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Short Communication: Biodiversity of the Gaga chicken from Pinrang, South Sulawesi, Indonesia based on the bioacoustic analysis and morphometric study

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Abstract. *Abinawanto, Effendi PS. 2017. Biodiversity of the Gaga chicken from Pinrang, South Sulawesi, Indonesia based on the bioacoustic analysis and morphometric study. Biodiversitas 18: 1618-1623.* Gaga chicken (*Gallus gallus domesticus*) is the local ornamental chicken originated from South Sulawesi, Indonesia, being kept for the crows. Gaga chicken which also called "*ayam ketawa*" ("laughing chicken") has the unique crowing song, which sounds like human laughing. Gaga chicken which has long and fast crowing song is called 'dangdut' type, while the short and slow crowing song is named 'slow' type. The objective of present study is to investigate the biodiversity of Gaga chicken from Pinrang, South Sulawesi, Indonesia based on morphometric and bioacoustic characters. Twenty samples of Gaga chicken have been collected, consisted of eight '*slow*' types and twelve '*dangdut*' types, respectively. Data were analyzed by t-test using SPSS ver. 22. The result showed that 'slow' type was bigger than 'dangdut' type. Morphometric characters could be applied to determine the biodiversity of Gaga chicken.

Keywords: Ayam ketawa, crowing song, Gaga chicken, morphometric

INTRODUCTION

Chickens (*Gallus gallus domesticus*) are estimated to have been domesticated since 8000 BC (Hirst 2017), originating from a single ancestor, the Red Jungle-Fowl (*Gallus gallus* (Linnaeus, 1758) in Southeast Asia (Fumihito et al. 1994; Hillel et al. 2003, 2007; Twito et al. 2007), but given the high diversity some researchers estimate it has multiple origins from Southeast Asia, South Asia and Southern China (Nishibori et al. 2005; Liu et al. 2006; Oka et al. 2007; Xiang et al. 2014; Peters et al. 2016). Now, Red Jungle-Fowl can still be found wildlife in India, China and Southeast Asia (BirdLife International. 2016).

Native chickens and local chicken breeds represent a diverse and unique genetic pool (Granevitze et al. 2007), but some of them are abandoned and endangered. Superior chickens breeds are used for cross breeding to produce new breeds according to market requirement and high production (Crawford 1990). New breeds continue to be generated, and old types that do not fit are removed.

The native or local chickens breeds are currently characterized by their geographic distribution (Suh et al. 2014). Today, Asia and Europe each have over 400 local chicken breeds. Africa and South America each have more than 100 local chicken breeds, and North America have less than 40 local chicken breeds (Hoffmann, 2009). Indonesia has at least 27 native chickens i.e. genuine chicken domesticated in Indonesia, and 11 local chickens i.e. cross-breeding between native and introduced chickens, that naturalized in Indonesia. In addition, there are also several types of introduced chickens (Ulfah 2016).

Chicken breeds are grouped by color, size, feathers, comb and body shape (Skinner 1978), even the rooster's sound (Childs et al 2016). There are more than 26 voice communications in chickens, and crowing is the most important to show social position in a population (Milius 2006).

Gaga chicken (in Buginese) or *ayam ketawa* (in Indonesian) is a type of local ornamental chicken that is popular among hobbyists due to its unique voice, namely slow and dangdut types (Bugiwati and Ashari 2013). Initially, this chicken was developed by the rulers of the old Ajatappareng region, which now includes Sidenreng Rappang (Sidrap), Pinrang, Enrekang, Parepare, and Barru of South Sulawesi Province, Indonesia. Currently, this chicken has been reared throughout Indonesia, but these areas remain the main population.

The crowing sound of Gaga chickens is different from crowing of other ornamental chickens of Indonesia, such as Balenggek from West Sumatra, Pelung from West Java, and Bekisar and Gaok from East Java, which has a longer sound of crowing (Rusfidra 2007), disjointed and resembles human laughter (Bugiwati and Ashari 2013).

