

Morphometric Comparison of Kampong Chickens in Uepai District and Soropia District, Konawe Regency

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ABSTRACT

Kampong chicken is the result of the domestication of the red jungle fowl (*Red jungle fowl or Gallus gallus*), raised by their ancestors for generations. It has spread to almost all parts of Indonesia. This study aims to identify and analyze the comparison of the quantitative characteristics of native chickens in the Uepai District and Soropia District, Konawe Regency. This research was conducted in Uepai District and Soropia District, Konawe Regency, from April to December 2022, using 400 kampong chickens aged 6-24 months consisting of 200 males and 200 females divided in the two study locations. This research shows that the quantitative characteristics of native chickens in the Uepai District have a higher average value than in the Soropia District, both for males and females. The coefficient of diversity value for body size of kampong chickens in Uepai District and Soropia District shows the medium ($5 \geq$) to high ($15 \geq$) category for both males and females.

Keywords: Native Chicken, Quantitative Traits, Konawe Regency.

INTRODUCTION

Kampong chickens are the result of the domestication of red jungle fowl (Red jungle fowl or *Gallus gallus*), which have been kept by their ancestors for generations and have spread throughout almost all regions of Indonesia. The characteristics of male native chickens are clearer in terms of shape. They have a strong body, whereas in females, their tail feathers are shorter than their body length and smaller body and head sizes (Rasyaf, 2011; Halyly et al., 2020; Apriyanto et al., 2021). Kampong chickens' appearance is diverse due to various feather colors, combs, and genetics (Subekti & Arlina, 2011; Ipa et al., 2021). Kampong chickens have a high potential for livestock development (Pagala et al., 2020) with simple maintenance and very low capital (Pagala et al., 2021) so that breeders can develop traditional kampong chickens (Nataamijaya, 2000; Kabir et al., 2021; Primawati et al., 2021).

Qualitative properties are properties that cannot be measured but can be distinguished. Feather color, shank color, and comb shape are examples of qualitative traits. Quantitative traits are traits that are controlled by many genes where the differences between phenotypes are not very clear are additive and have continuous variation (Pagala et al., 2013; Pagala & Ulupi, 2015; Pagala et al., 2015; Amlia et al., 2016). Usually, the most common relationship between alleles is codominant or incomplete dominant (Noor, 2008; Pagala et al., 2017; Pagala et al., 2019; Pagala et al., 2019). Quantitative traits that indicate variation include body weight, tarsometatarsus length, tibia length, femur length, wing length, distance between

pubic bones, third toe length, and comb height (Edowai et al., 2019; Akramullah et al., 2020; Badaruddin et al., 2020). Selection can be done in two ways: based on phenotypic information and molecular selection (Yunus et al., 2021). Molecular selection is faster than traditional selection (Woli et al., 2021).

To increase livestock productivity, improving feed and maintenance management alone is not enough without improving the genetic quality of the livestock (Badaruddin et al., 2023). Improving the genetic quality of livestock can be done by maintaining the unique characteristics of the livestock (Primawati et al., 2021; Andriani et al., 2022). Genetic information is necessary to describe the genetic quality of livestock, which can later be used as a reference in continuous selection and crossing (Rahmadhani et al., 2022); (Ramadhan et al., 2023). Information about the genetic resources of kampung chickens in Konawe Regency is still limited. Therefore, basic research is needed regarding the quantitative characteristics of kampung chickens in Uepai District and Soropia District, Konawe Regency, so that it can be useful for developing kampung chicken farming in the future.

MATERIALS AND METHODS

The tools used in this research were writing instruments, measuring tape, digital scales, forms for filling in quantitative data, and digital cameras. The materials used in this research were 400 kampung chickens aged 6 to 24 months, consisting of 200 males and 200 females. Quantitative data were analyzed differentially. Qualitative characteristic variables include feather color, comb shape, and shank color. Meanwhile, quantitative characteristic variables include body weight, chest circumference, back length, wing span length, femur length, tibia length, and shank length. Percentage calculations are carried out using a formula (Soeparna 1992):

$$P = \frac{\sum X_i}{n} \times 100\%$$

Information:

