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Comparative Analysis of Growth and Meat Quality of Male Kachhi Sheep under Semi-Intensive and Intensive Management Systems

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ABSTRACT

A study evaluated the growth, carcass characteristics, and meat quality of 12 male Kachhi sheep (3–4 months old) reared under semi-intensive (Group A; n = 6) and intensive (Group B; n = 6) systems for 12 weeks at Sindh Agriculture University, Tandojam. Group A received grazing with supplemental concentrate, while Group B was fed green fodder and concentrate without grazing. Age was determined via dental formula (Schoenian, 2010). Post-slaughter analysis revealed significantly higher ($p < 0.05$) weight gain (90.37% vs. 50.15%) and dressing percentage (54.56% vs. 51.07%) in Group A. Carcass components, including neck (1.65 vs. 0.97 kg), shoulder (2.37 vs. 1.97 kg), thorax (2.42 vs. 1.83 kg), loin/flank (2.31 vs. 1.45 kg), and legs (2.89 vs. 1.64 kg), were superior in Group A. Conversely, Group B exhibited heavier organ weights: kidneys (0.53 vs. 0.47 kg), liver (0.93 vs. 0.81 kg), spleen (0.31 vs. 0.21 kg), and heart (0.71 vs. 0.62 kg). Meat quality favored Group A, with higher pH (5.95 vs. 5.40), water-holding capacity (63.85% vs. 61.31%), ash (0.86% vs. 0.72%), fat (3.45% vs. 2.65%), moisture (72.73% vs. 70.54%), and protein (21.16% vs. 19.75%). However, Group B had elevated drip loss (4.85% vs. 4.20%) and cooking loss (38.97% vs. 35.19%). The semi-intensive system enhanced carcass yield and meat quality, attributed to grazing's physiological benefits, despite identical feed quantity/quality. These findings underscore grazing's critical role in optimizing growth and profitability in Kachhi sheep production, advocating its integration into management strategies.

INTRODUCTION

Livestock has emerged as the largest sub-sector in agriculture, playing a crucial role in economic growth, food security, and poverty reduction. It generates foreign exchange earnings, contributing approximately 3.1% of total exports. More than 8 million rural households are engaged in livestock farming, with the sector accounting for 35–40% of their income (GOP, 2020). Recognizing its significance, the government has prioritized livestock development, with the sector now contributing 60.1% of total agricultural output and 11.5% of GDP. The gross value addition of livestock increased by 3%, rising from Rs 1,461 billion in 2019–20 to Rs 1,505 billion in 2020–21 (GOP, 2020).

Small ruminants, particularly sheep, are primarily raised for their meat and skin, with milk production being less common. Sheep play a vital role in rural economies by converting roughages into valuable food products, contributing to employment and national income. They

are often reared in small to medium-sized flocks, either as part of integrated farming systems or extensive nomadic herding. the Thar Desert and Kohistan, relying heavily on natural rangelands for sustenance, particularly in winter and spring (Sahlu et al., 2009).

Sheep are well-adapted to traditional agricultural systems and are crucial for livelihoods in arid and semi-arid areas. Their ability to thrive in harsh environments makes them a valuable asset for communities facing food insecurity (Asnakew & Berhan, 2007). Sheep production is mainly pastoral, with about 90% raised in traditional systems across regions such as Kordofan, Darfur, and Southern Sudan, covering 110 million hectares and producing around 18.6 million tonnes of grain. Approximately 86% of animal feed is derived from natural rangelands, while 10% comes from agricultural residues and 4% from irrigated fodder and concentrate feeds. However, challenges such as uneven stocking distribution, deforestation, and water scarcity affect rangeland productivity (Bushara, 2015).

Sheep farming is particularly significant for small, marginal, and landless farmers, who constitute 75.8% of the sector, while medium and large farms account for the remaining 24.2% (Haque et al., 2013). Often referred to as "The Poor Man's Cow," sheep require minimal care and are easy to manage (Malisetty, 2013). Among the indigenous breeds, Kachhi sheep are known for their meat and wool production. They are primarily found in Sindh's Tharparker district and surrounding desert areas. Despite their economic importance, research on the breed remains limited, highlighting the need for further scientific investigation (Muhammad Ishaq & Zahoor-ul-Haq, 2007).

Keeping in view the importance of sheep breeds in the meat and wool production, and scare work done on the Kachhi meat quality, present study was planned to observe to achieve the following objects.

