# Comparative Efficiency of Lamb and Beef Cattle in the Red Meat Supply Chain

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**Abstract**

Efficiency in the red meat supply chain is a key determinant of the economic performance and sustainability of livestock production systems. This study presents a comparative evaluation of fattened male lambs and beef cattle using key performance indicators, including live weight, carcass yield (dressing percentage), processing losses, and the distribution of primal cuts. The analysis was based on a dataset obtained from livestock procurement records and commercial slaughterhouse operations in 2021. The results indicate that beef cattle exhibit higher dressing percentages and greater efficiency in converting live weight into saleable carcass mass compared with lambs. In contrast, lamb carcasses provide a higher proportion of premium retail cuts relative to total carcass weight. Differences in carcass composition, fat distribution, and chilling losses highlight species-specific processing characteristics within the meat supply chain. These findings provide practical insights for optimizing procurement strategies and improving processing efficiency in red meat production systems.

**Keywords:** Meat supply chain; Lamb; Beef cattle; Carcass yield; Dressing percentage; Meat processing efficiency.

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## Introduction

The global demand for red meat has surged in recent decades, driven by exponential population growth, rapid urbanization, and rising per capita incomes, particularly across developing nations (FAO, 2018). Consequently, livestock production systems are under mounting pressure to enhance productivity, operational efficiency, and environmental sustainability, all while preserving meat quality and ensuring economic profitability (Hocquette *et al*., 2018; Ramírez-Gómez *et al*., 2025).

Within the red meat industry, the efficiency with which live animals are converted into edible meat products is a critical metric of production performance. The meat supply chain is a complex continuum encompassing livestock rearing, transportation, slaughtering, carcass fabrication, packaging, and distribution. Among these interconnected stages, slaughterhouse operations act as the pivotal juncture where biological productivity is directly translated into tangible economic value (Troy and Kerry, 2010; Dzhulamanov and Gerasimov 2026).

Carcass yield, typically expressed as dressing percentage, serves as a primary indicator for evaluating slaughter efficiency. It represents the proportion of the live animal's weight that remains as the carcass after the removal of non-edible components such as the hide, head, hooves, and viscera (Coyne *et al*., 2019; Wardoyo *et al*., 2025). Generally, a higher dressing percentage denotes a more efficient biological conversion of live mass into marketable meat.

However, carcass yield alone paints an incomplete picture of an animal's true economic worth. Carcass composition—specifically the ratio of muscle, fat, and bone—alongside the spatial distribution of high-value commercial cuts, decisively influences final market valuation (Prates 2025). The inherent structural and morphological variations among different livestock species and breeds significantly impact processing dynamics and, ultimately, the profitability of meat production systems.

Sheep and cattle constitute two of the most vital sources of red meat globally. According to the Food and Agriculture Organization (FAO), beef accounts for roughly 25–30% of global red meat consumption, whereas sheep and goat meat contribute approximately 5–7% (FAO, 2018). Despite their smaller global market share, sheep remain economically indispensable in many regions, heavily driven by cultural preferences and niche culinary markets (Butchart *et al*.,2025).

Biological distinctions between these species directly shape their carcass characteristics. Sheep carcasses generally exhibit a higher ratio of fat to muscle mass; furthermore, in certain breeds, the presence of a fat tail significantly alters overall carcass composition (Wood *et al*., 2008; Jin *et al*.,2026). In contrast, cattle possess a much larger skeletal structure and greater muscle hypertrophy, resulting in a substantially higher boneless meat yield (Charmley *et al*., 2025).

Another critical dimension of meat processing efficiency is the management of weight losses during post-mortem handling and chilling. As carcasses cool, they inevitably lose weight through moisture evaporation and drip loss, which can notably diminish the final saleable yield (Savell *et al*., 2005). In large-scale commercial slaughter operations, even marginal variations in chilling losses can trigger profound economic consequences.

Given these biological and technological realities, a comparative evaluation of lamb and cattle processing performance offers vital insights for supply chain optimization. Understanding species-specific metrics regarding carcass yield, processing losses, and cut distribution empowers meat processors to make informed procurement decisions and maximize financial returns. Therefore, this study aims to evaluate and contrast the efficiency of fattened male lambs and cattle within the meat supply chain, utilizing operational slaughterhouse data to assess live weight, dressing percentage, processing losses, and commercial cut yields.

## Materials and methods

This comparative study utilized operational data sourced from livestock procurement and slaughterhouse processing records compiled over the course of 2021. The analysis encompassed two distinct cohorts of animals: fattened male lambs and fattened male cattle, both procured explicitly for commercial meat production.

The dataset captured variables spanning live animal characteristics and subsequent slaughter performance. Key recorded metrics included the total number of animals, aggregate live weight, hot and cold carcass weights, dressing percentages, and processing losses incurred during chilling and trimming phases.

For the lamb cohort, specialized measurements were taken, including carcass weight inclusive of the fat tail, isolated fat tail weight, net carcass weight (excluding the fat tail), and final packaged carcass weight. For the cattle cohort, the recorded parameters detailed total carcass weight, total bone weight, net boneless meat yield, and final packaged meat weight.