P = Percentage amount
 X_i = Observation value to-i
 n = Number of samples

The quantitative characteristics of kampung chickens are calculated into average values (\bar{X}) standard deviation and coefficient of diversity (KK) using the formula:

$$\bar{X} = \frac{\sum X_i}{n}$$

$$S = \sqrt{\frac{\sum (X_i - \bar{X})^2}{n-1}}$$

$$KK = \frac{S}{\bar{X}} \times 100\%$$

Information :

\bar{X} = The average value of observations or sample average
 \sum = Addition
 X_i = Observation value to-i
 n = Number of samples
 S = Standard deviation

KK = Diversity coefficient

A comparison of the qualitative characteristics of kampong chickens in the two research locations was tested using the t-test according to the following formula :

$$t = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\left(\frac{S_1^2}{n_1}\right) + \left(\frac{S_2^2}{n_2}\right)}}$$

Information :

t = T-calculated value

\bar{X}_1 = First population mean

\bar{X}_2 = Second population mean

n_1 = Number of individuals in the first group

n_2 = Number of individuals in the second group

S_2 = Combined variant

S_1^2 = First population variant

S_2^2 = Second population variant

RESULTS AND DISCUSSION

Quantitative Characteristics of Kampong Chickens

The quantitative characteristics of kampong chickens observed in this study were body weight, chest circumference, wing span length, back length, tibia length, femur length, and shank length.

Male Kampong Chicken

The quantitative characteristics of male kampong chickens based on research location are presented in Table 1.

Table 1. Quantitative characteristics of male kampong chickens at the research location

Variabel	Kecamatan					
	Uepai			Soropia		
	\bar{x}	SD	KK(%)	\bar{x}	SD	KK(%)
BB (kg)	1,52 ^A	2,32	15,31	1,25 ^B	1,79	14,29
LD (cm)	30,75 ^A	3,07	9,98	27,86 ^B	2,54	9,13
PRS (cm)	20,12 ^a	2,01	9,98	19,53 ^b	1,80	9,22
PP (cm)	20,42 ^a	1,90	9,30	19,84 ^b	1,80	9,09
PF (cm)	10,21	1,96	19,15	10,04	1,56	15,58
PT (cm)	12,65 ^A	1,70	13,44	12,00 ^B	1,19	9,89
PS (cm)	10,05 ^A	1,48	14,69	9,48 ^B	1,49	15,70

Note: Lowercase superscript letters on numbers in the same row indicate significant differences ($P < 0.05$), and uppercase letters indicate very significant differences ($P < 0.01$). BB= body weight, LD= chest circumference, PRS= wing span length, PP= back length, PF= femur length, PT= tibia length and PS= shank length

Body Weight

The research results in Table 1 show that the average body weight of male kampong chickens in Uepai District (1.52 ± 2.32 kg) is very significantly different ($P < 0.01$) from Soropia District (1.25 ± 1.79 kg). The difference in body weight is thought to be caused by different environmental and food conditions. Uepai District's area is mostly rice fields, so it has more food availability than Soropia District because its area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is

supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual compared with the results of research conducted by Indrawati et al., (2015). So, the results of this study are not much different, namely with an average body weight of male kampong chickens of 1.68 kg with a KK of 20.38%.

Chest Size

The research results in Table 1 show that the average chest circumference of male kampong chickens in Uepai District (30.75 ± 3.07 cm) is very significantly different ($P < 0.01$) from Soropia District (27.86 ± 2.54 cm). The difference in chest circumference is thought to be caused by different environmental and food conditions. The Uepai District's area is mostly rice fields, so it has a higher food intake than the Soropia District because its area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with the results of research conducted by Misnawati (2018), the results of this study are not much different; namely, the average chest circumference for male kampong chickens is 29.53cm with a KK of 16.47%.

Wing Span Length

The research results in Table 1 show that the average wing span of male kampong chickens in Uepai District (20.12 ± 2.01 cm) is significantly different ($P < 0.05$) from Soropia District (19.53 ± 1.80 cm). The difference in wing span length is thought to be caused by different environmental and food conditions. The Uepai District's area is mostly rice fields, so it has a higher food intake than the Soropia District because its area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with the results of research conducted by Misnawati (2018), the results of this study are not much different; namely, the average wing span length for male kampong chickens is 20.64 cm with a KK of 10.94%.

