

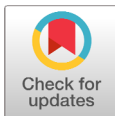
# Comparison of meat quality traits in muscovy ducks reared under two different management systems

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## Abstract

This study was designed to compare the meat quality traits in Muscovy ducks raised under extensive and semi-intensive management systems. Nine female birds from each management system were randomly selected and slaughtered at 18 wk of age. Meat samples were obtained from both breast (Pectoralis major) and thigh (Biceps femoris) meats and analyzed for physicochemical traits (color, pH, water holding capacity, cooking loss, and proximate analysis) and sensory properties. Results revealed that the ducks reared under the semi-intensive system had a significantly higher live weight than extensively reared ducks ( $p = 0.01$ ). In contrast, ducks from the extensive system showed significantly higher ( $p < 0.05$ ) relative weights for thigh and giblet. A higher crude fat content, water holding capacity, and a lower pH in meat were reported in ducks from the semi-intensive system compared to those from the extensive system ( $p < 0.05$ ). Breast meat from semi-intensively reared ducks showed higher redness, WHC, and relative fat content than the extensive system ( $p < 0.05$ ). However, the rearing system had no significant effect ( $p > 0.05$ ) on meat lightness. Results of the sensory analysis revealed that meat from the extensive management system had higher scores for taste, odor, flavor, juiciness, tenderness, and overall acceptability, irrespective of the meat cut ( $p < 0.05$ ). In conclusion, physiochemical traits in thigh and breast meats were significantly influenced ( $p < 0.05$ ) by the management systems in Muscovy ducks.

**Keywords:** Breast meat, Rearing system, Water holding capacity, Meat color, Sensory analysis

## INTRODUCTION

Ducks are known as the third most common livestock poultry species in the world following broiler [1]. They are one of the rapidly growing poultry species and duck meat is known as an excellent source of animal protein. Moreover, ducks dwell in aquatic environments; thereby, suitable for wider farming practices including integrated farming systems. Apart from that, there are other advantages associated with ducks as a livestock species, such as sociability, resilience against

### Competing interests

No potential conflict of interest relevant to this article was reported.

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### Availability of data and material

Upon reasonable request, the datasets of this study can be available from the corresponding author.

### Authors' contributions

Conceptualization: Bandara N, Jayasena DD.  
Data curation: Umagiliya MD.  
Formal analysis: Macelline SP, Nawarathne SR.  
Validation: Jayasena DD, Macelline SP, Manjula P.  
Investigation: Umagiliya MD, Jayasena DD.  
Writing - original draft: Umagiliya MD, Bandara N, Manjula P.  
Writing - review & editing: Umagiliya MD, Bandara N, Jayasena DD, Macelline SP, Nawarathne SR, Manjula P.

### Ethics approval and consent to participate

This article does not require IRB/ IACUC approval because there are no human and animal participants.

infectious diseases, larger egg size, year-round production, and their ability to forage on various plant materials. Pure duck breeds such as Pekin, Muscovy, Aylesbury, and crossbreeds like Mule are known as the main meat-type breeds. Muscovy duck is known as a hardy breed that was domesticated in the Latin American region and has more advantageous characteristics over other breeds. For instance, Muscovy ducks produce more lean meat tissues and have less subcutaneous fat than Pekin ducks [2]. Generally, Muscovy ducks have a well-built body type, and they are resistant to many diseases and able to adapt to a broad range of environmental conditions.

Duck meat is the world's third most widely produced poultry meat (2 million tons in 2020) after chicken (> 118 million tons in 2020) and turkey meat (6 million tons in 2020) [3]. It has a unique flavor and taste with some similar characteristics to red meat. Moreover, it contains a higher composition of essential amino acids, a higher level of phospholipids, and a preferable polyunsaturated fatty acids profile for humans [4]. Duck breast meat contains higher red muscle fibers than chicken breast meat [5], so it is considered as a red meat type. Global duck meat production has increased by 40% during the past decades and Asia holds the highest proportion of total duck meat production by region. China is the world's leading duck meat producer followed by France and Malaysia [3].

