the high aggressiveness of male ducks (Kholik et al., 2016).

The growth rate of neck circumference and neck length between male and female ducks was significantly different at DOD up to 2 weeks, with the growth rate of male ducks being higher compared to female ducks. The highest rate of growth in neck circumference in male and female ducks occurred at 2 weeks of age. The highest rate of growth in neck length for males occurs at 2 weeks of age, while for females it occurs at 4 weeks of age. Sampurna (2013) revealed that each organ, tissue or body part in each phase has a different speed or growth rate, so differences in the inflection point of growth rate in neck circumference and neck length between male and female ducks occur at different ages.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Morphometric chest circumference, chest width, neck circumference and neck length in male Turi ducks were significantly greater ($p<0.05$) starting at 2 weeks of age. Male Turi ducks have a faster growth pattern and rate of growth in chest circumference, chest width and neck circumference compared to female Turi ducks. The pattern and rate of growth in neck length between male and female ducks are not different.

Recommendation

Morphometric techniques of chest circumference, chest width, neck circumference and neck length can be used as a method to determine sexual dimorphism in Turi ducks starting at 2 weeks of age.

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