MATERIALS AND METHODS

Twelve male Kachhi sheep, approximately four months old, were purchased and brought to a livestock experimental station. Age was determined using dental formula (Schoenian, 2010). Six sheep (Group A) were raised under a semi-intensive system with grazing and a concentrate diet, while Group B received green fodder and concentrate without grazing. Green feed and water were freely available. After 12 weeks, three lambs from each group were slaughtered for meat quality analysis. Initial, weekly, and final weights were recorded. Carcass weight was measured post-slaughter, and dressing percentage was calculated after removing skin, viscera, and offal.

$$\text{Dressing (\%)} = \frac{\text{Carcass weight}}{\text{Live weight}} \times 100$$

After slaughter, the edible organs, including the heart, liver, kidneys, and spleen, were manually removed and weighed separately using an electrical weighing balance. Additionally, the weights of the neck, shoulder, thorax, loin, flank, legs, and kidneys were recorded. Meat quality parameters were assessed, including pH (Ockerman, 1985), water holding capacity (Wardlaw et al., 1973), cooking loss (Dhanda et al., 1999), and drip loss (Sen et al., 2004). Chemical composition, such as moisture, protein, fat, and ash, was analyzed following AOAC (2005) methods. Economic analysis included documentation of costs related to animals, feed, vaccination, labor, and market value to determine profit or loss.

Statistical Analysis

Statistical analysis was conducted using a computer program. Descriptive statistics were applied to assess data variability, followed by ANOVA to determine significant differences. If differences existed, the least significant difference (LSD) test at a 5% probability level was applied (Gomez & Gomez, USA).

RESULTS

Growth trend (%) of weekly weight gain of male Kachhi sheep reared under two management system

The weekly growth trend (%) of male Kachhi sheep, based on the management system (Groups A and B), demonstrates a notable difference between the two groups (Figure 1). Under the intensive management system, the initial body weight of male Kachhi sheep was 10.58 kg, with a progressive increase in weekly growth trend (%) as follows: 4.263%, 8.523%, 12.788%, 21.31%, 25.572%, 34.097%, 34.097%, 46.885%, and 50.147% by the end of the 12th week. In contrast, male Kachhi sheep under the same system but with an initial body weight of 10.63 kg exhibited a higher growth trend, increasing at rates of 7.53%, 15.062%, 30.13%, 37.66%, 46%, 52.72%, 60.28%, 75.31%, 82.84%, and 90.37% over 12 weeks.

Dressing (%) of male Kachhi sheep reared under two management system

The dressing percentage of male Kachhi sheep reared under two different management systems is presented in Figure 2. The highest dressing percentage (54.56%) was observed in sheep raised under the semi-intensive system, compared to 51.07% in those managed under the intensive system. A statistically significant difference ($P<0.05$) was found between the two management systems

Weight of neck (kg) of male Kachhi sheep reared under two management system

Figure 3 presents the neck weight of male Kachhi sheep under two management systems. The highest neck weight (1.65 kg) was observed in the semi-intensive system, compared to 0.97 kg in the intensive system. A significant difference ($p<0.05$) was found between the two systems.

intensive system resulted in significantly higher weights compared to the intensive system. Specifically, the shoulder weight was 2.37 kg in the semi-intensive system versus 1.97 kg in the intensive system, the thorax weight was 2.42 kg versus 1.83 kg, the loin and flank weight was 2.31 kg versus 1.45 kg, and the legs weight

