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Carcass Quality, Production of Local Duck Meat and Edible Offals in Traditional Markets on Lombok and Sumbawa Islands

I N Tirta Ariana¹, I K. Sumadi¹, Bulkaini², Syamsuhaidi², Yusuf Sutaryono², Maskur², Djoko Kisworo², and Sukarne²

¹ Faculty of Animal Science University of Udayana, Jimbaran Hill Campus, Denpasar, Bali, Indonesia 80361.

² Faculty of Animal Science University of Mataram, Majapahit Street, number 62, Gomong, Selaparang, Mataram Lombok, 83125, Tel: (0370). 633007, West Nusa Tenggara, Indonesia

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CORRESPONDING AUTHOR

*E-mail: b_kaini@yahoo.com

ABSTRACT

Based on the Indonesian National Standard, this study aimed to determine the quality of carcasses, meat production, and offal of local male ducks in traditional markets on the islands of Lombok and Sumbawa. The research material used 64 local male ducks aged 55-60 days, with details of 36 coming from chicken slaughterhouses in Mataram City, 12 ducks from chicken slaughterhouses in West Lombok Regency, and 16 ducks from chicken slaughterhouses in Sumbawa Regency. Local male ducks were sampled from each sub-district using a random sample. The research data of live weight, carcass weight, meat weight, carcass percentage, and offal percentage were analyzed using the Microsoft Excel and SPSS version 16. Data analysis showed that local male ducks slaughtered in traditional markets on the islands of Lombok and Sumbawa produced duck carcasses belonging to the quality I as much as $51.16 \pm 10.68\%$ of the total sample, quality II as much as $37.71 \pm 15.28\%$ and quality III of $17.13 \pm 6.85\%$. Pure local male duck meat products circulating in traditional markets on the islands of Lombok and Sumbawa are 43.96% and 44.82%, respectively. Conclusion: Carcass quality and meat production of local male ducks in the traditional markets of the islands of Lombok and Sumbawa have met the Indonesian National Standard, namely the live weight of 1,290 g, carcass percentage of 60.33%, and pure meat production of 44.25%.

1. INTRODUCTION

1.1. Research Background

Ducks as poultry as a national meat provider need to be developed because apart from producing eggs, they also have the potential to produce meat and edible offal [1]. Several types of ducks can be developed as meat producers: *Bali ducks*, *Khaki Campbell ducks*, *Peking ducks*, *Alabio ducks*, and *Manila ducks* [2]. Indonesian local ducks are germplasm that needs to be preserved and their genetic quality improved to increase farmers' income [3]. The naming of local ducks is adjusted to the location of their existence and the specific characteristics of these ducks, such as *Bali ducks* on the island of Bali [4], *Kemang ducks* in Sumatra [2], *Tegal ducks*, *Magelang ducks*, and *Mojosari ducks*. On the island of Java [5], *Sasak ducks* on the island of Lombok [3].

Ducks as meat producers, have a relatively low contribution to fulfilling the needs of animal protein for the Indonesian people due to the low population of ducks in Indonesia [6]. The high and low quality of duck carcasses depended on the meat contained in the carcass or the pure meat produced [7]. Carcass quality is the value of carcass made by livestock against marketing conditions [8]. Furthermore, it is said that the quality of carcass and pure meat production produced by ducks greatly affect the selling value of the carcass.

Based on the age of poultry (duck), carcasses could be grouped into 3 age categories, namely: 1) < 6 weeks or young ducks (fryer/broiler), 2) 6-12 weeks or adult ducks (roaster), and 3) > 12 weeks or old duck (stew), while based on carcass weight it was divided into 3 (three) types of size, namely: 1) <1.0 kg or small size, 2) 1.0 kg-1.3 kg or medium size, and 3) > 1.3 kg or large size [9].