Sri Lanka is one of the leading countries in South Asia in the context of the per-capita consumption of livestock products [6]. Although globally, ducks are accepted as an important commercial poultry species, it has only received less attention in the Sri Lankan context compared to other poultry species. Therefore, duck meat production has not contributed significantly to the local food and agriculture sector because of underdeveloped management and farming systems. Moreover, there is a significant reduction in the duck population in Sri Lanka from 2007 to 2017 based on livestock statistics. On the other hand, the demand for livestock products in the Sri Lankan market has increased rapidly in recent years due to increased population and changing lifestyles [6]. Therefore, there is a high potential to expand the alternative industries of poultry species like the duck farming industry to meet the increasing demand for poultry meat which could be a substantial addition to the local poultry sector in the future. Reporting the nutritional and physicochemical properties of duck meat may promote local duck meat consumption to a certain extent. However, very few studies can only be found in the literature about duck farming as an alternative meat source in Sri Lanka and more research studies need to be conducted to support the national meat demand and food security. Therefore, this study was designed to compare the impact of two common management systems of ducks—extensive and semi-intensive system—in Sri Lanka on physicochemical and sensory properties of breast (Pectoralis major) and thigh (Biceps femoris) meat of Muscovy ducks.

## MATERIALS AND METHODS

### Rearing birds and meat sample collection

Extensively and semi-intensively reared Muscovy ducks were used as the treatments. A total of 18 female Muscovy ducks were randomly selected from both extensive and semi-intensive farms located at Ja-Ela, Sri Lanka. Nine ducks from each management system were selected at

the age of 18 wk based on the farm records. The live weight of each bird was recorded. They were slaughtered, eviscerated, and the viscera and giblets were dissected. Afterward, the giblet weight of each replicate was recorded. Carcasses of each bird were then portioned into main cuts such as breast and thigh and their weights were recorded. Finally, samples were packed, labeled, and transported in chill condition (4°C) to the Meat Science and Research Laboratory of Uva Wellassa University, Sri Lanka, kept overnight under chill conditions (4°C), and finally stored in the freezer (-18°C) until further analysis.

### Meat sample preparation

Frozen meat samples were thawed at 4°C for 24 h by keeping them in a refrigerator before analysis. Then the thawed carcasses were de-skinned and deboned manually. The whole carcass of each replicate was separated into two halves and all inter-muscular fat, subcutaneous fat, visible connective tissues, and all adhered materials were removed. Afterward, one-half of each breast (Pectoralis major) and thigh (Biceps femoris) portions were dissected and minced separately and used for the evaluation of the physicochemical characteristics of meat. The remaining halves of each replicate were kept for sensory analyses.

### Determination of color values

The color measurements of minced breast and thigh meat were determined using a calibrated colorimeter (CR-410, Konica Minolta, Osaka, Japan) following the CIE LAB color system. Repeated color values of lightness (CIE L\*), redness (CIE a\*), and yellowness (CIE b\*) were obtained from three different locations on the meat surface to minimize possible reading errors. Finally, the average value of three repeated measurements was taken as the final color value of each replicate sample.

### Determination of pH value

The pH of breast and thigh meat from semi-intensive and extensive management systems were analyzed separately in duplicates according to the standard protocols of AOAC [7]. Briefly, 1 g of minced meat sample was mixed with 9 mL of distilled water and homogenized (T 10 basic Ultra-Turrax, Ika Laboratory Equipment, Namyangju, Korea). Each homogenate was filtered (No: 4, Whatman, Maidstone, UK) and the pH was determined using a pre-calibrated pH meter (pH 700, Eutech Instrument, Ayer Rajah Crescent, Singapore) at room temperature. The average value of two repeated measurements of each sample was used.