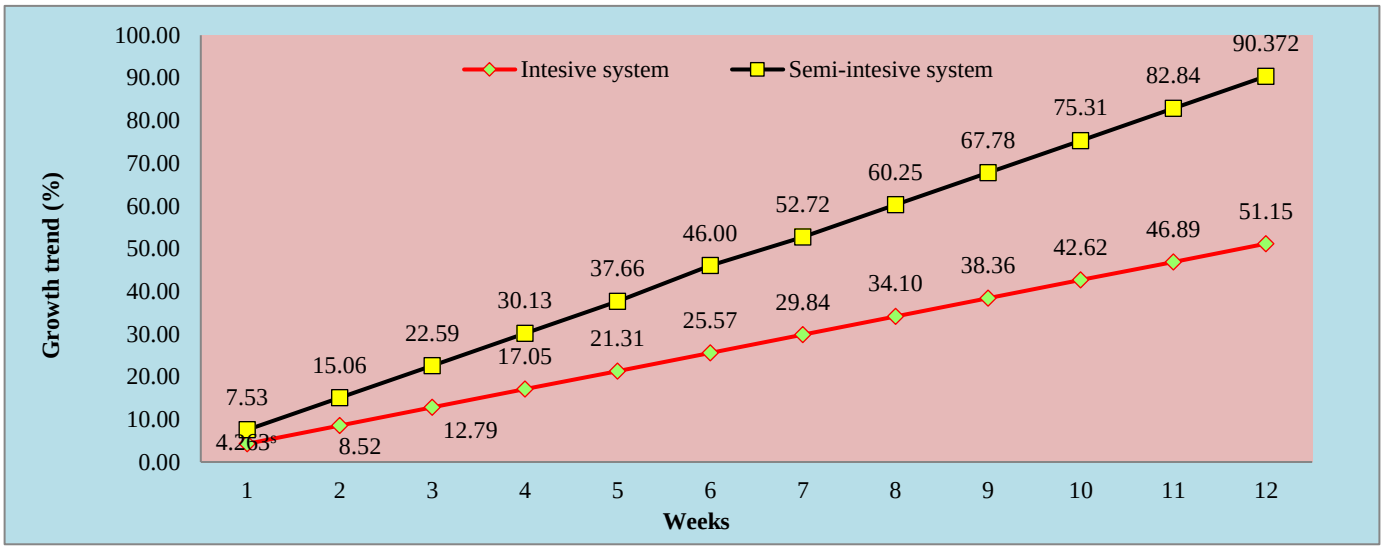


Figure-1:

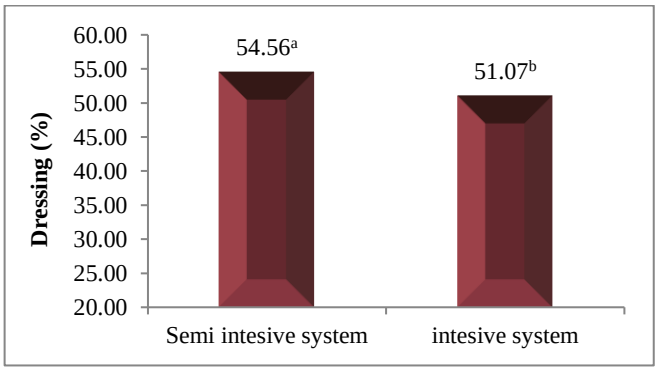


Figure-2: LSD (0.05): 5.8056 SE: 1.3493

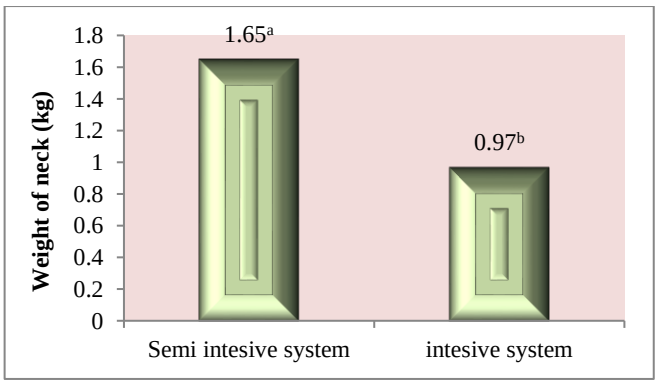


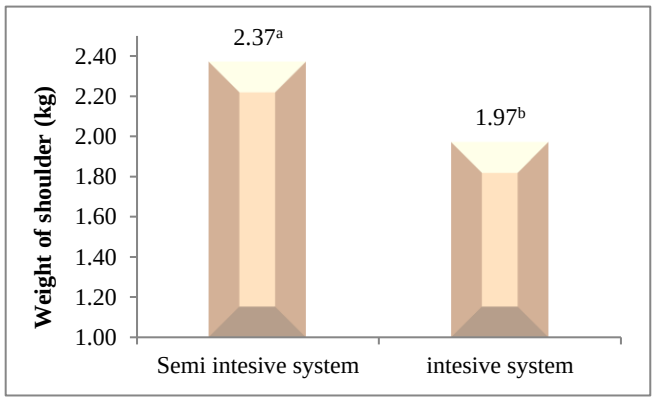
Figure-3: LSD (0.05):0.0481 SE: 0.0112

Comparative Weight Analysis of Male Kachhi Sheep Under Two Management Systems

Figure 4 through Figure 7 present the weights of various body parts (shoulder, thorax, loin and flank, and legs) of male Kachhi sheep reared under semi-intensive and intensive management systems. In all cases, the semi-

was 2.89 kg versus 1.64 kg, respectively. These results indicate that the semi-intensive system promotes better growth and weight gain in male Kachhi sheep.