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The carcass characteristics of poultry were shown by carcass weight, carcass percentage, meat production, bone weight, and fat weight [10]. The factors that influence the carcass characteristics and [production of duck meat were genetic factors [11], feed quality [8], handling of ducks before and after slaughtering, and slaughtering methods [12]. The slaughter process that fulfills the standards will produce carcasses and meat whose quality meets the provisions of the Indonesian National Standard [13]. Duck slaughtering was done by the Kosher method: cutting the *carotid artery*, *jugularis vena*, and *esophagus* between the skull and the first cervical vertebra [11]. Before the slaughter, the ducks were fasted for 12 hours while still being given water. Ducks completely dead are put into hot water at 50 °C – 60 °C for 0.5-1.0 minutes to facilitate the feather removal [4].

Other factors that affect carcass quality and pure meat production include the livestock rearing system and the completeness of slaughterhouse facilities [14]. The difference in facilities found in poultry slaughterhouses in West Nusa Tenggara causes the quality of the carcass and edible offal produced to vary widely [15]. To get an idea of the carcass quality and meat production of local male ducks in the traditional markets of the islands of Lombok and Sumbawa, it is necessary to conduct research.

1.2. Literature Review

Livestock that experiences high stress due to transportation not handled professionally from the farmer's location to the slaughterhouse could reduce the quality of carcass and meat [16]. Changes that occurred in livestock with high stress, namely muscle glycogen, would undergo enzymatic glycolysis and produce lactic acid which triggers changes in the pH of the meat so that the meat becomes pale, soft, and watery, as well as significant weight loss in edible offal (liver and deep fat) [17]. Changes in the pH of the meat in the carcass from an acidic environment (pH 5.1-5.8) to an alkaline environment (pH more than 6) caused the meat color to turn pale or dark red with low water holding capacity and high cooking loss [12].

The traditional slaughter of ducks in poultry slaughterhouses is one of the factors causing the low quality of the carcass produced [18] while slaughtering chickens or ducks by inserting the head of the poultry into the funnel can maintain carcass quality [19]. Carcass damage due to traditional slaughter can be in the form of bruises on the chest and thighs, reducing the profit of chicken slaughter by 10-20% [6]. The results of research on Cihateup-Alabio (CA) ducks were slaughtered at 8 weeks of age, and the manual rearing process could give a carcass percentage of 56.55% [20]. Local ducks rearing down on carcasses using Sionga wax can provide carcasses with the quality I of 25%. In comparison, maintenance of downy fur on carcasses of local ducks can give carcasses with the quality I of 13% [21]. It was reported that hybrid ducks repairing down on carcasses could produce carcasses with a quality I of 50%; furthermore, hybrid ducks keeping down feathers could use carcasses with a quality I of 88%.

The quality of duck meat was largely determined by the level of carcass cleanliness [11]. Assessment of meat quality can also be seen in terms of color or carcass brightness [22]. Cleaning duck feathers using the dipping method in a wax solution for 90 seconds can darken the carcass and cause damage to the skin of the carcass [23].

1.3. Research Objectives

Based on the description above, a study was conducted to know the carcass quality and meat production of local male ducks in the traditional markets of Lombok and Sumbawa Island based on the Indonesian National Standard number 3924:2009.

1. MATERIALS AND METHODS

2.1. Research materials

The materials used in this study were 64 local male ducks with a slaughter age of 55-60 days. Thirty-six heads were taken from a slaughterhouse in Mataram City, twelve from a slaughterhouse in West Lombok Regency, and sixteen from a slaughterhouse in Sumbawa Regency. Male local ducks, as research material, received different feeding treatments, depending on the potential for feed availability and farmers' feeding habits. Ducks as research material were reared semi-extensively (ducks during the day looking for their food, while at night were given additional feed in the form of bran) by duck farmers in each research site. Male local ducks in the starter phase aged 1-14 days in all sampling locations were given the same type feed with the same type, namely commercial feed in the form of flour, while ducks aged 15-60 days at night were given concentrate feed in the form of bran with different percentage

2. Research Methods

2.1. Research sample determination

Male local ducks as research samples came from the island of Lombok, namely Mataram City and West Lombok Regency, while for Sumbawa Island they were taken from Sumbawa Regency. The random sampling method determined male local ducks as research samples for each sub-district in both the City and District areas. All samples of ducks, before being slaughtered, were given the same treatment, namely: 1) Ducks from the rearing place to the slaughterhouse are transported using a four-wheeled pick-up vehicle with a distance of 10-15 km; 2) Before slaughtering the ducks fasted for 12 hours at the shelter, and 3) Applying the Islamic sharia method in the process of slaughtering ducks.