Back Length

The research results in Table 1 show that the average back length of male kampong chickens in Uepai District (20.42 ± 1.90 cm) is significantly different ($P < 0.05$) from Soropia District (19.84 ± 1.80 cm). The difference in back length is thought to be caused by different environmental and food conditions. The Uepai District's area is mostly rice fields, so it has higher food content than the Soropia District because its area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. When compared with the results of research conducted by Rahmatullah et al., (2018), the results of this study are not much different, namely the average back length of local male East Kalimantan chickens is $22.38 \text{ cm} \pm 1.31$ with a KK of 5.85%.

Femur Length

The research results in Table 1 show that the average femur length of male kampung chickens in the Uepai District (10.21 ± 1.96 cm) is not significantly different from that of the Soropia District (10.04 ± 1.56 cm). However, overall, the average value of femur length in the Uepai District is higher than in the Soropia District. The difference in femur length is thought to be caused by different environmental and food conditions. The Uepai District's area is mostly rice fields, so it has a higher food intake than the Soropia District because its area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with the results of research conducted by Misnawati (2018), the results of this study are not much different; namely, the average femur length for male kampung chickens is 9.54 cm with a KK of 10.80%.

Tibia Length

The research results in Table 1 show that the average tibial length of male kampung chickens in Uepai District (12.65 ± 1.70 cm) is very significantly different ($P < 0.01$) from Soropia District (12.00 ± 1.19 cm). Different environmental and food conditions cause the difference in tibia length. Uepai District's area is mostly rice fields, so it has a higher food intake than Soropia District because its area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with the results of research conducted by Indrawati et al., (2015), the results of this study are not much different, namely the average tibial length of male kampung chickens is 9.70 cm with a KK of 14.26%.

Shank Length

The research results in Table 1 show that the average shank length of male kampung chickens in Uepai District (10.05 ± 1.48 cm) is very significantly different ($P < 0.01$) from Soropia District (9.48 ± 1.49 cm). Different environmental and feed conditions cause the difference in shank length. Uepai District is mostly rice fields, so it has higher feed than Soropia District because the area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with research by Indrawati et al., (2015), the results of this study are not much different, namely the average shank length of male kampung chickens is 9.97 cm with a KK of 14.84%.

Female Kampung Chicken

Body Weight

The research results in Table 3.8 show that the average body weight of female native chickens in Uepai District (1.17 ± 1.41 kg) is very significantly different ($P < 0.01$) from Soropia District (1.04 ± 1.67 kg). The difference in body weight is thought to be caused by different environmental and food conditions. Uepai District's area is mostly rice fields, so it

has a higher food intake than Soropia District because its area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with research by Indrawati et al., (2015), the results of this study are not much different, namely with the average body weight of female kampong chickens, the average body weight is 1.31 kg with a KK of 31.48%.

Table 2. Quantitative characteristics of female kampong chickens at the research location

Variabel	Kecamatan					
	Uepai			Soropia		
	\bar{x}	SD	KK(%)	\bar{x}	SD	KK(%)
BB (kg)	1,17 ^A	1,41	11,99	1,04 ^B	1,67	15,98
LD (cm)	29,30 ^A	1,75	5,98	26,94 ^B	2,19	8,12
PRS (cm)	18,79	1,80	9,57	18,74	1,53	8,18
PP (cm)	18,84	1,44	7,62	18,71	1,31	6,99
PF (cm)	9,34	1,31	13,98	9,39	1,17	12,51
PT (cm)	11,76	1,50	12,79	11,49	1,26	10,98
PS (cm)	9,11	1,06	11,68	8,93	1,06	11,87

Note: Lowercase superscript letters on numbers in the same row indicate significant differences ($P < 0.05$), and uppercase letters indicate very significant differences ($P < 0.01$). BB= body weight, LD= chest circumference, PRS= wing span length, PP= back length, PF= femur length, PT= tibia length and PS= shank length

Chest size

The research results in Table 2 show that the average chest circumference of female kampong chickens in Uepai District (29.30 ± 1.75 cm) is very significantly different ($P < 0.01$) from Soropia District (26.94 ± 2.19 cm). The difference in chest circumference is thought to be caused by different environmental and food conditions. Uepai District's area is mostly rice fields, so it has a higher food intake than Soropia District because its area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with research by Misnawati (2018), the results of this study are not much different. Namely, the average female chest circumference was 26.45 cm, with a KK of 9.20%.