Crowing sound behavior of this chicken is influenced by the dominance (status), morphology, and physiology (Leonard and Horn 1995). According to Shimmura and Yoshimura (2013), the chicken crowing behavior is influenced by circadian rhythms caused by the internal biological clock. Additionally, Yoshimura et al. (2000) stated that the internal biological clock between species

differs, so that the circadian system is different and lead to different behaviors of crowing sound. Yoshimura et al. (2000) also have mapped three genes which affect the internal biological clock, the clock gene is located on chromosome 4q1.6-Q2.1, while genes Per2 and Per3 respectively are in micro-chromosomes.

A limited number of individuals and the selection of a particular trait in the domestication process could increase the occurrence of inbreeding and influence number of genetic frequencies or genetic drift (Grasteau et al. 2005). Without proper control, this will affect on phenotypic diversity, such as changes in the external morphology, internal morphology, physiology, organ development, and behavior (Jensen 2006). Based on the Decree of the Minister of Agriculture No. 2920/Kpts/OT.140/6/2011, Gaga chicken has been established as one of the local chicken breeds of Indonesia which its genetic resources need to be protected and conserved. However, the problem is genetic diversity of Gaga chicken is still unknown.

The objective of this study was to investigate the biodiversity of Gaga chicken from Pinrang, South Sulawesi, Indonesia based on morphometric and bioacoustic characters. Therefore, this study is very important to increase the economic value of the chicken. The research activities were conducted, first, with an analysis of phenotypic form bioacoustics and morphometric analysis.

MATERIALS AND METHODS

Study area

This research was conducted in Pinrang Regency, South Sulawesi, Indonesia in 2014-2017. Pinrang Regency is located at 3° 19'13 " to 4° 10'30" S and 119° 26'30 " to 119° 47'20" E with an area of 1,961,77 km², and a population density of 171 ind./km² . This area is generally lowland (500 m, 60%), but there are also medium hills (500-1000 m, 20%) and highlands (> 1000 m, 10%). Field research was conducted in the lowland area.

Procedures

Twenty Gaga chicken (8 slow type and 12 dangdut type) is from several farms in Pinrang, South Sulawesi, Indonesia. Pinrang consists of the village of Malimpung, Tiroan, Mattiro Bulu, Lamrisang, and Sawito (Wattang Sawito). The morphometric and weight were used to measure and observe the behavior of crowing. The morphometric character measured is the length of neck bone (mm), weight (grams), femur length (mm), length of the tibia (mm), length of shank (mm) diameter shank (cm), the length of the maxilla above (mm), length wings (cm), the length of the third finger (mm), length of the Cestbone (mm) and length comb (mm) (Brahmantyo and Mulyono 2003).