2.2. Measurement of research variables

The research variables were measured at the Animal Health Laboratory of each research location, namely: 1) Laboratory of Animal Products Processing Technology, the University of Mataram for the City of Mataram; 2) Animal Health Laboratory of the West Lombok Agriculture and Livestock Service for the West Lombok region and 3) Animal Health Laboratory of the Sumbawa Regency Livestock Service Office for the Sumbawa Regency area. The equipment facilities for testing research variables in each laboratory are the same and have met the standard of accuracy level. The method of measuring research variables is described as follows:

2.2.1. Live weight

Male local ducks were weighed before being fasted for 12 hours to get live weight [7].

2.2.2. *Carcass weight*

Carcass weight is the difference between live weight and the weight of the neck, head, hair, legs (from the knees to the fingers), and the innards except the lungs [4].

2.2.3. *Percentage of carcass*

Carcass weight divided by live weight multiplied by 100% is called carcass percentage [17]

2.2.4. *Weight and percentage of offal*

The weight of offal is the result of weighing the intestines, liver, heart and gizzard after being cleaned of feces. The result of dividing the weight of offal by live weight multiplied by 100% is called the percentage of offal.

Weight and percentage of edible offal (paws, neck and head)

The result of weighing each edible offal weight is called the edible offal weight. The result of dividing the total weight of edible offal with live weight multiplied by 100% is called the percentage of edible offal.

2.2.5. *Weight of pure meat*

The result of weighing the meat on the primal cut of the breast carcass after being separated from the bone is called the weight of pure meat. The percentage of pure meat is the result of dividing the weight of the meat by the carcass weight multiplied by 100% [7].

2.2.6. *Classification of carcass weight and quality*

The results of the research in the form of carcass weight were grouped into three, namely: 1) Carcass weighing < 1 kg were called small sizes; 2) Carcass weighing >1.0-1.3 kg are called medium size and 3) Carcass weighing >1.3 kg are called large sizes [9]. The grouping of carcass quality is divided into 3, namely quality I, quality II and quality III with the indicators presented in Table 1.

Table 1 . Indicators for Determining the Quality of Duck Carcass *

Number	Quality factor	Quality I	Quality II	Quality III
1.	Carcass Whole	whole	The skin is a little torn, but not on the chest	There is a torn skin on the chest
2.	Hygiene	Free from pin feathers	There is a little shoot hair that spreads, but not on the chest	There are shoots of hair on the chest

* (BSN, 2009) [9]

Determination of carcass quality based on quality indicators (Table 1) involved 15 semi-trained panelists from the Faculty of Animal Science University of Mataram. Carcass quality is determined at the Animal Health Laboratory of each Regency, except for the Mataram City area, which is carried out at the Laboratory of Animal Products Processing Technology, Faculty of Animal Science University of Mataram.

2.3. *Analysis of Data*

Research data related to carcass quality and meat production such as live weight, carcass weight, and percentage, offal weight and percentage, edible offal weight and percentage, and meat weight

and rate were analyzed using the Microsoft Excel program and regression correlation analysis using the SPSS version 16 software program [24].

3. RESULTS AND DISCUSSION

3.1. The proportion of body parts of local male ducks

Bodyweight proportions of local male ducks, including live weight, carcass weight, pure meat weight, offal, and edible offal weight are presented in Table 2.

