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Relationship of BCS, physical and post-mortem parameters with live body weight and dressing percentage in Nellore Brown rams

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Abstract
This study focused on evaluating the relationship between body condition score (BCS) and various physical and post-mortem parameters in Nellore Brown rams of 1 year age. The objective was to evaluate the impact of BCS on live body weight and dressing percentage. Data was collected from 1-year-old Nellore Brown rams at a slaughterhouse in Banaganapalle, Andhra Pradesh. Physical measurements such as height, body length, and thoracic circumference were recorded, along with live body weight. Post-mortem parameters, including drained-out blood weight, skin weight, visceral organ weight, weight of the gastrointestinal (GI) tract, shank weight, and hot carcass weight, were also measured. The data was analysed for significance and correlation using SPSS. The results showed that an increase in BCS was associated with an increase in the height, body length, and thoracic circumference of the rams. Live body weight also increased significantly with an increase in BCS. Post-mortem parameters such as drained-out blood weight, skin weight, weight of the GI tract, and weight of the head and shanks increased with higher BCS. However, the weight of visceral organs was highest in rams with BCS 4.0. Hot carcass weight showed a significant increase with an increase in BCS. The relationship between physical and post-mortem parameters with live body weight showed positive and significant correlations, with various parameters having the strongest relationship at different BCS levels. For dressing percentage, negative and significant relationships were observed between GI tract weight and dressing percentage at BCS 2.0, while positive relationships were found between hot carcass weight and dressing percentage at BCS 3.0 and BCS 4.0. Negative relationships were observed between skin weight and GI tract weight with dressing percentage at BCS 5.0. In conclusion, this study highlights the significant impact of BCS on physical parameters, post-mortem parameters, live body weight, and dressing percentage in Nellore Brown rams. The findings provide valuable insights for farmers and researchers, aiding in the better management and selection of Nellore Brown rams for improved productivity and profitability in the livestock industry.

Keywords: Body condition score (BCS), dressing percentage and Nellore brown rams

Introduction
Nellore brown is the tallest mutton breed of India and its home tract is Nellore and Prakasam districts and widely distributed throughout the state of Andhra Pradesh (Jonnakutti, S, 2018) [7]. Body condition score is the widely accepted technology through which body condition and wellbeing of animal can be determined. The nutritional status of sheep at different production phases could be estimated with the BCS system, allowing the farmers to make decisions regarding the time and in what way to supplement the flock to attain a productive goal in an economic way (Maurya *et al.* (2017) [8]. Dressing percentage is a crucial factor in determining meat yield and profitability in the livestock industry. Dressing percentage is based on the relationship between the dressed carcass weight and the live animal weight after things like the hide and internal organs have been removed. A high dressing percentage is generally desirable as this implies a greater proportion of the live weight (i.e., a cost to producers) ends up as a saleable yield (J.M. Coyne, 2019) [4].
The tool can be used to measure the relative body fat through which the carcass yield and dressing percentage can be determined. Previous researchers have studied on the body condition score of the Nellore brown sheep and its relationship in management of flock at different stages. But the data on relationship of Body condition score with live body weight, carcass yield and dressing percentage is not available. Keeping this in view, the present study was conducted on Relationship of physical and post mortem parameters with live body weight

and dressing percentage in Nellore Brown rams with the following objectives

- To evaluate dressing percentage in the rams of Nellore Brown sheep of different BCS
- To study relationship of physical parameters with live body weight and dressing percentage in Nellore brown rams
- To study relationship of BCS with live body weight and dressing percentage in Nellore Brown rams.

Materials and Method

The study was conducted at slaughter house of Banaganapalle of Nandyal District, Andhra Pradesh during January to April 2023. Data was collected from the rams of 1 year age of Nellore brown breed that slathered during the study period in the slather house at Banaganapalle. The sample animals were selected using purposive random sampling method. Pre slaughter data on body measurements viz. body length, height at withers, circumference at chest region and live body weight was collected using measuring tape and digital weighing balance. The post mortem parameters viz. weight of drained out blood, skin, visceral organs, GI tract, shanks, separated head and weight of hot carcass was collected using digital weighing balance. The data was tabulated and analysed for significance and correlation coefficients using SPSS.

Results and Discussion

The rams of the study were distributed according to age and body condition score and presented in table 1. The data clearly indicated that majority of the rams of 1 year age were of BCS of 3.0 (35.21%) followed by BCS 4.0 (29.58%), BCS 5.0 (19.72%) and BCS 2.0 (15.49%).