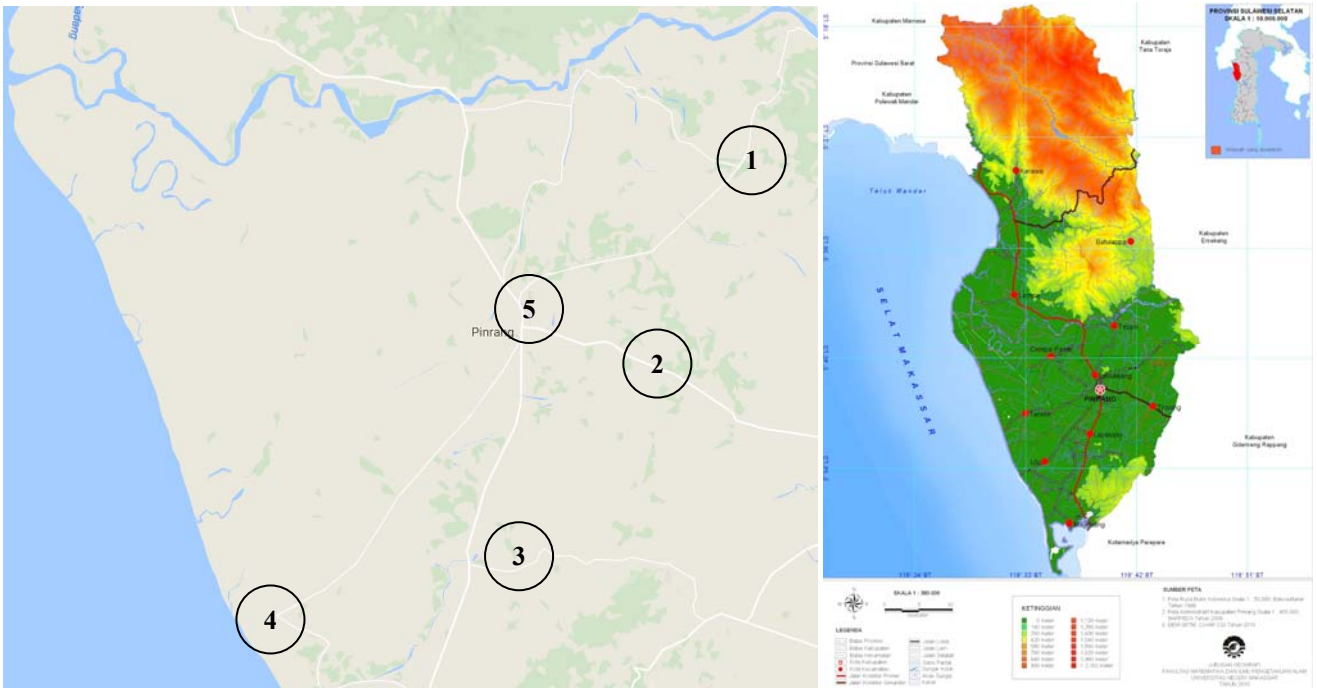

Figure 1. Study site in Pinrang District, South Sulawesi, Indonesia. A. Malimpung, B. Tiroan, C. Mattiro Bulu, D. Lamrisang, and E. Sawito (Wattang Sawito)

Morphometric characters were measured using a ruler. The total weight was weighed using a digital scale. Crowing behavior was observed using a video camera and voice recorder (Rachma et al. 2013). Number of beats that indicate the type of Gaga chicken as slow or dangdut were measured through software Cool Edit Pro 2.1 Portable (Bugiwati and Ashari 2013).

Data analysis

Data were analyzed by t-test using SPSS ver. 22, based on the average of each sample of observed morphometric characters. While, the crowing sound of Gaga chicken were analyzed descriptively using Cool Edit Pro 2.1 Portable.

RESULTS AND DISCUSSION

Bioacoustic analysis

Recording result of crowing sound from the two types of Gaga chicken was analyzed using Cool Edit Pro 2.1 Portable. Based on measurement of the software, crowing sound Gaga' chicken slow type has 3 - 5 times of beats and dangdut type has 4-7 times of beats. The result of bioacoustics analysis of the two types of Gaga chicken in a graphical display can be seen in Figure 1.

Based on the bioacoustics graphic, dangdut type of Gaga chicken has a longer crowing sound than slow type and it is influenced by genes factor in producing the crowing sound of both types of Gaga chicken. Bugiwati and Ashari (2013) stated that in the area of South Sulawesi, there are three types of Gaga chickens crowings, namely dangdut type, slow type, and crystal type. Slow type of Gaga chicken dominates the area of Sidrap, while dangdut type dominates Pinrang area. Gaga chicken that has a high value for sale is crystal type, it is a Gaga chicken of slow type which has a crisp and clear sound. It is rarely found.