Table 2. Average Body Weight Proportion of Male Local Ducks in West Nusa Tenggara (g)

Number	Research Location	Number of samples	Live weight	carcass	Pure meat	Offal	Edible offal*
1.	Mataram city	36	1.088	604.170	463.060	145.220	91.690
2.	West Lombok	12	1.444	900.000	669.170	153.330	131.670
3.	Sumbawa	16	1.338	857.810	596.250	156.250	119.060
Total		64	3.870	2361.980	1728.480	454.80	342.420
Average			1.290	787.327	576.160	151.600	114.140
Standard of deviation			0.183	160.015	104.513	5.715	20.439

*head, neck, and shanks

The results study (Table 2) showed that the average live weight of local male ducks in West Nusa Tenggara was 1.290 ± 0.183 g. The average live weight of local male ducks obtained in this study was lower than the live weight of male Bali ducks with the additional feed of 8 weeks old mung bean flour waste of 1.464 g and the live weight of male Peking ducks with rations containing 10% fermented pineapple peel in 8 weeks of age reaches a weight of 1.693 g [1];[7]. Whereas male Peking ducks fed a complete wafer ration containing 2.5% coffee husk waste at 8 weeks reached a weight of 1,866.7 g [25].

The high and low live weight of ducks was caused by several factors, including the strain of ducks [23], age, sex, type of feed [26], maintenance management (cage density, presence or absence of access to the outside cage) or natural conditions such as ambient temperature, humidity and air pressure [27]. Age differences are said to produce different live weights [20]. The results of previous research proved that local male ducks fed feed containing 10% leubim fish meal produced a live weight of 1.726 g [25], While Male Bali ducks fed a diet containing 12.5% mung bean waste flour from the basal ration resulted in a live weight of 1,449.80 g [1].

The difference between intensive and semi-intensive rearing systems is that the place where the maintenance and fulfillment of feed needs for ducks greatly affects the growth (body weight) and production [28]. Furthermore, it was said that the male *Tegal ducks* reared semi-intensively for 42 days had a bodyweight of

766.60 g, while those reared intensively were 994.28 g. *Magelang ducks* kept semi-intensively for 6 months had a bodyweight of 1.683 g, while the bodyweight of *Magelang ducks* kept intensively for 6 months was 1.683 g [26]. The results of this study illustrate that the bodyweight of local ducks slaughtered on the island of Lombok and Sumbawa island was still in the range of body weight of local ducks reared semi-intensively, which is in the range of 500-2.625 g. It is said that intensive maintenance and free-range access affect broilers' morphometrics and body weight [29]. Previous studies have proven that broiler body weight is also affected by the material and thickness of the litter in the cage [30]. Male *Magelang ducks* reared extensively on commercial feed at 6 weeks of age had a body weight of 1.349 g, while females 1.284 g [31].

The results study (Table 2) showed that the average carcass weight of male local ducks in West Nusa Tenggara was 787.327 ± 160.015 g. The high standard deviation in the results of this study (Table 2) was due to the large difference in carcass weight obtained between the research locations.

3.2. Percentage of male local duck body parts

The percentages of male local duck body parts including the percentage of the carcass, the percentage of pure meat, the percentage of offal, the percentage of edible offal, and the percentage of other body parts were presented in Table 3.

Table 3. Average Percentage of Male Local Duck Body Parts in West Nusa Tenggara

Number	Research Location	Number of samples	Carcass (%)	Pure meat (%)	Offal (%)	Edible offal*(%)	Other** (%)
1.	Mataram City	36	55.50	42.62	13.49	8.54	22.46
2.	West Lombok	12	61.03	45.32	11.87	10.59	16.51
3.	Sumbawa	16	64.47	44.82	11.67	8.93	14.93
Total		64	181.00	132.76	37.03	28.06	53.90
Average			60.33	44.25	12.34	9.35	17.97
Deviation standard			4.53	1.44	1.00	1.09	3.97

*Edible offal: head, neck and shanks

**Others: feathers, blood and feces and calculated by the formula: $[100 - (\% \text{ carcass} + \% \text{ offal} + \% \text{ edible offal})]$.