### Determination of water holding capacity (WHC)

WHC was determined based on the technique described by Wilhelm *et al.* [8]. Meat samples (2.00 ± 0.10 g) were carefully placed between two pieces of filter papers (No. 4; Whatman International) on acrylic plates and left under a 10 kg weight for 5 min separately. After recording the final weight of each sample, WHC was calculated using the following equation.

$$\text{WHC (\%)} = 100 - \left[ \frac{(\text{Initial weight of the sample} - \text{Final weight of the sample}) \times 100}{\text{Initial weight of the sample}} \right]$$

### Cooking loss

To determine the cooking loss, 25 g of each, vacuum packed meat samples were cooked for 30 min maintaining 85°C temperatures at the water bath (LWB-IIID, Daihan Labtech, Namyangju, Korea) until the core temperature of samples reaches 72°C. After 30 min all the meat samples were allowed to cool down to reach room temperature. Then the vacuum pack was removed and the final weight was recorded after removing the excess moisture. Finally, the cooking loss was calculated using a slightly modified method proposed by Piao et al. [9].

$$\text{Cooking loss (\%)} = 100 - \frac{(\text{Weight before cooking} - \text{Weight after cooking})}{\text{Weight before cooking}} \times 100$$

### Proximate analysis

Moisture content, crude protein content, crude fat content, and ash content of breast and thigh meat samples of Muscovy duck from two management systems were determined by the methods of AOAC [7].

### Sensory evaluation

Two sensory evaluations were performed for both breast and thigh meat samples separately. Meat samples were grilled (SG 9, ASAIN, Zhengzhou Ohfu Ind. Ent., Zhengzhou, China) until their core temperature reaches 85°C for 15 min and cut into 2.0 × 2.0 cm<sup>2</sup> pieces, and served in random order to the sensory panel on coded (with random 3-digit numbers) white dishes with drinking water. The sensory panel consisted of 30 untrained panelists of age between 21–27 years representing each sex. A seven-point hedonic scale (1 = dislike very much, 4 = neither like nor a dislike, 7 = like very much) was used for the sensory evaluation and sensory attributes were color, taste, flavor, odor, juiciness, tenderness, and overall acceptability.

### Statistical analysis

Experimental data were analysed by pair-wise comparison using the JMP Pro 14.0 (SAS Institute, Cary, NC, USA). The individual bird was considered as the experimental unit and a probability level of less than 5% was considered statistically significant. Treatment interactions (rearing system and specific meat cut) were obtained by performing a two-way ANOVA test using the same statistical software. Pearson's correlation coefficient (r) was generated using linear and quadratic correlation procedures. Friedman test was used to analyze the sensory evaluation data by Minitab 17 Software package.

## RESULTS

### Live body weight and carcass parameters

The mean live body weights and relative breast, thigh, and giblet weights of Muscovy ducks are shown in Table 1. Muscovy ducks reared under a semi-intensive management system showed higher ( $p = 0.011$ ) live body weights than birds reared under an extensive system (1,967 versus 1,600 g). The extensive management system supported heavier ( $p < 0.001$ ) relative thigh weights than the semi-intensive system by 19.6% (214 versus 179 g/kg) whilst relative breast muscle weights were not influenced by the rearing systems ( $p = 0.410$ ). Relative giblet weight was significantly higher in ducks reared under an extensive system (67.7 g/kg) than those raised under a semi-intensive system (46.2 g/kg) by 46.5%.

### Physicochemical properties of meat

The influence of different rearing systems on physicochemical parameters of breast and thigh muscles in ducks are shown in Table 2.

Table 2 illustrated the two-way ANOVA comparison (interactive effect) of rearing systems and specific meat cuts on various physicochemical parameters in Muscovy ducks. As the main effect, thigh meat has a higher lightness value than breast meat ( $p = 0.006$ ) but the redness value is higher in breast meat over thigh meat ( $p = 0.018$ ), irrespective of rearing systems. Based on the rearing system effect, the semi-intensive management system supported higher meat redness ( $p = 0.005$ ) whilst the extensive management system supported higher yellowness ( $p = 0.031$ ) than their counterparts. The average pH value of duck meat in the present study is 6.29 (ranged from 6.07 to 6.57). As the main effect, the extensive management system generated higher pH than the semi-intensive management system ( $p < 0.001$ ) and thigh muscles had a higher pH value than breast muscles ( $p = 0.005$ ) regardless of the rearing system. The WHC of the duck meat obtained from semi-intensive management was higher than those obtained from the extensive management system by 12.1% (81.3 versus 72.5%,  $p = 0.006$ ), regardless of meat cut. There was 2.6% more water content in thigh meat than in breast meat (78.1 versus 76.1%,  $p = 0.035$ ) which was not influenced by the rearing system. Cooking loss of duck meat from extensive system was higher than that of semi-intensive system. Whereas the meat cuts concern, thigh meat shown higher cooking lost than breast meat irrespective of rearing system.