Figure-4 LSD (0.05): 0.0776 SE: 0.0180



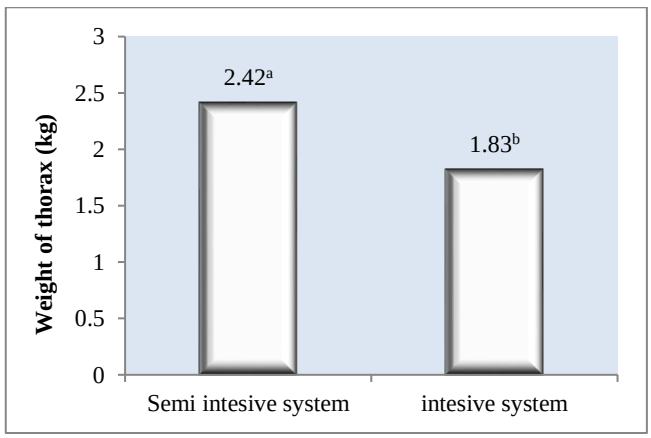


Figure-5 LSD (0.05):0.0913 SE: 0.0212

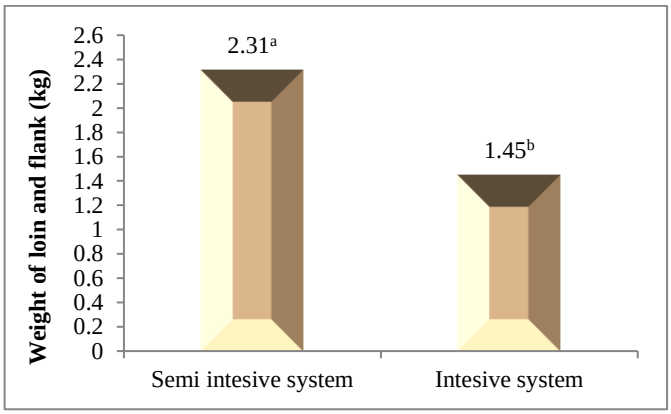


Figure-6 LSD (0.05): 0.0776 SE: 0.0180

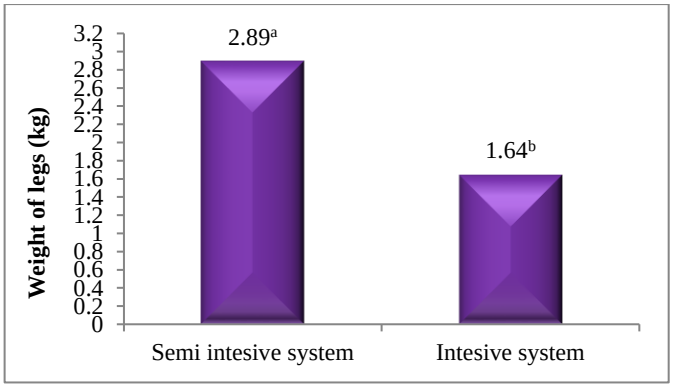


Figure-7 LSD (0.05): 0.1443 SE:0.0335

Organ Weight Comparison of Male Kachhi Sheep Under Two Management Systems

Figure 8 through Figure 11 present the weights of various organs (kidneys, liver, spleen, and heart) of male Kachhi sheep reared under intensive and semi-intensive management systems. The intensive system recorded the highest organ weights, with kidneys at 0.53 kg, liver at 0.93 kg, spleen at 0.31 kg, and heart at 0.71 kg, compared to the semi-intensive system's weights of 0.47 kg, 0.81 kg, 0.21 kg, and 0.62 kg, respectively. The differences in organ weights between the two management systems were non-significant ($p>0.05$), indicating that while there is a trend towards heavier organs in the intensive system, the variations are not statistically significant.