Wing Span Length

The research results in Table 2 show that the average wing span of female kampong chickens in Uepai District (10.21 ± 1.96 cm) is not significantly different ($P > 0.05$) from Soropia District (10.04 ± 1.56 cm). However, overall, the average value of wing span length in the Uepai District is higher than in the Soropia District. The difference in wing span length is thought to be caused by different environmental and food conditions. Uepai District's area is mostly rice fields, so it has higher food levels than Soropia District, whose area is mostly coastal. Compared with the results of research conducted by Sitanggang et al., (2015), the results of this study are not much different, namely the average wing span length for male kampong chickens is 22.80 cm with a KK of 7.58%.

Back Length

The research results in Table 2 show that the average back length of female kampung chickens in Uepai District (18.84 ± 1.44 cm) is not significantly different ($P > 0.05$) from Soropia District (18.71 ± 1.31 cm). However, overall, the average value of back length in the Uepai District is higher than Soropia District. The difference in back length is thought to be caused by different environmental and food conditions. Uepai District's area is mostly rice fields, so it has a higher food content than Soropia District, whose area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. This is supported by the opinion (Subekti & Arlina, 2011) that genetic and environmental variations cause the variations found in an individual. Compared with the results of research conducted by Rahmatullah et al., (2018) the results of this study are not much different. Namely, the average back length of female wearing chickens is $21.83\text{cm} \pm 1.09$ with a KK of 4.99%.

Femur Length

The research results in Table 2 show that the average femur length of female kampung chickens in Uepai District (9.34 ± 1.31 cm) is not significantly different ($P > 0.05$) from Soropia District (9.39 ± 1.17 cm). However, overall, the average value of femur length in the Uepai District is higher than in the Soropia District. The difference in femur length is thought to be caused by different environmental and food conditions. Uepai District's area is mostly rice fields, so it has higher food intake than Soropia District, which is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with the results of research conducted by Misnawati (2018), the results of this study are not much different; namely, the average femur length for female kampung chickens is 8.54cm, with a KK of 11.90%.

Tibia Length

The research results in Table 2 show that the average tibial length of female kampung chickens in Uepai District (11.76 ± 1.50 cm) is not significantly different ($P > 0.05$) from Soropia District (10.04 ± 1.56 cm). However, overall, the average value of tibia length in the Uepai District is higher than in the Soropia District. Different environmental and food conditions cause the difference in tibia length. Uepai District's area is mostly rice fields, so it has a higher food intake than Soropia District, whose area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with the results of research conducted by Indrawati et al., (2015), the results of this study are not much different, namely the average tibial length of female kampung chickens is 9.37 cm with a KK of 10.84%.

Shank Length

The research results in Table 2 show that the average shank length of female kampung chickens in Uepai District (9.11 ± 1.06 cm) is not significantly different ($P > 0.05$) from Soropia District (8.04 ± 1.56 cm). However, overall, the average value of shank length in the Uepai District is higher than in the Soropia District. Different environmental and feed

conditions cause the difference in shank length. The Uepai District's area is mostly rice fields, so it has a higher feed rate than the Soropia District, whose area is mostly coastal. This is the opinion of Kusuma & Prijono (2007) that environmental conditions of origin, different breeds, and different rearing environments cause variations in chicken body size. She is supported by the opinion of Subekti & Arlina (2011) that genetic and environmental variations cause the variations found in an individual. Compared with the results of research conducted by Indrawati et al., (2015), the results of this study are not much different, namely the average shank length of female kampung chickens is 8.34 cm with a KK of 14.96.