There was a rearing system and meat-cut interaction effect ( $p = 0.023$ ) found on fat concentration in the meat where fat content in thigh muscle decreased by 16.0% compared to

**Table 1.** Influence of two different rearing systems on live body weight and carcass parameters at 18 wk of age

Rearing system	Live body weight (g)	Relative breast weight (g/kg)	Relative thigh weight (g/kg)	Relative giblet weight (g/kg)
Extensive	1,600	212	214	67.7
Semi-intensive	1,967	227	179	46.2
SEM	83.0	12.3	3.8	2.43
$p$ -value	0.011	0.410	< 0.001	< 0.001

Table 2. Physicochemical parameters of Muscovy duck meat as affected by rearing system, meat cuts and their interaction

Rearing system	Meat-cut	Meat quality						Proximate composition			
		CIE L*	CIE a*	CIE b*	pH	WHC	Cooking loss	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Extensive	Breast	47.2	13.3	11.5	6.14	72.6	40.7	77.1	18.2	3.71 <sup>a</sup>	1.00
	Thigh	50.6	11.1	10.7	6.57	72.3	40.2	78.5	16.8	3.82 <sup>a</sup>	0.89
Semi-intensive	Breast	44.2	15.1	9.6	6.07	83.5	36.1	75.1	14.8	8.76 <sup>c</sup>	1.36
	Thigh	48.9	13.7	8.2	6.39	79.1	39.7	77.7	13.9	7.36 <sup>b</sup>	1.02
SEM		1.32	0.69	0.95	0.039	2.89	1.33	0.88	1.07	0.307	0.138
Main effects											
Rearing system											
	Extensive	48.9	12.2 <sup>a</sup>	11.1 <sup>b</sup>	6.35 <sup>b</sup>	72.5 <sup>a</sup>	40.4	77.8	17.5	3.76	0.94
	Semi-intensive	46.6	14.4 <sup>b</sup>	8.8 <sup>a</sup>	6.23 <sup>a</sup>	81.3 <sup>b</sup>	37.9	76.3	14.4	8.06	1.19
Meat-cut											
	Breast	45.7 <sup>a</sup>	14.2 <sup>b</sup>	10.5	6.10 <sup>a</sup>	78.1	38.4	76.1	16.5	6.24	1.18
	Thigh	49.8 <sup>b</sup>	12.4 <sup>a</sup>	9.4	6.48 <sup>b</sup>	75.7	40.0	78.1	15.4	5.59	0.95
Significance ( <i>p</i> -value)											
	Rearing system (R)	0.089	0.005	0.031	0.005	0.006	0.076	0.126	0.008	< 0.001	0.086
	Meat-cut (M)	0.006	0.018	0.257	< 0.001	0.423	0.258	0.035	0.305	0.048	0.115
	R × M interaction	0.584	0.547	0.743	0.165	0.493	0.134	0.517	0.789	0.023	0.426

<sup>a-c</sup>Mean values within columns not sharing a common superscript are significantly different the 5% level of probability.

breast muscle under the semi-intensive management system (7.36 versus 8.76 g/kg) but did not alter under the extensive management system.

Rearing systems influenced the protein content in meat ( $p = 0.008$ ) where extensive management system supported higher protein content over semi-intensive management system by 21.5% (17.5% versus 14.4%).

### Sensory analysis

The results of the sensory evaluations of the breast and thigh meat of Muscovy ducks are given in Fig. 1 and Fig. 2, respectively. Odor, flavor, juiciness, taste, tenderness, and overall acceptability of breast meat were affected ( $p < 0.05$ ) by the rearing system while no significant difference in color ( $p = 0.144$ ) was observed.