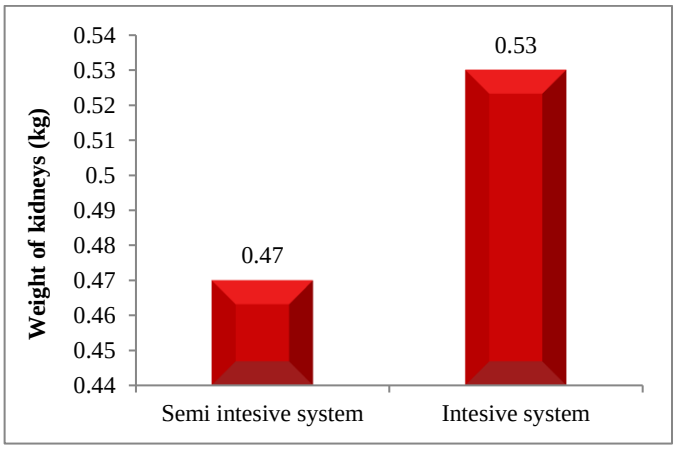


Figure-8 SE:0.0224

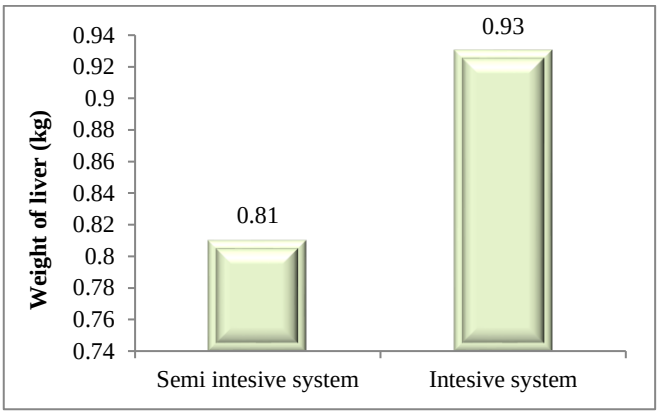


Figure-9 SE: 0.0212

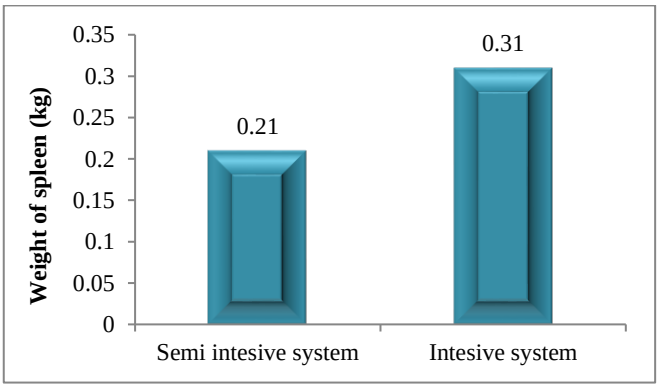


Figure-10 SE: 0.0112

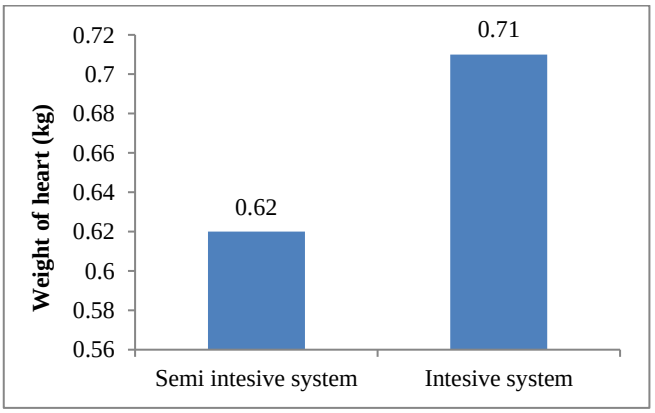


Figure-11 SE: 0.0212

Meat Quality Comparison of Male Kachhi Sheep Reared Under Different Management Systems

Results on the quality of male Kachhi sheep meat reared under semi-intensive and intensive management systems reveal significant differences in various parameters. As presented in Figure-12, the pH of meat from sheep reared under the semi-intensive system was higher (5.95) compared to those reared under the intensive system (5.40), with a non-significant difference ($P>0.05$). Figure-13 shows that water holding capacity was significantly greater (63.85%) in semi-intensive reared sheep compared to those reared intensively (61.31%) ($P<0.05$). Conversely, drip loss was higher (4.85%) in

intensively reared sheep than in semi-intensively reared ones (4.20%) as depicted in Figure-14 (P<0.05). Additionally, Figure-15 indicates that cooking loss was significantly higher (38.97%) in intensively reared sheep compared to those reared semi-intensively (35.19%) (P<0.05). These findings underscore the impact of rearing management systems on the meat quality of male Kachhi sheep, suggesting that the semi-intensive system may favor better water holding capacity and reduced cooking and drip loss, whereas the intensive system shows a higher pH and cooking loss.

