Growth Performance, Economic Profitability and Carcass Traits of Karadi and Hamdani Lambs Raised at Two Different Feeding Levels

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Abstract
This study evaluates the growth performance, economic profitability and carcass traits of Karadi and Hamdani lambs raised under two feeding levels (3% body weight and ad libitum). Twenty-eight lambs, divided equally between the breeds, were fed barley over a 60-day period. Results revealed that average daily intake (ADI) (1.09 Kg), total feed intake (TFI) (65.22±1.24 Kg), average daily gain (ADG) (0.193±0.09 Kg), total gain (TG) (11.59±0.61 Kg), final weight (FW) (42.39±0.54 Kg), feed conversion ratio (FCR) (5.76±0.11) and feed efficiency (FE) (0.17±0.03) and then gain profit (4,691±281 IQD) and total profit (60,297±3,600 IQD) as well as slaughter body weight (SBW) (42.50±1.15 Kg), empty body weight (EBW) (37.23±1.23 Kg), hot carcass weight (HCW) (22.31±0.80 Kg) and hot dressing percentage (HDP) based on SBW (fed 3%) (52.47±0.72 %) for Hamdani lambs were significantly ($P \leq 0.05$) higher than Karadi lambs, indicating their genetic potential for growth. While head weight differed between breeds, other non-carcass components remained consistent. It is concluded that growth performance, economic profitability and carcass traits for Hamdani lambs were significantly higher than Karadi lambs. These findings suggest that Hamdani lambs may be more profitable for meat production in the region.

Keywords: Karadi, Hamdani, Feeding level, Growth performance, Profitability and carcass traits

Introduction

The most important farm animals in Kurdistan region are sheep, and lamb sale is the greatest portion of the income. Karadi and Hamdani as well as other Iraqi breeds' productivity is rather low and likely to render meat production as low efficient operation. As compared with exotic breed products, the native breed products are high quality (Karym et al., 2019). It is widely recognized that the breed (genotype) can significantly influence the performance of lambs, as well as their carcass traits and meat quality (Hoffman et al., 2003). In lamb production, one of the most important feedlots technical and economic traits is daily weight gain which affected by different factors such as nutrition, fattening period, breed, sex and age. Feeding system improve growth and carcass yield, as well as enhances the lamb's meat quality (Murray et al., 2001 and Karaca et al., 2016). In Kurdistan region and Iraq, fattening lambs usually depends on barley in a feeding lot (Dosky et al., 2014). The effect of nutrition on animal growth and development are well documented. It was found that lambs fed high energy diet had higher daily body weight, feed conversion ratio, body weight, carcass weight and

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dressing percentage than lambs fed medium and low energy diets (Mahgoub et al., 2000.(

In view of the above findings, this work was conducted to evaluate Karadi and Hamdani male lambs for growth performance and economic profitability as well as the carcass traits raised under two levels of feeding.

.2MATERIALS AND METHODS

.2.1Animals and experimental design

The study was conducted at a commercial sheep fattening farm in Sulaymaniyah, Iraq, from October 14 to December 29, 2023. The experiment involved 28 male lambs, comprising 14 Karadi and 14 Hamdani breeds, at about 7 months of age per each and mean body weight of 29.41±0.18 kg. The lambs were housed indoors under uniform conditions and were randomly assigned to two feeding levels (7 lambs/level). Prior to the study, all lambs were clinically examined and treated for parasites. One group received daily allowance of barley at 3% of their body weight (given twice-a-day), while the other group had unrestricted access (ad libitum) to barley for 60 days. A two-week adaptation period was followed by the experimental phase. Throughout the experiment, the lambs had free access to water, straw and mineral blocks. Daily feed offered and refusals were recorded and the lambs were weighed weekly to determine the daily allowance.

.2.2Growth performance

After the adaptation period, the lambs' initial weights were recorded. During the 60-day experiment, their weights were measured weekly. The study calculated the average daily intake (ADI), total feed intake (TFI), average daily gain (ADG), total gain (TG), final weight (FW), feed conversion ratio (FCR) and feed efficiency (FE.(

.2.3Economic profitability

Profitability was determined by subtracting the costs of growth from the income of the lamb's sale. The costs of growth were calculated based on market prices at the time of the study. The equations used are as follows :

Feed Cost (IQD) = 420 (IQD) × Total feed intake (kg(

Rearing Cost (IQD) = Growth Period × Daily rearing expenses

Total cost (IQD) = Feed Cost + Rearing Cost

Gain Cost (IQD/Kg) = Total cost (IQD) ÷ Total gain (kg(

Gain Profit (IQD/kg) = Live weight price (IQD/kg) – Gain Cost (IQD/kg(

Total Profit (IQD) = Gain Profit (IQD/kg) × Total gain (kg(

Where:

The price of lamb live weight is 8,000 (IQD/kg) = $5.333/kg.