Table 1: Distribution of rams of 1 year age according to BCS

S.No	BCS	Number of ewes	%
1	2.0	11	15.49
2	3.0	25	35.21
3	4.0	21	29.58
	5.0	14	19.72
		71	100

Physical parameters

The data on physical parameters viz height, body length, heart girth and live body weight of Nellore Brown rams of 1 year age are presented in table 2. The data clearly indicated that the height at withers of the rams was highest in the animals with BCS 5.0 (28.33±0.33inch) followed by BCS 4.0 (27.86±0.29), BCS 3.0 (26.86±0.32inch) and BCS 2.0 (24.24±0.76inch). It was observed that the height of rams increased with the increase in the BCS from 2.0 to 5.0. Vatankhah *et al*. 2013 [16] have reported similar positive relationships between height and BCS. The increase in height with higher BCS could be attributed to better nutrition and overall body development.

The body length of Nellore Brown rams was ranged from 20.13±0.68 to 25.04±0.49 inch. The height body length was recorded in the rams with BCS 5.0 and lowest was observed in the rams with BCS 2.0. It was observed that the body length of rams increased with the increase in BCS from 2.0 to 5.0. This finding is consistent with previous studies, which have demonstrated a positive correlation between body length and BCS in sheep (Zergaw *et al.,* 2017) [20]. The longer body length in rams with higher BCS suggests better body development and growth potential.

The circumference at chest region in the rams of Nellore Brown sheep of one year age was ranged between 23.92±0.87 inch in the rams with BCS 2.0 and 29.04±0.63 inch in the rams with BCS 5.0. It was observed that the circumference at chest region of the rams was increased with the increase in the BCS from 2.0 to 5.0. This observation aligns with previous research highlighting the positive association between chest circumference and BCS in sheep (Pandey *et al.,* 2018) [11]. The increase in chest circumference with higher BCS indicates improved muscularity and body condition in the rams.

Similarly, the live body weight of Nellore Brown rams of 1 year age was highest in the animals with BCS 5.0 (29.04±0.63kg) and lowest was recorded in the animals with BCS 2.0 (17.13±1.30kg). It was observed from the data that the live body weight was increased with increase in BCS from 2.0 to 5.0. This finding is in line with previous studies that have reported a positive relationship between live body weight and BCS in sheep (Mekasha *et al.,* 2015) [9]. The increase in live body weight with higher BCS suggests better overall body condition and weight gain.

Table 2: Physical parameters of rams of BCS varies from 2.0 – 5.0

Parameter	BCS 2.0 n=11	BCS 3.0 n=25	BCS 4.0 n=21	BCS 5.0 n=14
Height	24.24±0.76	26.86±0.32	27.86±0.29	28.33±0.33
Length	20.13±0.68	22.63±0.38	24.42±0.39	25.04±0.49
Heart girth	23.92±0.87	27.46±0.48	28.67±0.38	29.04±0.63
Live body weight	17.13±1.30	23.67±0.61	28.32±0.69	30.89±1.69

Post-mortem parameters

The data on post-mortem parameters viz. weight of drained out blood, skin, GI tract, Visceral organs, separated head and shanks and hot carcass weight is presented in table 3. The data clearly indicated that the weight of the drained-out blood in the Nellore Brown rams was ranged from 0.60±0.06kg to 1.18±0.1kg. It was observed that significant increase in the weight of drained out blood with increase in BCS from 2.0 to 5.0. This increase can be attributed to the improved vascularity and blood volume associated with higher body condition scores (Yıldız *et al.,* 2014) [19]. Higher blood volume contributes to better nutrient supply and overall physiological functioning.

The weight of skin after skinning in the Nellore Brown rams of 1 year age was ranged from 1.86±0.25kg to 3.57±0.2kg. The highest weigh of skin was recorded in the rams with BCS 5.0 and lowest was recorded in the animals with BCS 2.0. It was observed significant improvement in the skin weight with increase in the BCS from 2.0 to 5.0. This observation aligns with previous research that reported an increase in skin weight with higher BCS in sheep (Alonso-Díaz *et al.,* 2018) [1]. The improvement in skin weight can be attributed to increased subcutaneous fat deposition associated with better body condition.

Similarly, the weight of the GI tract with the ingesta was highest in the rams with BCS 5.0 (5.67±0.47kg) and lowest was recorded in the rams with BCS 2.0 (3.33±0.35kg). It was observed from the data that significant improvement in the weight of GI tract with increase in BCS from 2.0 to 5.0 of Nellore Brown rams. This finding is consistent with previous studies that have demonstrated a positive relationship between GI tract weight and BCS in sheep (Oluwafemi *et al.,* 2019) [10]. The increase in GI tract weight indicates improved

digestive capacity and nutrient assimilation.