The sensory results of thigh meat showed that consumers did have a higher preference ( $p < 0.05$ ) for the meat obtained from the extensive management system over the meat from the semi-intensive management system based on odor, flavor, juiciness, taste, tenderness, and overall acceptability. There was no significant difference observed ( $p > 0.05$ ) between management systems for acceptability concerning thigh meat color.

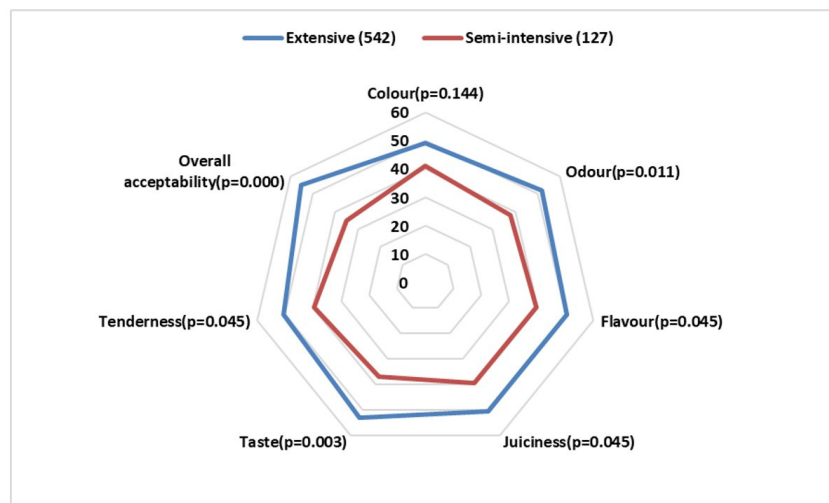


Fig. 1. Web diagram of sensory evaluation of Muscovy duck breast meat.

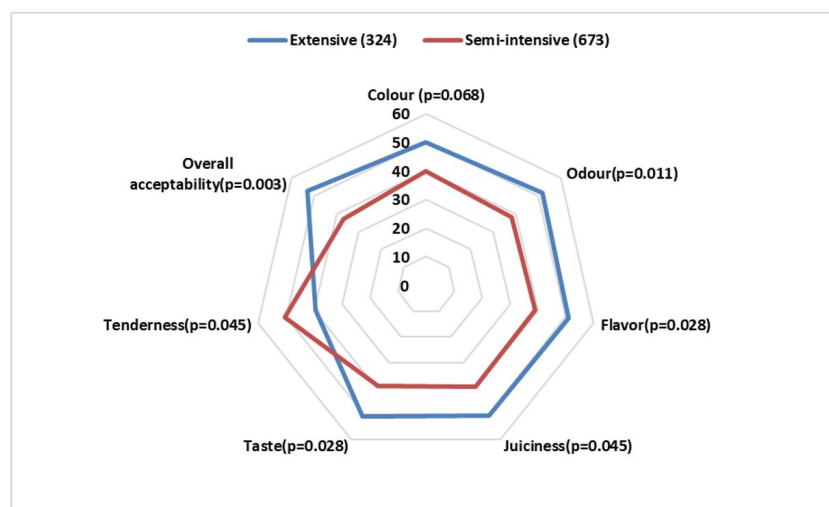


Fig. 2. Web diagram of sensory evaluation of Muscovy duck thigh meat.

## DISCUSSION

### Live weights and internal organ weights

In the present study, ducks reared in a semi-intensive management system have higher body weights than ducks reared in an extensive management system at 18 wk of age. These outcomes on live weights could be attributed to different management and environmental conditions in the two farming systems. For instance, nutrient density in feed, feed composition, stress factors, microclimatic conditions, and animal activities are dependent on the rearing system [2,10–12]. Similarly, it has been reported that Muscovy ducks reared under three types of management systems gave significantly different weight gains at 14 wk of age [12], and Abo Ghanima et al. [13], reported that four different housing systems influenced the growth performance in Pekin ducks. It is obvious that ducks reared in an extensive management system had more land area



to peck, walk, run and perform their natural behaviors than those reared in a semi-intensive management system; this is likely to be subjected to high energy expenditure that might be limited their growth [14]. Similar outcomes were reported in the literature that the ducks and chickens reared under extensive management systems had lower body weights and feed efficiency compared to semi- and fully- intensive type farming systems [15–18].