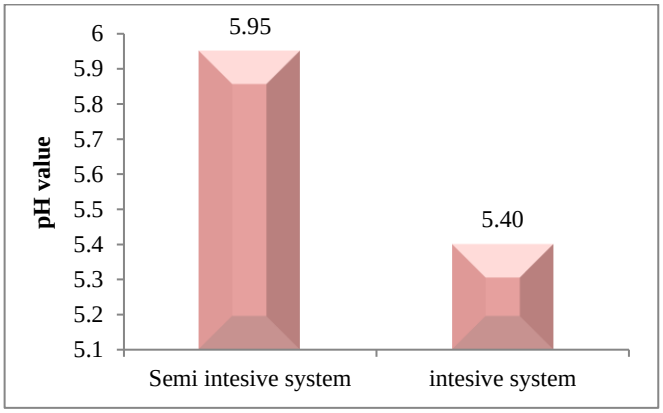


Figure-12: SE: 0.1803

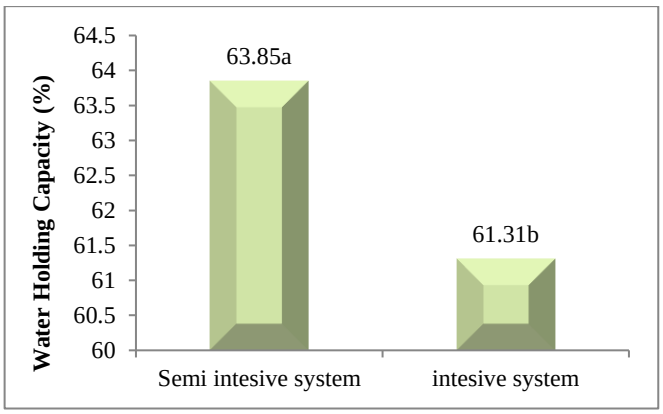


Figure-13: LSD (0.05):1.1230 SE: 0.2610

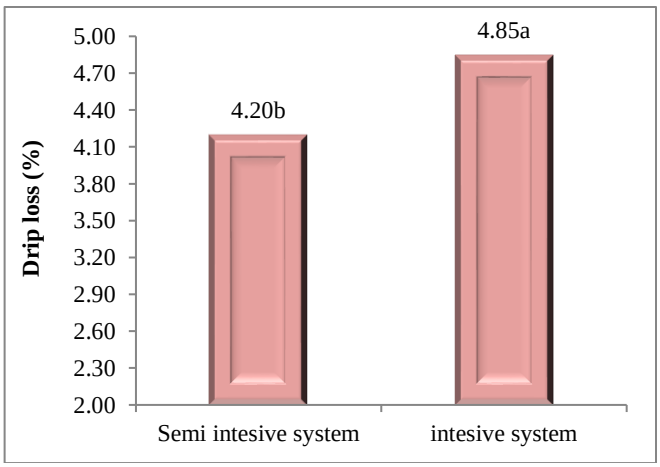


Figure-14 LSD (0.05):0.4811 SE: 0.1118

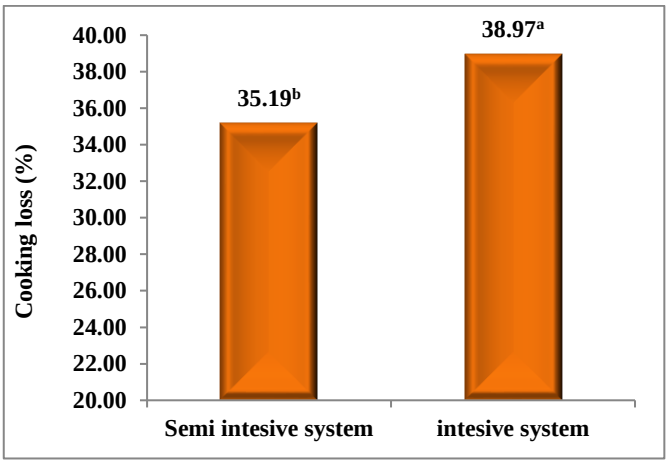


Figure-15 LSD (0.05):1.8449 SE: 0.4288

Proximate Composition of Male Kachhi Sheep Meat Reared Under Different Management Systems