CONCLUSION

This research shows that the qualitative characteristics of kampung chickens in the Uepai District and Soropia District, both males and females, are similar in feather color, flickering feather patterns, and comb shape. However, there are differences in the feather pattern and shank color. The quantitative characteristics of kampung chickens in the Uepai District have a higher average value than in the Soropia District for both males and females. The coefficient of diversity value for body size of kampung chickens in Uepai District and Soropia District shows the medium ($5 \geq$) to high ($15 \geq$) category for both males and females.

REFERENCES

- Akramullah, M., Sumantri, C., & Ulupi, N. (2020). Association of TGF- β 2 Gene Polymorphism with Salmonella pullorum Bacterial Infection Resistance in Tolaki Chickens. *International Journal of Scientific Research in Science, Engineering and Technology*, 7(1):46–54. <https://doi.org/10.32628/IJSRSET20716>
- Amlia, A., Pagala, M. A., & Aka, R. (2016). Studi Karakteristik Sifat Kualitatif Dan Kuantitatif Ayam Kampung Di Kecamatan Lasalimu Kabupaten Buton. *Jurnal Ilmu Dan Teknologi Peternakan Tropis*, 3(1), 31-39.
- Andriani, L., Pagala, M. A., & Badaruddin, R. (2022). Karakteristik Sifat Kualitatif Ayam Bangkok di Kota Kendari. *Jurnal Ilmiah Peternakan Halu Oleo*, 4(4), 255-258. <https://doi.org/10.56625/jipho.v4i4.28695>
- Apriyanto, A., Aku, A. S., & Aka, R. (2021). Penampilan Produksi Hasil Persilangan Resiplokal Ayam Peranakan Bangkok dan Ras Petelur Umur 1-8 Minggu. *Jurnal Ilmiah Peternakan Halu Oleo*, 2(2), 221-227.
- Badaruddin, R., Pagala, M. A., Nafiu, L. O., & Saili, T. (2023). External Genetic Characteristics and Introgression Rate Bangkok Chicken in Kendari City. *Indonesian Journal Of Animal Agricultural Science (IJAAS)*, 4(3), 30-42.
- Badaruddin, R., Pagala, M., Abadi, M., & Akramulla, M. (2020). Physical Quality of Native Chicken Eggs in Laying Phase and Fed with Different Shrimp Flours. *International Journal of Scientific Research in Science, Engineering and Technology*, 7(2):19–21. <https://doi.org/10.32628/IJSRSET207129>
- Edowai, G., Tumbal, E. L. S., & Fransisco M. M. (2019). penampilan sifat kualitatif dan kuantitatif ayam Kampung di Distrik Nabire Kabupaten Nabire. *Jurnal Fapertanak*. 4(1):50-57
- Halylu, L. O., Hafid, H., & Has, H. (2020). Karakteristik Telur Tetes Ayam Kampung dan Ayam Persilangan Kampung-Bangkok yang Ditetaskan dengan Mesin Tetes. *Jurnal Ilmiah Peternakan Halu Oleo*, 2(1), 26-29.
- Indrawati E., Saili T., & Rahadi S. (2015). Fertilitas, daya hidup embrio, daya tetas dan bobot tetas telur ayam ras hasil inseminasi buatan dengan ayam tolaki. *Jurnal Ilmu dan Teknologi Peternakan Tropis*, 2(2):10-18.