The weight of visceral organs consisting of lungs, liver, spleen and heart was recorded in the slaughtered Nellore Brown rams. The data indicated that the highest weight was recorded in the rams with BCS 4.0 (0.92±0.07kg) followed by BCS 5.0 (0.79±0.09kg), BCS 3.0 (0.72±0.07kg) and BCS 2.0 (0.61±0.08kg). It was observed that the weight of the visceral organs was not increase with the increase in BCS.

The weight of the separated head and shanks of four legs in the slaughtered Nellore Brown rams was highest in the animals with BCS 5.0 (2.88±0.21kg) and lowest was recorded in the animals with BCS 2.0 (1.76±0.17kg). It was observed significant increase in the weight of separated head and shanks with increase in BCS from 2.0 to 5.0. This finding is consistent with previous research that has reported a positive correlation between head and shank weight and BCS in sheep (Oluwafemi *et al.*, 2019) [10]. The increase in head and shank weight reflects better muscular development and body condition.

The hot carcass weight of slaughtered Nellore Brown rams was highest in the animals with BCS 5.0 (15.26± 0.9kg) followed by BCS 4.0 (14.17±0.54kg), BCS 3.0 (11.68±0.39kg) and BCS 2.0 (8.59±0.67kg). It was observed that the hot carcass weight increased significantly with the increase in the BCS from 2.0 to 5.0. This finding is in line with previous studies that have reported a positive association between carcass weight and BCS in sheep (Tadesse *et al.*, 2016) [15]. The increase in hot carcass weight indicates improved meat yield and overall carcass quality.

Table 3: Post-mortem parameters of rams of BCS varies from 2.0 – 5.0

Parameter	BCS 2.0 n=11	BCS 3.0 n=25	BCS 4.0 n=21	BCS 5.0 n=14
Weight of the drained-out blood	0.60±-.06	0.79±0.04	1.10±0.08	1.18±0.1
Weight of the skin	1.86±0.25	2.46±0.18	3.21±0.15	3.57±0.2
Weight of GI tract	3.33±0.35	4.27±0.2	5.18±0.33	5.67±0.47
Weight of visceral organs	0.61±0.08	0.72±0.07	0.92±0.07	0.79±0,09
Weight of head and shanks	1.76±0.17	2.25±0.11	2.57±0.08	2.88±0.21
Hot carcass weight	8.59±0.67	11.68±0.39	14.17±0.54	15.26±0.9

Relationship of physical and post-mortem parameters with the live body weight of Nellore Brown rams with BCS from 2.0 to 5.0

The data on correlation coefficients of physical and post-mortem parameters with live body weight was presented in Table 4. The data clearly indicated that the live body weight of rams with BCS 2.0 was positive and significant relation ($p<0.05$) with height, body length, circumference at the chest region, the weight of the skin, the weight of visceral organs, and hot carcass weight.

The live body weight of the rams with BCS 3.0 had a positive and significant relationship with the height, body length, and circumference at the chest region, the weight of skin, the weight of the separated head and shanks, and hot carcass weight. The live body weight of the rams with BCS 4.0 had a positive relationship with the circumference at chest region, the weight of skin and the weight of GI tract. The live body weight of the rams with BCS 5.0 had positive and significant ($p<0.05$) relationship with all the physical and post-mortem parameters.

The result obtained is similar to the report smith *et al*. (2018) [14] conducted a study on one-year-aged sheep and found a positive correlation between body length and live body weight. Similarly, Williams and Brown (2019) [17] reported a significant correlation between chest girth and live body weight in sheep of the same age group. The Johnson *et al.* (2020) [6] demonstrated a positive correlation between hot carcass weight and live body weight in one-year-aged sheep. Furthermore, Anderson and Smith (2017) [3] revealed significant associations between the weight of visceral organs and live body weight in sheep.

The overall data revealed that the live body weight had positive and significant relationship with all the physical and post-mortem parameters in Nellore Brown rams of one year age.

Relationship of physical and post-mortem parameters with the dressing percentage of Nellore Brown rams with BCS from 2.0 to 5.0

The data presented in Table 5 revealed that the dressing percentage of the rams with BCS 2.0 had positive and nonsignificant relation with the weight of drained out blood, weight of skin and hot carcass weight. But negative and significant relation ($p<0.05$) with weight of the GI tract whereas the other parameters viz. height, length, heart girth, weight of the visceral organs and weight of the head and shanks had nonsignificant negative relationship with dressing percentage in the rams with BCS 2.0. This result highlights the importance of considering the GI tract weight when predicting dressing percentage in BCS 2.0 sheep (Smith *et al.*, 2017) [13].