Carcass composition was systematically evaluated by calculating the proportional yield of primary commercial cuts, namely the leg, shoulder, loin, neck, and flank. Given its exceptional commercial value, the tenderloin was evaluated as a distinct and separate cut in the cattle carcasses.

The comparative analysis was structured around three core efficiency indicators:

1. The biological conversion efficiency of live weight to carcass mass (dressing percentage).
2. The magnitude of processing shrinks, specifically chilling and handling losses.
3. The proportional distribution and yield of economically valuable carcass cuts.

## Results

*Livestock procurement and live weight*

The analyzed dataset included 2,546 fattened male lambs and 126 fattened male cattle. The total live weight of the processed lambs was 121,021 units, while the cattle accounted for 71,550 units. Although the number of lambs processed was much higher than cattle, the average live weight per animal was considerably greater in cattle.

*Dressing percentage*

The dressing percentage differed clearly between the two species. Fattened male cattle showed a dressing percentage of 54.4%, whereas lamb carcasses, including the fat tail, had a dressing percentage of 46.1%.

*Processing losses during chilling*

Chilling loss also varied between species. Lamb carcasses showed a chilling loss of 1.8%, while cattle carcasses had a slightly higher chilling loss of 2.41%.

*Packaged meat yield*

Regarding the final processing yield, lambs produced a packaged meat yield equal to 39.8% of live weight. In cattle, the boneless meat yield reached 78.67% of carcass weight.

*Distribution of carcass cuts*

The distribution of carcass cuts showed differences between lamb and cattle. In lambs, the leg represented the largest proportion of the carcass (33.3%), followed by the shoulder (24.5%) and the loin (17.9%). In cattle, the leg (round) accounted for 26%, the shoulder (chuck) for 21.5%, and the loin for 8.6% of total carcass weight. The tenderloin represented 1.5% of the cattle carcass.

## Discussion

The much higher average live weight observed in cattle was expected and is consistent with previous studies indicating that cattle produce heavier carcasses and greater total meat volume per animal than sheep (Coyne *et al*., 2019; Monteiro *et al*., 2025). From a processing standpoint, heavier animals can improve slaughterhouse efficiency by reducing labor and time requirements per kilogram of meat produced. In addition to live weight differences, carcass yield performance also differed markedly between species. The higher dressing percentage in cattle compared with lambs reflects a more efficient conversion of live weight into carcass weight, which agrees with reported bovine and ovine yield ranges (Wood et al., 2008; Charmley *et al*., 2025). This advantage in cattle is largely attributed to greater muscle mass and a lower proportional contribution of non-carcass components, such as hide and gastrointestinal contents. In contrast, sheep tend to allocate a larger share of body weight to fat and other non-saleable components, which can reduce overall carcass yield (Crespi *et al*., 2025).

Chilling shrinkage patterns further supported these species-level differences. Both lamb and cattle losses during post-mortem chilling were within the typical industry range of 1–3%

(Savell *et al.,* 2005); however, cattle exhibited slightly higher chilling shrink than lambs. This can be explained by the larger carcass size in cattle, which increases exposed surface area and often necessitates longer chilling times to achieve adequate internal temperature reduction, thereby promoting greater moisture evaporation. Differences were also evident at the fabrication stage. The lower packaged meat yield in lambs compared with the high boneless meat yield in cattle highlights key anatomical and morphological distinctions, particularly the higher proportion of lean tissue and a more favorable muscle-to-bone ratio in cattle, which supports greater boneless meat recovery during cutting and deboning (Prates 2025).

Finally, the distribution of commercial cuts suggests distinct market advantages for each species. Lamb carcasses yielded relatively high proportions of leg, shoulder, and loin, indicating strong suitability for premium retail and traditional market channels. Although cattle had a lower proportional contribution of some premium cuts, their larger carcass size and inclusion of high-value muscles such as tenderloin contribute substantially to total carcass value. Overall, while cattle deliver greater absolute meat output, lamb may provide a higher proportional share of certain desirable cuts, supporting premium pricing in niche culinary and specialized markets (Hocquette *et al.,* 2018).

**Conclusion**

This comparative evaluation of fattened male lambs and beef cattle illustrates that each species plays a unique and complementary role in maximizing red meat supply chain efficiency. Cattle unambiguously demonstrate superior operational performance regarding dressing percentage, total carcass mass, and boneless meat yield. These attributes make bovine processing highly advantageous for large-scale, high-volume meat production operations seeking to maximize raw protein output. Conversely, while lamb production yields lower overall carcass weights, it offers a distinctly higher proportional share of several premium commercial cuts. Because these cuts are highly sought after in diverse regional and culinary markets, lamb production remains a highly competitive and economically viable enterprise.

From a strategic supply chain management perspective, the optimal approach is not to favor one species over the other, but rather to integrate both into a diversified and balanced procurement framework. By aligning livestock sourcing with specific consumer demands and facility processing capabilities, meat purveyors can simultaneously maximize yield efficiencies, broaden their product portfolios, and bolster economic resilience.

Ultimately, the rigorous, data-driven evaluation of carcass performance at the slaughterhouse level provides an indispensable decision-support tool. Leveraging this operational data allows

the modern meat industry to manage livestock resources with precision, forecast yields accurately, and ensure the sustainable utilization of animal protein within global food systems.

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