Morphometric characters

Body size measurements were performed to eleven parameters of the two types of Gaga chicken. Based on the measurement, slow type of gaga chicken has a heavier weight of body than that of dangdut type, while the length of the neck bones of slow type is shorter than that of dangdut type. It causes the duration of the crowing sound of dangdut type longer than that of slow type. The average result of eleven morphometric parameters can be seen in Table 1 and Figure 2. While, the difference in morphometric parameters between slow and dangdut types can be seen in Table 2.

Discussion

All chickens breeds are descended from red jungle fowl in multilocation of Southeast Asia, South Asia, and southern China. Genetic selection over generations has developed a lot of chicken breeds that have specific characteristics. Gaga chicken is one of Indonesian local chicken, which has a unique physical shape and genetic composition, and good adaptability to environmental limitations. This breeds began to be widely farmed in Indonesia, but the continuous protection and conservation for them needs to be supported.

Evaluation of genetic diversity of native or local breeds is an important factor for the identification of unique and valuable genetic resources. Research on genetic structure and genetic diversity of these breeds is an important step to identify and conserve valuable genetic resources (Suh et al. 2014).

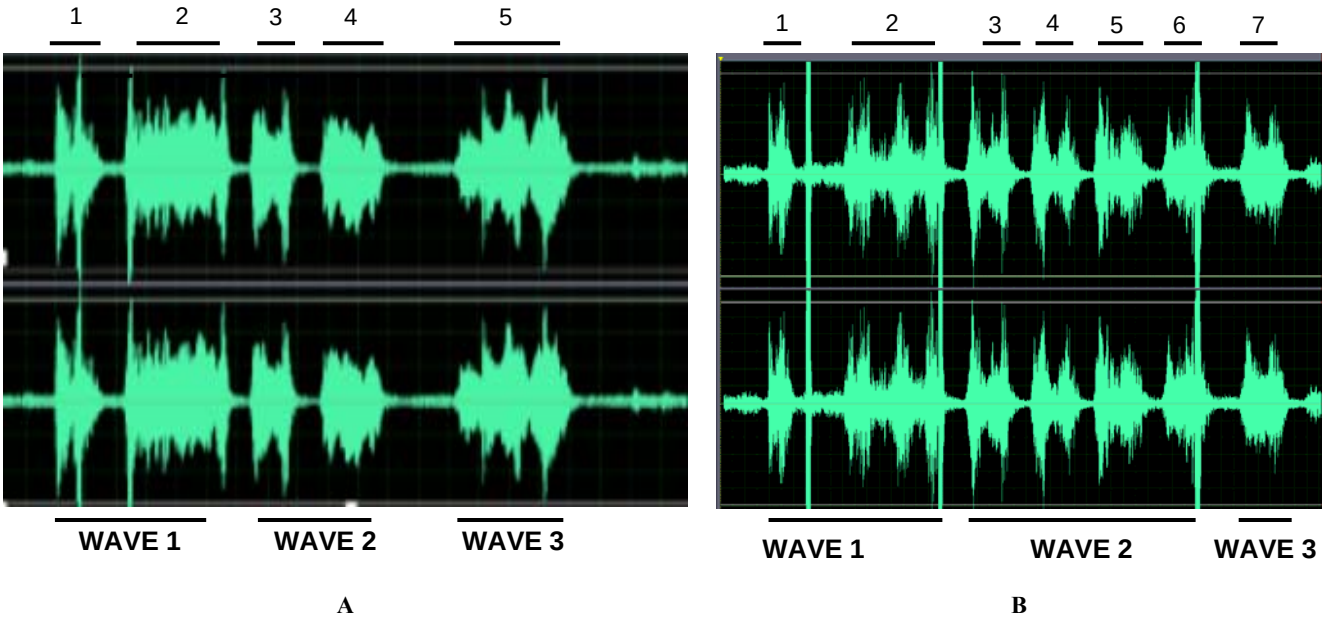

Figure 1. Bioacoustic analysis of Gaga chicken. A. Slow type, B. Dangdut type

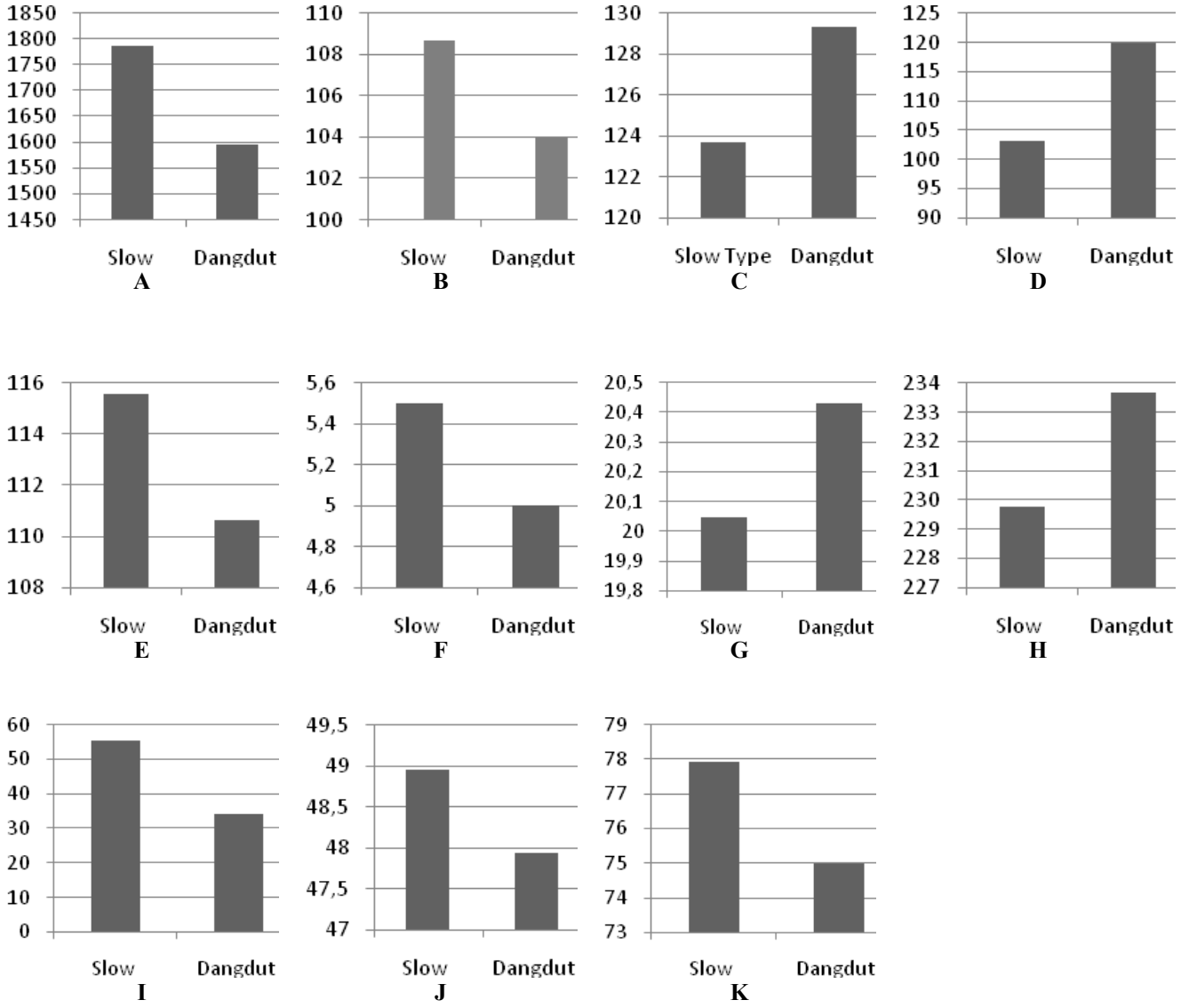

Figure 2. Graphic of Morphometric characteristic Analysis of Gaga chicken, Dangdut Type and Slow Type. A. A. Body weight (g), B. Neck bone length (mm), C. Femur length (mm), D. Tibia length (mm), E. Shank length (mm), F. Shank diameter (cm), G. Maxilla length (mm), H. Wings length (cm), I. Comb length (mm), J. Third finger length (mm), K. Cestbone length (mm)