The price of barley grain is 420 IQD/kg = $0.28/kg.

.2.4Slaughtering of the animals

After 60 days of the experiment, six lambs from each breed were slaughtered, with three lambs from each feeding level. The slaughter was conducted according to Halal meat guidelines, as prescribed by Islamic law, after a 12-hr feed withdrawal. Just before slaughter, the slaughtered body weight (SBW) was recorded. After removing the head, skinning and evisceration, the hot carcass weight (HCW) and the weights of non-carcass components were measured. The empty body weight (EBW) was determined by subtracting the weight of the digestive contents from the slaughter weight. According to Rouse et al., (1970), dressing percentage was then calculated as following:

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Dressing Percentage %=HCW/(SBW or EBW) ×100

.2.5Statistical analysis

The statistical software used to analyze the effects of breed and feeding levels on performance, profitability and slaughter traits within a Completely Randomized Design (CRD-factorial) was XLSTAT (Addinsoft, 2021). The analysis used the following General Linear Model (GLM:(

$Yijk = \mu + Fi + Bj + FB ij + eijk$

Where:

Yijk= Observations for growth performance, profitability and slaughter traits.

μ = Overall mean.

Fi = Effect of feeding levels (either 3% of body weight or free access to barley grain.(

Bj = Effect of breed (Karadi or Hamdani.(

FBij = Interaction effect between feeding levels and breed.

eijk = Experimental error

Duncan's multiple range test was employed to assess significant differences between trait means at a probability level of $P \leq 0.05$ (Duncan, 1955.(

.3RESULTS AND DISCUSSION

.3.1Growth performance

The growth performance of two lamb breeds, Karadi and Hamdani, was assessed under two feeding levels: 3% feed and ad libitum (n=7) (Table 3.1). The growth parameters measured were IW, FW, ADG and TG. The mean IW was 30.80±0.17 kg, showing no significant differences between breeds or feeding levels. However, FW, ADG, and TG were significantly ($P \leq 0.05$) higher in Hamdani lambs compared to Karadi lambs. Hamdani lambs had superior growth across both feeding levels. The superiority growth performance may result from genetic differences, suggesting Hamdani lambs have better feed conversion efficiency and growth potential.

Recent studies confirm the impact of breed and feeding levels on lamb growth, supporting the results of this study. El-Nomeary et al. (2021) emphasized the effect of dietary protein on growth metrics, while Claffey et al. (2018) observed superior growth rates in Texel cross lambs compared to Scottish Blackface under various feeding conditions. Suliman et al. (2021) confirmed the impact of breed on fattening performance, consistent with the observed breed differences in the current study. Additionally, Taylor et al. (1989) and Ellis et al. (1997) suggested that certain breeds possess genetic advantages in weight gain, further reinforcing the conclusion that breed plays a key role in growth performance

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Table 3.1: Growth performance across different breeds (Karadi or Hamdani) at different levels of feeding (3% or free *ad lib*) (Mean ± SE; n=7/group)

Item		No.	IW (Kg)	FW (Kg)	ADG (Kg)	TG (Kg)
Overall mean		7	30.80±0.17	42.39±0.54	0.193±0.09	11.59±0.61
Karadi	**3%**	7	30.80±0.23 a	41.00±0.55 b	0.170±0.10 b	10.20±0.68 b
	ad lib	7	30.87±0.49 a	40.57±0.38 b	0.161±0.11 b	9.70±0.75 b
Hamdani	**3%**	7	30.77±0.39 a	44.03±0.58 a	0.221±0.13 a	13.26±0.90 a
	ad lib	7	30.75±0.41 a	43.97±0.61 a	0.220±0.13 a	13.22±0.91 a

Means with different letters within each treatment column are significantly different (P≤0.05).

.3.2Feed efficiency

Table (3.2) presents the feed intake and conversion efficiency by Karadi and Hamdani lambs under two feeding levels (3% and ad libitum). The overall ADI was 1.09±0.02 kg, with a TFI of 65.22±1.24 kg. The FCR averaged 5.76±0.11 and FE was 0.17±0.03. Hamdani lambs had significantly higher (P≤0.05) ADI, TFI and feed efficiency, while Karadi lambs showed poorer feed utilization. These differences may be due to breed-specific traits, affecting metabolic efficiency and nutrient utilization, giving Hamdani lambs a genetic advantage in converting feed into body mass.