Interestingly, the ducks in the extensive management system had higher relative thigh and gible weights than in the semi-intensive management system in the present study. The liver, heart, gizzard, and neck are grouped as giblets in poultry and the study of Marapana [19], reported that the weight of giblets is decreased as the animal weight increases. However, except for the neck, the other three main components in giblets may be influenced by the feed type, birds' activity, and their metabolic stress. Feeding whole grains has been reported to increase gizzard weights in the study of Moss et al. [20] and high fibrous diets also influenced the development of larger gizzards [21]. It is a well-known fact that ducks in extensive management systems are subjected to a fed natural source of plant materials which are richer in fibre content than commercial feed. Therefore, ducks from extensive management system might have developed heavier gizzards than those from semi-intensive management system in the present study. As per the dietary fibre content, commercial feeds are balanced for other major nutrients such as protein, starch and fat based on recommended nutrition requirement in ducks; nevertheless, ducks in extensive management system might receive nutrient-deficient diets which may lead to have higher metabolic stress in the liver for maintaining metabolic processes such as lipogenesis, glycogenesis, gluconeogenesis. Therefore, to meet such metabolic demands, hepatic tissues could have to develop well, and it may result heavier livers. Moreover, heavier relative thigh meat weight in the ducks from the extensive management system could be result of their higher activity because they are able to walk and exercise more than ducks reared in semi-intensive management system with the availability of larger land areas. This may trigger the protein syntheses and protein accretion in thigh muscles up to a larger extent in ducks raised under an extensive management system than a semi-intensive management system. Similar outcomes were reported as broilers raised in an extensive system obtained higher relative leg meat weights than broilers raised in an intensive system (338 versus 179 g/kg) [22].

### Differences in physicochemical properties of meat

As the most important physicochemical properties in meat, pH (24 h after slaughter), WHC, cooking loss, and meat color were compared based on meat cut and two farming systems. Muscle pH value is one of the most critical factors affecting meat quality because it has a direct effect on meat proteins denaturation, meat tenderness, water holding capacity, and meat color [23], which also influence the consumer preference for meat. The mean pH in duck meat at 24 h after slaughtering is generally ranged between 5.7–6.3 [24,25] which is aligned with the pH observed in the present study. Interestingly, thigh meat had a higher pH value than breast meat whilst meat from the extensive management system had a higher pH value than the semi-intensive management system in the present study. Similar outcomes were reported by Chaosap and Sivapirunthep [26], where the pH of thigh meat was higher than that of breast



meat of Cherry Valley ducks. The pH of meat is related to its glycogen content such that higher glycogen content in meat results in a lower pH value [27]. Therefore, glycogen content in thigh meat could be lower than in breast meat as well as the extensive management system may have generated lower glycogen content in meat. The breast muscle contains a higher proportion of white fibrils, whereas the leg muscles are mostly composed of red fibrils. The rapid glycolytic changes of white fibrils cause a swift decline in pH value than in the red muscles [28,29]. The rationale behind this scenario may not be straight forward but it is anticipated that thigh meat has higher energy demand than breast meat and likewise ducks in an extensive management system have higher energy expenditure than those in a semi-intensive management system. Glycogen is a polysaccharide that serves as an energy storage component in muscle tissues and releases its energy by oxidation when required.

Meat color determines the consumers' purchasing behavior; particularly, the red color of fresh meat is the most determinant factor for the acceptance and the selection of red meat [30]. It has been reported that there is a strong correlation between ultimate muscle pH and meat color where muscles with lower pH have a higher CIE L\* value [31]. However, these findings do not support the results of the present study. On the other hand, Zhang et al. [32] reported similar outcomes to those of the present study that pH reduction in meat resulted in higher CIE a\* value in beef 24 h after slaughtering. Their justification for this outcome is that lower pH in meat decreased the activity of mitochondria rapidly after the slaughtering and it increased the oxymyoglobin concentration in meat tissues than of higher pH value in meat. The composition of the diet is more likely to impact meat yellowness (CIE b\*) where the ingestion of larger amounts of forages that are rich in carotenoids gives a greater intensity of yellowness in their meat [33]. Therefore, a higher CIE b\* value in meat obtained from the extensive management system regardless of the meat cut in the present study could be influenced by their access to carotenoids-rich plant materials.