Results on the proximate composition of male Kachhi sheep meat reared under semi-intensive and intensive management systems reveal significant differences in various parameters. As presented in Figure-18, the moisture content was higher (72.73%) in meat from sheep reared under the semi-intensive system compared to those reared under the intensive system (70.54%) (P<0.05). Figure-17 shows that fat content was also higher (3.45%) in semi-intensive reared sheep compared to those reared intensively (2.65%) (P<0.05). Similarly, protein content was greater (21.16%) in semi-intensive reared sheep compared to those reared intensively (19.75%) as depicted in Figure-19 (P<0.05). Additionally, Figure-16 indicates that ash content was higher (0.86%) in semi-intensive reared sheep compared to those reared intensively (0.72%) (P<0.05). These findings highlight the impact of rearing management systems on the proximate composition of male Kachhi sheep meat, suggesting that the semi-intensive system may favor higher moisture, fat, protein, and ash content compared to the intensive system.

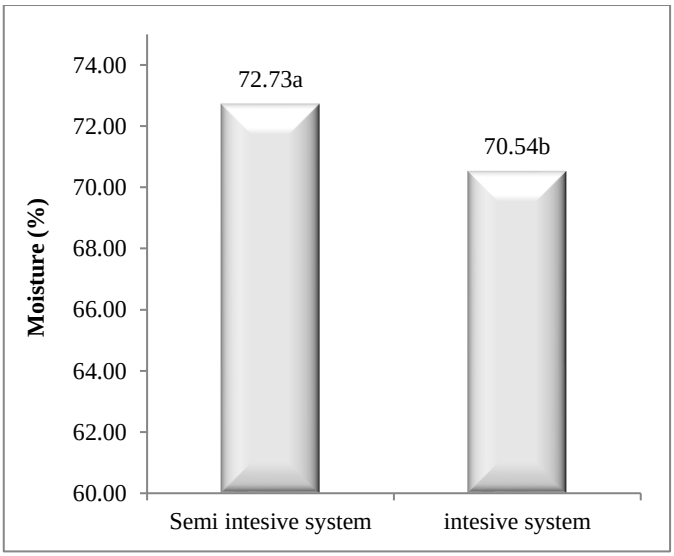


Figure-16: LSD (0.05):1.3366 SE: 0.3106

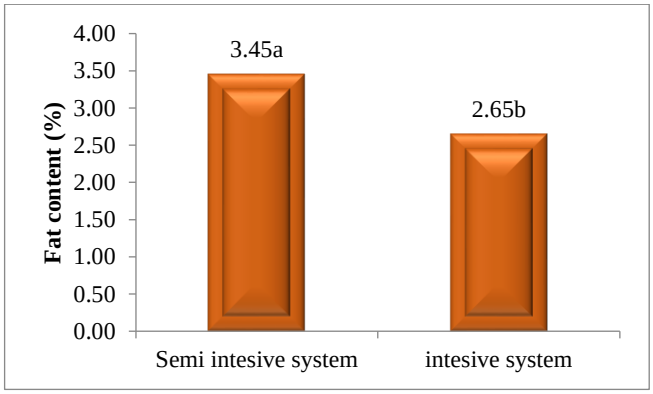


Figure-17 LSD (0.05):0.3042 SE: 0.0707

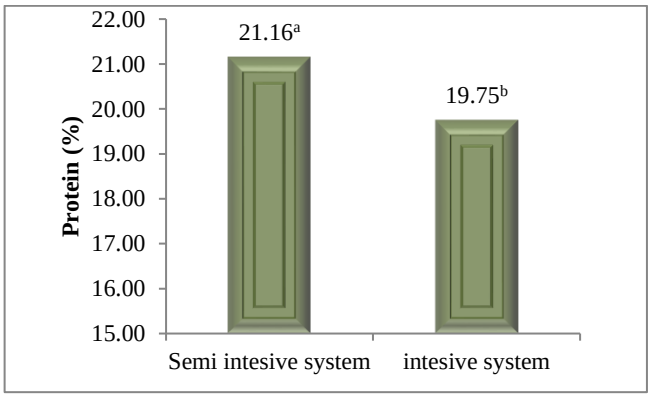


Figure-18 LSD (0.05):1.4008 SE: 0.3256

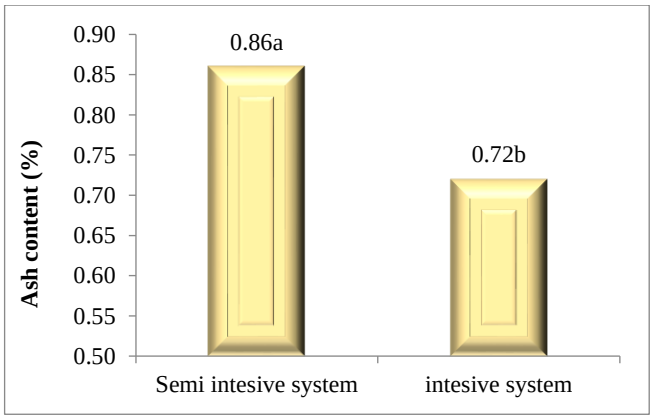


Figure-19 LSD (0.05):0.1097 SE: 0.0255

Economic Analysis of Male Kachhi Lamb Management Systems

A 12-week study was conducted to evaluate the impact of different management systems on the growth and carcass weight of male Kachhi lambs, followed by an economic analysis. Both groups were given ad libitum feed: each lamb received 250 g concentrate mixture and 2.5 kg green fodder daily. However, feeding strategies differed. In groups A and B, the total feed cost was Rs. 1407/lamb. Weight gain in groups A and B was 16.42 kg and 21.39 kg/lamb, respectively. Average sale prices were Rs. 19704 and Rs. 25668/lamb. After deducting total production costs of Rs. 8387 and Rs. 8437/lamb, net profits were Rs. 11317 and Rs. 17231/lamb, respectively. Grazing with green fodder and a self-prepared concentrate mixture proved more profitable than the intensive system, where lambs were fed the same feed quantity without grazing.

DISCUSSION

The Kachhi sheep, native to Pakistan's Sindh Province and the surrounding desert regions like the Rann of Kutch and Tharparker district, is known for its meat and wool. These medium-sized sheep have a white body with a brown or black stumpy head, brown marks on their legs, and a large Roman nose. Their ears are small, and they have a well-developed udder. They produce around 2.0 kg of medium-quality wool with a fiber diameter of 40.0 microns. Despite their significance, the Kachhi breed has not been extensively studied, leading to limited information on their productive traits.