These observations align with previous research. Snowder and Van Vleck (2003) emphasized the role of breed-specific traits in feed efficiency. Similarly, Yeaman et al. (2013) highlighted the benefits of unrestricted feeding for growth performance, although this trend was not consistently observed in the current study. Perea et al. (2017) added a microbiological perspective, noting that differences in rumen microbiota could explain variations in feed efficiency between breeds. Touitou et al. (2022) also linked metabolic profiles to feed efficiency, further reinforcing the genetic influence on these traits. Snowder and Van Vleck (2003) further explored the interaction between feeding levels and productivity, underscoring the complex interplay between genetics and diet in shaping feed efficiency among lambs.

Table 3.2: Feed intake and efficiency across different breeds (Karadi or Hamdani) at different levels of feeding (3% or free *ad lib*) (Mean ± SE; n=7/group)

Item		No.	ADI (Kg)	TFI (Kg)	FCR	FE
Overall mean		**7**	1.09±0.02	65.22±1.24	5.76±0.11	0.17±0.03
Karadi	**3%**	**7**	1.08±0.03 b	64.62±1.80 b	6.34±0.16 a	0.16±0.05 b
	ad lib	**7**	1.07±0.03 b	64.29±1.89 b	6.63±0.16 a	0.15±0.05 b
Hamdani	**3%**	**7**	1.11±0.03 a	67.12±1.98 a	5.07±0.12 b	0.20±0.06 a
	ad lib	**7**	1.12±0.03 a	67.25±1.98 a	5.09±0.12 b	0.20±0.06 a

Means with different letters within each treatment column are significantly different

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(P≤0.05).

.3.2Economic profitability

Table (3.3) shows the economic profitability of Karadi and Hamdani lambs at two feeding levels (3% and ad libitum). The overall feed cost was IQD 27,665±1,650, with rearing costs at IQD 7,506±450, leading to total costs of IQD 35,171±2,100. The overall gain cost was IQD/kg 3,308±198, resulting in a profit of IQD 4,691±281 and total profits of about IQD 60,297±3,600. Hamdani lambs had significantly lower gain costs and higher profits compared to Karadi lambs, especially at 3% feeding, highlighting their better economic efficiency. This is likely due to genetic growth efficiency and better adaptation to feeding practices, maximizing profits.

These findings support the USDA's (2024) view that farm practices significantly affect economic outcomes. Research highlights that efficient feed conversion and proper management are essential for profitability in livestock farming. Khalaf and Oray (2021) found that breed type plays a major role on gain cost in fattening lambs. The study supports this, showing that the Hamdani breed outperformed the Karadi breed in terms of economic efficiency. Studies by Atsbha et al. (2021) and Karim and Mahmood (2022) confirm that nutrition and feeding systems are important for reducing gain costs and increasing profits.

Table 3.3: Economic profitability across different breeds (Karadi or Hamdani) at different levels of feeding (3% or free *ad lib*) (Mean ± SE; n=7/group)

Item		No.	Feed cost (IQD)	Rearing Cost (IQD)	Total Cost (IQD)	Gain Cost (IQD/kg)	Gain Profit (IQD/kg)	Total Profit (IQD)
Overall mean		7	27,665±1,650	7,506±450	35,171±2,100	3,308±198	4,691±281	60,297±3,600
Karadi	**3%**	7	27,140±1,573 a	7,327±425 a	34,468±1,999 a	3,379±196 a	4,620±267 b	47,131±2,733 b
	ad lib	7	27,001±1,563 a	7,290±422 a	34,292±1,987 a	3,535±204 a	4,464±258 b	43,307±2,508 b
Hamdani	**3%**	7	28,274±1,638 a	7,634±442 a	35,908±2,080 a	2,706±156 b	5,294±306 a	70,251±4,069 a
	ad lib	7	28,245±1,636 a	7,626±442 a	35,871±2,077 a	2,713±157 b	5,286±306 a	69,888±4,048 a

Means with different letters within each treatment column are significantly different (P≤0.05).

.3.3Slaughter and carcass characteristics

.3.3.1Carcass traits

The carcass traits of two lamb breeds, Karadi and Hamdani, was assessed at two feeding levels: 3% feed and ad libitum (Table 3.4). The results indicated that Hamdani lambs had significantly (P≤0.05) higher slaughter body weight (SBW), empty body weight (EBW) and hot carcass weight (HCW) compared to Karadi lambs, regardless of the feeding level. However, Hamdani lambs fed 3% of BW had significantly (P≤0.05) higher hot dressing percentage (HDP) based on SBW, while no significant differences were found in HDP based on EBW. This may be attributed to the Hamdani lambs' genetic potential for growth

and better feed efficiency compared to Karadi lambs.