3.3. Percentage of carcass

The results (Table 3) showed that the average percentage of male local duck carcasses was $60.33 \pm 4.53\%$ higher than the percentage of male Peking duck carcasses fed with 10% probiotic feed in the ration at 8 weeks of slaughter age of 53.99% [32], also greater with male Peking duck carcass fed with 10% fermented pineapple peel in the ration at 8 weeks of slaughter age by 55.25% [12], and also superior to the percentage of male local duck carcass fed a diet containing 10% leubim bone meal in the ration at 16 weeks of slaughter of 59.65% [25]. Previous studies reported that male Serati ducks fed rations with a crude protein content of 17.65% and adding herbal solution of 3 ml/head/day at 12 weeks of slaughter produced higher carcasses. 63.09% [2].

The high and low percentage of duck carcass were caused by several factors, including live weight [11]; age, sex, type of feed [26]; non-carcass weight, and wasted parts [32]; maintenance

management (cage density, whether or not there is access outside the cage), or natural conditions such as ambient temperature, humidity, and air pressure [27]. It was explained that differences in feed composition (protein content) would produce different carcass percentages[33]. This study's carcass weight of male ducks also closely correlates with live weight. This was evidenced by the very high value of the correlation coefficient and R^2 , namely: 0.92 with the regression correlation equation $y = 0.6531x - 71.63$ (x =live weight; y =carcass weight) shown in Figure 1. The regression correlation equation above can predict the carcass weight of local male ducks if the live weight was known without going through the slaughter process.

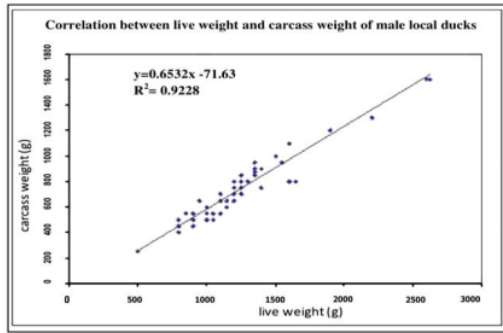


Figure 1 : Graph of correlation between live weight and carcass weight of male local ducks on Lombok Island and Sumbawa Island

3.4. Pure meat percentage

The study (Table 3) showed that the average percentage of pure meat to live weight of local male ducks was 44.25±1.55%. Pure meat production was reflected by the size of the ratio of meat and bones[5]. The meat produced in this study was higher than that of male Bali duck meat fed with fermented mung bean sprout waste flour (12.5%), which was 42.03%[1]. The results of previous studies reported that the percentage of male local duck breast meat with commercial feed added with 2.5% betel leaf solution was 58.08%[34].

The percentage of local duck meat from the thigh is 53.08%, with the percentage of 302 bones being 14.17%. The results obtained in this study illustrate that the production of 303 local male duck meat circulating on the islands of Lombok and Sumbawa is still lower than the results of the 304 studies above. This is because the local ducks slaughtered in traditional markets are mostly 305 tails kept semi-intensively with additional feed at night or during the day in bran.

Production of pure meat also has a very close relationship (correlation) with carcass weight, this was evidenced by the very high value of the correlation coefficient and R², namely: 0.97 as shown in Figure 2 with the regression correlation equation: $y=0.7064x + 24.237$ (x = weight of carcass; y = weight of pure meat). The regression correlation equation can predict pure meat weight based on carcass weight. The production of local male duck meat can be seen directly from the weight, percentage of carcass and the large proportion of high-value carcass parts [35]

3.5. Offal percentage

The results (Table 3) show that the percentage of male local duck offal to live weight is 12.34 ± 1.00%. These results were almost the same as the observations from [36] on the weight of duck offal aged 7 months that were kept organically, which was 154.83 g. The results of previous research showed that ducks supplemented with probiotics in their feed and slaughtered at 6 weeks of age had an 8.30% lower percentage of offal than the results of this study [37]. The weight of the offal of female Peking ducks was 168.8 g, and of male Peking ducks was 129.3 g at the rejected age (27 months)[38].