A 12-week study highlighted the benefits of semi-intensive management systems over intensive management for male Kachhi lambs. Johnson and McGowan (1998) found that semi-intensive methods improved live and slaughter weights and increased dressing percentage. Similar findings were reported by Herrera et al. (2011) and Hossain et al. (2003), demonstrating enhanced live weight gain in semi-intensive and extensive systems compared to intensive systems. Further studies by Kosum et al. (2003) and Atti et al. (2004) supported these findings, showing better growth rates and body composition in animals under semi-intensive management.

In the present study, male Kachhi lambs under semi-intensive management, receiving green fodder and a self-prepared concentrate mixture, showed significantly better growth ($P<0.05$) compared to those under intensive management. The semi-intensive system allowed for grazing, contributing to animal welfare and growth. Paramasivam et al. (2002) and Karim et al. (2013) also reported similar findings, with significant differences ($P<0.05$) in body weight between management systems.

The economic analysis revealed that the semi-intensive method, combining green fodder, concentrate mixture, and grazing, was more profitable than the intensive system. The net profit for lambs under semi-intensive management was significantly higher, consistent with the findings of Huma et al. (2016). Studies by Paramasivam et al. (2002), Thiruvenkadan et al. (2007), and Limea et al. (2009) further confirmed the advantages of semi-intensive management in terms of net returns.

In conclusion, the semi-intensive management system not only enhances the growth and body composition of male Kachhi lambs but also proves to be more economically viable compared to the intensive system. These findings underscore the importance of adopting semi-intensive methods for sustainable and profitable sheep farming.

CONCLUSION

The findings indicate that the development of male Kachhi lambs was significantly enhanced under semi-intensive management systems compared to intensive management systems. Additionally, carcass parameters showed considerable improvement under the semi-intensive system. Despite receiving the same amount and quality of feed, grazing had a notable impact on the male Kachhi lambs, resulting in significantly greater weight growth under the semi-intensive management system than under the intensive management system.

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