Similar findings were reported by Al-Sherwany and Alkass (2021), where Karadi lambs showed lower dressing percentage compared to Awassi lambs at different feeding systems. Moreover, studies on different lamb breeds indicated that feeding systems significantly affect carcass yield. In this context, the impact of feeding levels on fattening performance is also supported by the findings of Karim and Mahmood (2022), who showed that feeding regime influences dressing percentages.

Table 3.4: Carcass traits across different breeds (Karadi or Hamdani) at different levels of feeding (3% or free *ad lib*) (Mean ± SE; n=3/group)

Item		**No.**	SBW (kg)	EBW (kg)	HCW (kg)	HDP (SBW)	HDP (EBW)
Overall mean		**3**	42.50±1.15	37.23±1.23	22.31±0.80	52.47±0.72	59.91±1.48
Karadi	**3%**	**3**	41.15±0.33 b	35.88±0.14 b	21.23±0.44 b	51.58±0.66 b	59.16±1.01 a
	ad lib	**3**	40.78±0.14 b	35.53±0.27 b	20.97±0.10 b	51.42±0.08 b	59.02±0.16 a
Hamdani	**3%**	**3**	44.21±0.18 a	39.08±0.33 a	23.83±0.41 a	53.90±0.71 a	61.00±1.57 a
	ad lib	**3**	43.84±0.14 a	38.44±0.54 a	23.22±0.15 a	52.97±0.22 b	60.45±1.19 a

Means with different letters within each treatment column are significantly different (P≤0.05).

.3.3.2Internal organs and non-carcass parts

The internal organs and non-carcass parts expressed as a proportion of EBW of Karadi and Hamdani lambs under two feeding levels (3% and ad libitum) are given in Table (3.5). The results showed that Hamdani lambs had significantly (P≤0.05) higher head weight compared to Karadi lambs when fed at 3% of their BW. However, for other non-carcass components like skin, feet, heart, liver, kidney, spleen, testes, and lung and trachea, there were no significant (P≤0.05) differences between the breeds or feeding levels. Superiority of Hamdani lambs in weight of head may be attributed to genetic differences, since Hamdani lambs generally have larger body proportions. However, the lack of significant differences in other non-carcass components indicates that these traits are less influenced by genetic or dietary factors.

Studies on similar breeds, like the Karadi lambs raised on different feeding systems, have also reported no significant variations in non-carcass components such as liver and lungs, affirming that these traits remain relatively stable across feeding regimes and breeds (Dosky et al., 2014 and Karim and Mahmood, 2022). Additionally, the results are consistent with broader findings in sheep research, where non-carcass traits do not vary as drastically as carcass weight or dressing percentage (Shaker et al., 2003(

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Table 3.5: Lambs' non-carcass components across different breeds (Karadi or Hamdani) at different levels of feeding (3% or free *ad lib*) (Mean ± SE; n=3/group))

Item		No.	Skin	Head	Feet	Heart	Liver	Kidney	Spleen	Testes	Lung and trachea
Overall mean		3	13.04±0.07	5.30±0.12	2.59±0.10	0.42±0.01	1.49±0.03	0.26±0.02	0.32±0.01	0.52±0.02	1.77±0.03
Karadi	**3%**	3	12.87±0.08 a	4.83±0.17 b	2.36±0.10 a	0.40±0.02 a	1.53±0.09 a	0.25±0.02 a	0.31±0.01 a	0.49±0.03 a	1.75±0.08 a
	ad lib	3	12.96±0.07 a	5.23±0.15 ab	2.54±0.25 a	0.45±0.02 a	1.49±0.09 a	0.23±0.02 a	0.29±0.04 a	0.51±0.03 a	1.73±0.06 a
Hamdani	**3%**	3	13.04±0.13 a	5.59±0.02 a	2.84±0.21 a	0.39±0.02 a	1.46±0.03 a	0.26±0.03 a	0.33±0.02 a	0.52±0.04 a	1.78±0.08 a
	ad lib	3	13.28±0.19 a	5.54±0.25 a	2.61±0.25 a	0.42±0.03 a	1.48±0.09 a	0.29±0.05 a	0.36±0.03 a	0.56±0.02 a	1.81±0.08 a

Means with different letters within each treatment column are significantly different (P≤0.05).

Conclusion

This study demonstrates the superior growth performance and economic efficiency of Hamdani lambs compared to Karadi lambs, under both 3% feeding and ad libitum regimes. Hamdani lambs showed higher final weight, daily gain and better feed conversion, indicating their genetic advantage in growth. They also produced higher slaughter and carcass weights, making them more suitable for meat production. While head weight differed between breeds, other non-carcass parts like liver and kidneys showed no significant variation. These findings provide valuable insights into optimizing feeding strategies and selecting breeds to enhance profitability in lamb production.

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