The high percentage of male local duck offal obtained in this study was because ducks were kept semi-intensively, so the intake of feed nutrients was not controlled in terms of quality and quantity. Ducks given feed with high crude fiber content will

cause enlargement of the digestive tract, causing a higher percentage of offal.

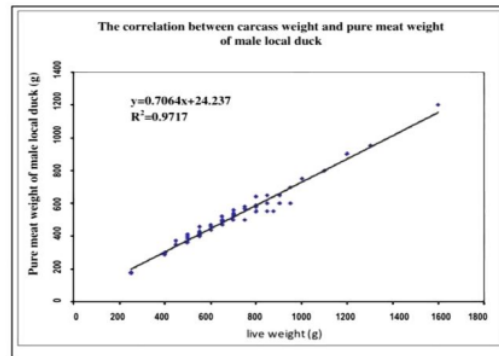


Figure 2 : Graph of correlation between live weight and pure meat weight of male local ducks on Lombok Island and Sumbawa Island

3.6. Edible offal percentage (head, neck, and legs)

The results (Table 3) show that the average percentage of edible offal male local ducks aged 8 weeks (9.35±1.09%). The results of this study are lower than those of Makram *et al.* (2021)[39], namely the edible offal weight of *Peking ducks* aged 8 weeks (11.15%), *Sudan ducks* aged 14 weeks (10.84%) and ducks from a Peking-Sudan cross at the age of 9 weeks (11.10%). It is said that the percentage of offal of local ducks slaughtered at 24 weeks of age was 35.33%, Peking ducks killed at 9 weeks of age was 30.30% [40], while male Bali ducks aged 8 weeks had offal weight (head, neck, and feet) of 144.66 g[41].

3.7. Miscellaneous percentage (feather and blood)

The results study (Table 3) show that the average percentage of combined weight of fur, blood, and feces calculated by the formula: $[100 - (\% \text{ carcass} + \% \text{ offal} + \% \text{ edible offal})]$ is 17.97 ± 3.97% with a maximum value of 22.465 and a minimum of 14.93%. The results of this study are higher than those of [39], namely Peking ducks aged 8 weeks had a combined percentage of fur, blood and feces of 12.14%, Sudan ducks aged 14 weeks (11.17%), and ducks from Peking-Sudan crosses of 10.08%. It was explained that the local duck (male Bali duck), aged 8 weeks had feathers and a blood weight of 70 g [41]. Peking ducks aged 40 days with live weight of 1,590 g had feather and blood weight of 278 g with a feather and blood percentage value of 8.04% [42]. Adding an energy source from soybean oil to the feed also affects the weight of ducks' blood and feathers, which reach 8.23% of the carcass weight[43]. A general description of the proportions of the body components of local male ducks on the islands of Lombok and Sumbawa is presented in Figure 3.

Figure 3 shows that the largest body component of local male ducks is carcass (66.33%), followed by other components in the form of feathers and blood (17.97%), offal (12.34%), and edible offal 9.35%. Carcass, the largest component of the duck body, consists of meat, bones, and fat with a pure meat content of 44.25% [44]. Previous research reported that local male ducks fed commercial feed at 8 weeks of slaughter yielded pure meat on the thigh primal carcass by 57.33%, whereas on the breast primal carcass produced pure meat on the thigh primal carcass by

57.33%, namely 58.08% [34]. *Magelang ducks* with a semi-extensive rearing system for 6 months produced 85% of the pectoralis muscle, 83.35% of Tegal ducks, and 84.97% of *Pengging ducks* [5]

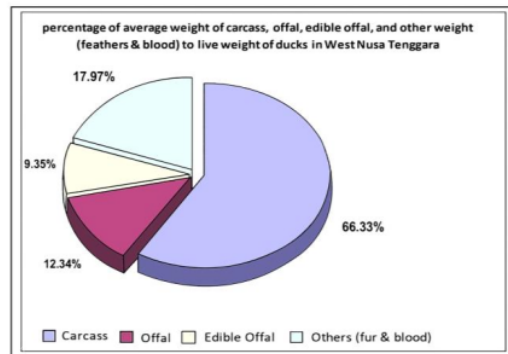


Figure 3 : Percentage of carcass weight, offal weight, edible offal weight and other weights to live weight of local male ducks on