Artificial selection and crossbreeding for superior chicken breeds have been conducted for a long time and cause commercial breed types to flourish and dominate the poultry industry. The preeminence of a highly productive of superior breed type threatens the existence of native or local breeds (FAO 2007), because superior breeds type is farmed more intensively and the low-performing of native or local chicken is neglected (Granevitze et al. 2007). Characterization of the genetic diversity of chickens can inform the development of conservation initiatives (Wilkinson et al. 2012)

On the other hand, local chickens often have the advantage of having better resistance to local environmental changes and adapting to limited food. It is passed from generation to generation genetically. With the extinction of local chickens, then this advantage is lost and not conserved to form a chicken breeding program (Blackburn 2006).

In addition, most genetic and phenotypic studies focus on commercial breeds stored in industrialized countries (FAO 2011). Due to poor commercial performance, native breed breeds in many countries are often overlooked and far less attention is paid to the genetic conservation of these resources (Wilkinson et al. 2011).

In conclusion, the results of bioacoustics analysis of Gaga chicken of slow and dangdut type show the difference beat at the end of the crowing sound. Slow type produces 3-5 beats while dangdut type produces 5-7 beats. Mean of morphometric data from both Gaga chicken types are still vary in results so it is necessary for the selection program to produce main breed.

Table 1. Morphometric characters of Gaga chicken from Pinrang, South Sulawesi, Indonesia.

No	Body weight (g)	Neck bone length (mm)	Femur length (mm)	Tibia length (mm)	Shank length (mm)	Shank diameter (cm)	Maxilla length (mm)	Wings length (cm)	Comb length (mm)	Third finger length (mm)	Cestbone length (mm)	Type
1	1400	98.56	114.69	91.6	106.72	50	18.26	218.11	51.05	50.64	77.59	Slow
2	1800	130.87	116.84	106.74	113.6	60	18.11	228.62	55.23	42.79	76.08	Slow
3	1300	97.48	75.76	79.04	114.14	50	19.3	202.64	39.22	49.83	82.69	Slow
4	2000	119.32	134.66	111.59	111.1	60	19.75	223.59	54.61	52.3	78.01	Slow
5	1500	105.41	134.13	73.8	99.34	50	16.58	165.09	50.77	47.22	68.01	Slow
6	2000	122.1	134.49	128.85	121.43	60	20.27	271.3	47.61	48.75	81.4	Slow
7	2200	108.21	144.47	119.86	114.54	60	21.58	225.1	38.35	43.63	112.92	Dangdut
8	2200	106.66	136.35	118.71	123.93	50	21.48	239.53	65.81	49.53	88.81	Slow
9	1400	90.42	136.85	95.53	113.94	50	15.42	224.93	42.56	49.02	65.99	Dangdut
10	2100	89.13	142.4	114.65	134.27	60	26.66	289.21	80.89	50.57	70.83	Slow
11	2300	109.87	137.72	107.99	138.97	60	26.01	260.37	51.74	63.35	92.4	Dangdut
12	1100	103.1	126.58	106.37	112.83	40	22.39	247.26	17.28	43.83	99.16	Dangdut
13	2400	105.28	150.72	108.51	125.38	60	19.79	258.1	19.82	56.57	68.83	Dangdut
14	1700	99.01	123.92	95.8	112.84	50	23.87	250.95	61.23	53.84	69.54	Dangdut
15	1400	116.9	131.7	102.93	93.36	50	23.41	247.48	28.72	49.28	73.26	Dangdut
16	600	65.53	93.91	67.73	83.93	40	16.76	135.09	10.66	46.1	60.67	Dangdut
17	1500	131.55	134.47	107.17	104.79	50	14.47	206.5	13.6	19.96	31.62	Dangdut
18	1800	106.07	112.4	98.78	107.47	50	14.98	236.95	63.06	45.88	74.17	Dangdut
19	1000	83.05	121.61	89.85	110.99	40	20.32	259.29	18.47	52.36	66.33	Dangdut
20	1750	128.91	138.13	121.5	108.37	50	26.1	252.11	44.42	51.35	84.59	Dangdut
∑	33450	2117.43	2541.8	2047	2251.94	1040	405.51	4642.22	855.1	966.8	1522.9	
x̄	1672.5	105.8715	127.09	102.35	112.597	52	20.2755	232.111	42.755	48.34	76.145	