- Ipa, W., Nafiu, L. O., & Badaruddin, R. (2021). Ukuran-Ukuran Tubuh Ayam Lokal Umur 12-19 Minggu yang Diberi Pakan dengan Perbandingan BP 11 dan Jagung Berbeda. *Jurnal Ilmiah Peternakan Halu Oleo*, 2(2), 128-133.
- Kabir, K., Nafiu, L. O., & Has, H. (2021). Fertilitas, Daya Hidup Embrio dan Daya Tetas Telur Hasil Persilangan Ayam Bangkok dan Ayam Tolaki yang Diberi H2O2 Berbeda. *Jurnal Ilmiah Peternakan Halu Oleo*, 2(3), 282-285.
- Kusuma, D & Prijono, N. S. (2007). *Keanekaragaman Sumber Daya Hayati Ayam Lokal Indonesia : Manfaat dan Potensi*. LIPI Press. Jakarta.
- Kusuma A. S. (2002). Karakteristik kuantitatif dan kualitatif ayam merawang dan ayam kampung umur 5-12 minggu. [Skripsi]. Fakultas Peternakan Institut Pertanian Bogor, Bogor.
- Misnawati. (2018). Performa ukuran tubuh ayam kampung di Kecamatan Moramo, Kabupaten Konawe Selatan. [Skripsi]. Fakultas Peternakan Universitas Halu Oleo, Kendari.
- Nataamijaya A.G. (2000). *The Native Chicken of Indonesia*. Buletin Plasma Nutfah, 6(1):1-6.
- Noor, R. R. (2008). Genetika Ternak. Penebar Swadaya. Jakarta.
- Pagala, M. A., Indi, A., Badaruddin, R., Sandiah, N., & Aprianti, N. (2020). The egg fertility from offspring of crossbreeding results of Bangkok chickens and laying hens. *IOP Conference Series: Earth and Environmental Science*, 465(1), 012052. <https://doi.org/10.1088/1755-1315/465/1/012052>
- Pagala, M. A., Muladno, M., Sumantri, C., & Murtini, S. (2013). Association of Mx Gene Genotype with Antiviral and Production Traits in Tolaki Chicken. *International Journal of Poultry Science*, 12(12), 735–739.
- Pagala, M. A., Nafiu, L. O., & Maharani, S. (2019). Keragaan Ukuran Dimensi Tubuh Hasil Persilangan Ayam Petelur dan Bangkok pada Fase Starter. *Jurnal Ilmu dan Teknologi Peternakan Tropis*, 6(2), 251-258.
- Pagala, M. A., Sandiah, N., Aku, A. S., Badaruddin, R., & Munadi, L. O. M. (2021). Study of Qualitative Nature and Structure of the Local Chicken Population in Southeast Sulawesi. *Budapest International Research and Critics Institute-Journal (BIRCI-Journal)*, 4(4), 13506-13514. <https://doi.org/10.33258/birci.v4i4.3428>
- Pagala, M. A., & Ulupi, N. (2015). Deteksi Gen Mx Ayam Tolaki Menggunakan Teknik Ekstraksi Dna Yang Berbeda. *Jurnal Ilmu dan Teknologi Peternakan Tropis*, 1(1), 1-8. <https://doi.org/10.33772/jitro.v1i1.355>
- Pagala, M., Hafid, H., Sandiah, N., Aku, A., Zulkarnaen, D., Has, H., Badaruddin, R., & Kurniawan, W. (2019). Feeding Substitution Using Fish Waste, Papaya Leaf and Banana Peel for Kampung Chicken Production. *International Journal of Poultry Science*, 18, 499–503. <https://doi.org/10.3923/ijps.2019.499.503>
- Pagala, M., Takdir, S., Nafiu, L., Sandiah, N., Baa, L., Aku, A., Zulkarnain, D., & Kurniawan, W. (2017). Polymorphism of Mx|Hpy81 Genes in Native Chickens Observed using the PCR-RFLP Technique. *International Journal of Poultry Science*, 16, 364–368. <https://doi.org/10.3923/ijps.2017.364.368>
- Pagala, M., Tasse, A., Ulupi, N., Kampus, M., Tridharma, H., Anduonohu, & Kendari. (2015). Association of cGH EcoRV Gene with Production in Tolaki Chicken. *International Journal of Sciences: Basic and Applied Research*, 24, 88–95.
- Primawati, N., Nafiu, L. O., & Badaruddin, R. (2021). Karakteristik Ukuran-Ukuran Tubuh Ayam Lokal Umur 3-10 Minggu pada Strain Berbeda. *Jurnal Ilmiah Peternakan Halu Oleo*, 3(1), 62-66. <https://doi.org/10.56625/jipho.v3i1.16906>
- Rahmadhani, P., Badaruddin, R., & Aka, R. (2022). Keragaman Fenotip dan Pendugaan Jarak Genetik Ayam Kampung Super Menggunakan Analisis Morfometrik. *Jurnal Ilmiah Peternakan Halu Oleo*, 4(1), 13-18. <https://doi.org/10.56625/jipho.v4i1.23536>