Water holding capacity is defined as the ability of meat to retain all or part of its own or added water upon application of external forces [34]. It is a very sensitive indicator in the structure of the myofibrillar protein and highly impacts the revenue of the meat processing industry [35]. Higher water loss in meat in the extensive management system in the present study would cause higher economic losses during processing. Szmańko et al. [36] reported that higher fat concentration in turkey meat resulted in lower WHC due to the fact that the possibility of releasing fat instead of water while taking the measurements. In other words, higher fat concentration in meat causes underrated WHC results. However, it is interesting that data from the present study showed a significant positive linear relationship between fat content in meat and WHC ( $r = 0.532$ ,  $p = 0.007$ ). Moreover, it is deduced from the quadratic equation that WHC starts to increase when the fat composition in meat exceeds 4.53%;

$$\text{WHC} = 85.8 - 6.12 \times \text{meat fat} + 0.675 \times \text{meat fat}^2 \quad (r = 0.629, p = 0.005)$$

### Proximate composition and sensory attributes of duck meat

A high moisture content was reported in the thigh meat over breast meat regardless of the

farming system in the present study may be indicating the higher nutrient content in the breast muscle. However, Pearson's correlation analyses showed that only ash content negatively correlated to moisture content ( $r = -0.424$ ,  $p = 0.039$ ) but not the fat content in meat. Interestingly, the extensive management system decreased the fat content in meat whilst thigh meat had lower content of fat than breast meat. Similarly, Latif et al. [22] stated that broilers reared in an extensive management system reduced crude fat content in both leg and breast muscles whereas ducks only reduced the fat content in leg muscles. The lower fat content in extensively reared ducks may have resulted from their increased activity which required higher energy that leads to low excess energy. The same rationale would be applied to differentiate the fat contents in breast and thigh meat such that higher energy demand in thigh meat may support increased fat oxidation by minimizing deposition. On the other hand, it is interesting that the extensive management system supported higher crude protein content in meat than the semi-intensive management system, regardless of meat-cut. Similar outcomes were reported in Latif et al. [22], where broilers reared in an extensive management system obtained higher protein content than an intensive system in leg meat. In contrast, some studies reported non-significant outcomes for the influence of farming systems on protein content in neither leg nor breast meats in ducks [15,37]. However, it is deduced from the present study that meat fat concentration has a negative linear correlation with protein concentration ( $r = -0.663$ ,  $p < 0.001$ ). Therefore, higher fat deposition might have hindered the protein deposition in ducks reared under a semi-intensive system in the present study; nevertheless, these mathematical outcomes may not be causative but indicative to explain observed outcomes.

Based on the sensory results, the meat ducks from the extensive management system had the highest score for the meat qualities such as taste, flavor, odor, juiciness, and overall acceptability for both thigh and breast meats over the semi-intensive system. It is presumed that a higher intramuscular fat content reflects the tenderness, flavor, and nutritional value of meat [38-40].

## CONCLUSION

Based on the results it can be concluded that different rearing systems significantly affected on the live weight, relative thigh weight and physicochemical parameters of the duck meat. A higher crude fat content, water holding capacity, and a lower pH in duck meat obtained from the semi-intensive system compared to those from the extensive system. In addition, breast meat from semi-intensively reared ducks showed higher redness, WHC, and relative fat content than the extensive system. Further, interaction effect of meat cuts and rearing systems had a significant impact on fat content of duck meat. Sensory analysis revealed that duck meat from the extensive system had higher scores for taste, odor, flavor, juiciness, tenderness, and overall acceptability, irrespective of the meat cut.

However, further studies are essential to evaluate the effect of different rearing systems and dietary nutrition density on growth performance and meat quality in the local context of Muscovy duck farming in Sri Lanka.

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