It was observed that the dressing percentage in the rams with BCS 3.0 had positive and significant relation ($p<0.05$) with the hot carcass weight and non-significant relationship with height, length, heart girth, weight of drained out blood and weight of the skin. But negative and significant relationship ($p<0.05$) of dressing percentage was observed with weight of visceral organs and nonsignificant negative relationship was observed with weight of the head and legs. This suggests that sheep with heavier visceral organs may exhibit lower dressing percentages, as these organs contribute to a larger proportion of the live body weight but not the carcass weight (Johnson *et al.*, 2019) [5].

The dressing percentage in the rams with BCS 4.0 had positive and significant relation ($p<0.01$) with the hot carcass yield and nonsignificant relation was observed with height, length and heart girth. Negative and significant relationship ($p<0.05$) of dressing percentage was observed with weight of the GI tract and nonsignificant relation was observed with drained out blood, weight of skin, weight of the visceral organs and weight of the head and shanks. This finding suggests that BCS 4.0 sheep with a heavier GI tract may have

a lower dressing percentage due to a larger proportion of their live body weight being attributed to the GI tract rather than the carcass (Williams and Brown, 2020) [18].

Similarly, the dressing percentage in the rams with BCS 5.0 had significant and negative relationship with weight of the GI tract and skin whereas nonsignificant negative relationship was observed with height, length, heart girth, drained out blood, weight of the visceral organs, weight of the head and legs and hot carcass weight. From the data it was cleared that the dressing percentage in the rams with BCS 5.0 had negative relation with the physical parameters, inedible body parts and hot carcass weight. Similarly, a heavier GI tract may result in a reduced carcass weight, leading to a lower dressing percentage (Anderson and Davis, 2018) [2].

Table 4: Correlation coefficients between live body weight and physical parameters, the weight of body parts, ingesta, and hot carcass weight in the rams of age with BCS of 2.0 – 5.0

Parameter	Live body weight				
	BCS 2.0 n=11	BCS 3.0 n=25	BCS 4.0 n=21	BCS 5.0 n=14	Pooled sample n=71
Height	0.816**	0.540**	0.077	0.854**	0.705*
Length	0.726*	0.584**	0.328	0.666**	0.778**
Heart girth	0.837**	0.432*	0.500*	0.861**	0.730**
Blood	0.198	0.360	0.099	0.876**	0.684**
Skin	0.777**	0.280	0.498*	0.885**	0.715**
GI tract	0.599	0.307	0.643**	0.926**	0.751**
Visceral organs	0.766**	0.127	0.285	0.625*	0.380**
Head and legs	0.345	0.623**	0.381	0.884**	0.749**
Hot carcass weight	0.845**	0.870**	0.819**	0.948**	0.879*

Table 5: Correlation coefficients between dressing percentage and physical parameters, the weight of body parts, ingesta and hot carcass weight in the rams of age with BCS of 2.0 – 5.0

Parameter	Dressing (%)				
	BCS 2.0 n=11	BCS 3.0 n=25	BCS 4.0 n=21	BCS 5.0 n=14	Pooled sample n=71
Height	-0.120	0.105	0.386	-0.385	0.112
Length	-0.356	0.288	0.210	-0.392	0.079
Heart girth	-0.288	0.139	0.275	-0.482	0.132
Blood	0.332	0.346	-0.063	-0.522	0.031
Skin	0.274	0.010	-0.073	-0.549*	0.044
GI tract	-0.639*	-0.178	-0.454*	-0.606*	-0.189
Visceral organs	-0.164	-0.416*	-0.376	-0.444	-0.129
Head and legs	-0.153	-0.081	-0.023	-0.474	0.077
Hot carcass wt	0.508	0.685*	0.737**	-0.066	0.487**

Conclusion

Overall, the results indicate that body condition score (BCS) has a significant impact on the physical parameters, post-mortem parameters, live body weight, and dressing percentage in Nellore Brown rams of 1 year age. Higher BCS is associated with increased body measurements, greater live body weight, and higher post-mortem parameters. These findings can be valuable for farmers and researchers in understanding the relationship between body condition and various parameters, thereby helping in better management and selection of Nellore Brown rams for improved productivity and profitability.

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