Table 4. Classification of Carcass Weight and Quality of Male Local Ducks (%)

Location	Number of samples	Carcass weight Classification (kg)		Carcass quality Classification (%)			
		< 1 kg	>1-1.3 kg	> 1.3 kg	Quality I	Quality II	Quality III
Mataram City	36	100.00	0.00	0.00	38.89	47.22	13.89
West Lombok	12	50.00	25.00	25.00	58.33	16.67	25.00
Sumbawa Besar	16	93.75	6.25	0.00	56.25	31.25	12.50
Average		81.25	10.42	8.33	51.16	31.71	17.13
Deviation standard		27.24	13.01	14.43	10.68	15.28	6.85

Source: Primary data processed

Based on the standard carcass weight classification as described in the material and method section, it can be explained that the carcass weight of local male ducks circulating in traditional markets on the islands of Lombok and Sumbawa, which are included in the large category reaches $8.33 \pm 14.43\%$, the medium type is $10.42 \pm 13.01\%$, while with a small category of $81.25 \pm 27.24\%$. The results of the study are in line with the study of [28] reported that local male ducks fed with *Indigofera zollingeriana* leaf meal and *lemuru* fish oil at a level of 5.5% with a slaughter age of 34 weeks produced a relatively small carcass weight, because the carcass weight was less than 1 kg (928.33 g).

The results of this study illustrated that the carcass quality of local male ducks circulating in traditional markets on the islands of Lombok and Sumbawa with category I quality was $51.16 \pm 10.68\%$, quality II was $37.71 \pm 15.28\%$ and quality III was $17.13 \pm 6.85\%$. The difference in carcass quality was caused by the completeness of the feather removal facility [18], the process of slaughtering ducks was not carried out professionally, and the occurrence of stress in the transportation process [45] ; [16]. The main cause of the decline in the carcass quality of local male ducks was the handling of unprofessional slaughter, such as manual hair removal, causing bruises on the carcass surface [13], and the presence of shoot hairs that spread over the entire surface of the carcass skin [14].

3.8. Classification of carcass weight and quality

The classification of carcass weight and quality of local ducks circulating in traditional markets on the islands of Lombok and Sumbawa is guided by the provisions of SNI 3924:2009 [9], as described in the materials and methods. The carcass weight and quality of local male ducks circulating in the traditional markets of Lombok and Sumbawa were presented in Table 4.

The results of the study (Table 4) showed that the carcasses of local male ducks circulating in the traditional markets of Lombok and Sumbawa Island in the large size category (weight above 1.3 kg) were $8.33 \pm 14.43\%$; the medium-size type (weight >1-1.3 kg) was $10.42 \pm 13.01\%$ and the carcass with small size (weight <1 kg) was $81.25 \pm 27.24\%$. Differences in carcass weight circulating in traditional markets both on Lombok and Sumbawa islands were caused by differences in live weight [11], reproductive organ weight [32], stress levels before slaughter [16] and consumer tastes [44].

4. CONCLUSION

Carcass quality and meat production of local male ducks in the traditional markets of the islands of Lombok and Sumbawa have met the Indonesian National Standard, namely the live weight of 1.290 g, carcass percentage of 60.33%, and pure meat production of 44.25%.

Acknowledgment

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Novelty Statement

This research was conducted for the first time and found the latest formula, $Y = 0.6531x - 71.63$ to predict carcass weight and $Y = 0.7064x + 24.237$ to predict duck meat weight without slaughter very useful for chicken slaughter entrepreneurs.

Author's Contribution

ll authors contributed to the design and conduct of the study, analysis of the results, and manuscript writing.

Conflict Of Interest

We declare that there is no conflict of interest related to the publication of this scientific article.

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