Table 2. Morphometric characters of Gaga chicken from Pinrang, South Sulawesi, Indonesia based on crowing type

No.	Body weight (g)	Neck bone length (mm)	Femur length (mm)	Tibia length (mm)	Shank length (mm)	Shank diameter (cm)	Maxilla length (mm)	Wings length (cm)	Comb length (mm)	Third finger length (mm)	Cestbone length (mm)
	Slow type										
1	1400	98.56	114.69	91.6	106.72	50	18.26	218.11	51.05	50.64	77.59
2	1800	130.87	116.84	106.74	113.6	60	18.11	228.62	55.23	42.79	76.08
3	1300	97.48	75.76	79.04	114.14	50	19.3	202.64	39.22	49.83	82.69
4	2000	119.32	134.66	111.59	111.1	60	19.75	223.59	54.61	52.3	78.01
5	1500	105.41	134.13	73.8	99.34	50	16.58	165.09	50.77	47.22	68.01
6	2000	122.1	134.49	128.85	121.43	60	20.27	271.3	47.61	48.75	81.4
7	2200	106.66	136.35	118.71	123.93	50	21.48	239.53	65.81	49.53	88.81
8	2100	89.13	142.4	114.65	134.27	60	26.66	289.21	80.89	50.57	70.83
∑	14300	869.53	989.32	824.98	924.53	440	160.41	1838.09	445.19	391.63	623.42
x̄	1787.5	108.69	123.66	103.12	115.56	55	20.05	229.76	55.64	48.95	77.92
	Dangdut type										
1	2200	108.21	144.47	119.86	114.54	60	21.58	225.1	38.35	43.63	112.92
2	1400	90.42	136.85	95.53	113.94	50	15.42	224.93	42.56	49.02	65.99
3	2300	109.87	137.72	107.99	138.97	60	26.01	260.37	51.74	63.35	92.4
4	1100	103.1	126.58	106.37	112.83	40	22.39	247.26	17.28	43.83	99.16
5	2400	105.28	150.72	108.51	125.38	60	19.79	258.1	19.82	56.57	68.83
6	1700	99.01	123.92	95.8	112.84	50	23.87	250.95	61.23	53.84	69.54
7	1400	116.9	131.7	102.93	93.36	50	23.41	247.48	28.72	49.28	73.26
8	600	65.53	93.91	67.73	83.93	40	16.76	135.09	10.66	46.1	60.67
9	1500	131.55	134.47	107.17	104.79	50	14.47	206.5	13.6	19.96	31.62
10	1800	106.07	112.4	98.78	107.47	50	14.98	236.95	63.06	45.88	74.17
11	1000	83.05	121.61	89.85	110.99	40	20.32	259.29	18.47	52.36	66.33
12	1750	128.91	138.13	121.5	108.37	50	26.1	252.11	44.42	51.35	84.59
∑	19150	1247.9	1552.48	1222.02	1327.41	600	245.1	2804.13	409.91	575.17	899.48
x̄	1595.83	103.99	129.37	119.86	110.61	50	20.42	233.67	34.15	47.93	74.956

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