- Ramadhan, S. T., Rusdin, M., & Badaruddin, R. (2023). Karakteristik Kualitatif Ayam Kampung Di Kecamatan Uepai Dan Kecamatan Soropia Kabupaten Konawe. *Jurnal Ilmiah Peternakan Halu Oleo*, 5(3), 257-261.
- Rahmatullah S, Efendi, N. Z., Mayulu, H., Ardhani F., & Sulaiman, A. (2018). Perbandingan morfometrik ayam lokal Kalimantan Timur berdasarkan pendekatan analisis diskriminan. *Journal of Tropical Animal Science*, 6(3):817– 828.
- Rasyaf M. (2011). Beternak Ayam Kampung. Penebar Swadaya. Jakarta.
- Rusdin, M., Nafiu, L. O., Saili, T., & Aku, A. S. (2011). Karakteristik fenotipe sifat kualitatif ayam tolaki di Kabupaten Konawe Sulawesi Tenggara. *Agriplus Majalah Ilmiah*, 21(3): 249-250.
- Rusdin, M. 2007. Analisis fenotipe, genotype dan suara Ayam Pelung di Kabupaten Cianjur. [Tesis]. Program Pascasarjana Institut Pertanian Bogor, Bogor.
- Sadarman, Elfawati & Sadriadi. (2013). Studi frekwensi sifat kualitatif dan kuantitatif ayam kampung di Desa Menaming Kecamatan Rambah Kabupaten Rokan Hulu Propinsi Riau. Seminar nasional Teknologi Peternakan dan Veteriner.
- Sitanggang, E. N., Hasnudi, & Hamdan. (2015). Keragaman sifat kualitatif dan morfometrik antara ayam kampung, ayam bangkok, ayam katai, ayam birma, ayam bagon dan magon di Medan. *Jurnal Peternakan Integratif*, 3(2): 167-189.
- Subekti, K., & Arlina, F. (2011). Karakteristik genetik eksternal ayam kampung di Kecamatan Sungai Pagu Kabupaten Solok Selatan. *Jurnal Ilmiah Ilmu Ilmu Peternakan*, 14(2):74-86.
- Sudjana, M. A. (1989). *Metode Statistik*. Edisi Kelima. Tarsito. Bandung.
- Sulandari, S., Zein, M. S. A. Paryanti, S., Sartika, T., Sidadolog, J. H. P. Astuti, M. T., Widjastuti, E., Sujana, I., Setiawan, D., Garnida, S., Iskandar, D., Zainuddin, T., Herawati, I., Wayan & Wibawan, T. (2007). Keanekaragaman sumber daya hayati ayam lokal indonesia manfaat dan potensi. Pusat Penelitian Biologi LIPI. Jakarta.
- Soeparno. (1992). Ilmu dan Teknologi Daging. Yogyakarta (ID): Gadjah Mada University Press.
- Steel, R. G. D., & Torrie, J. H. (1993). *Prinsip dan Prosedur Statistika*. Gramedia Pustaka Utama, Jakarta
- Woli, L. O., Nafiu, L. O., & Syamsuddin, S. (2021). Karakteristik Genetik Eksternal Ayam Kampung di Kecamatan Kusambi Kabupaten Muna Barat Provinsi Sulawesi Tenggara. *Jurnal Ilmiah Peternakan Halu Oleo*, 2(3), 228-237. <https://doi.org/10.56625/jipho.v2i3.16866>
- Yunus, Y., Pagala, M. A., & Rusdin, M. (2021). Asosiasi Gen TGF- β 2 dengan Ukuran- Ukuran Tubuh pada Ayam Tolaki. *Jurnal Ilmu Dan Teknologi Peternakan Tropis*, 8(3), 202-209. <https://doi.org/10.33772/jitro.v8i3.12891>
- Tarigan, R. T. (2010). Karakteristik sifat kualitatif dan kuantitatif Ayam Walik di Sumedang dan Bogor. [Skripsi]. Departemen Ilmu Produksi dan Teknologi Peternakan Fakultas Peternakan Institut Pertanian Bogor, Bogor.