# Comparative study of fat-tailed and thin-tailed sheep carcass quality

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T1EDK-05479

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# Background

**Fat-tailed sheep (FTS)** in Greece

- Reared for their milk production
- Undervalued meat production compared to **thin-tailed (TTS)**

→ Relevant research data ?



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# Objective

To assess and compare the

**carcass quality** of **FTS and TTS**

reared in Greece



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# Materials & Methods

146 FTS

97 TTS

- Semi-intensive flocks
- Representative of local populations (crossbreds)
- Male & Female
- 5 slaughter weight groups (SGs)



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# Materials & Methods

146 FTS

97 TTS

- Semi-intensive flocks → Roughage; Concentrate mix (16% protein); Grazing (spring-summer)
- Representative of local populations (crossbreds)
- Male & Female
- 5 slaughter weight groups (SGs) → 25%, 35%, 50%, 70%, 100% of mature live weight



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# Materials & Methods

146 FTS

97 TTS

*Measurements:*

- Wither height
- Hot carcass weight
- Carcass yield
- Carcass length
- Carcass pH



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# Materials & Methods

146 FTS

97 TTS

*Measurements:*

- Wither height
- Hot carcass weight → SGs:
  - 25%
  - 35% included **head & viscera**
  - 50%
- Carcass yield → (Carcass weight / Live weight) × 100
- Carcass length → Base of neck – base of tail
- Carcass pH → Non-destructively
  - 1 hour after refrigeration
  - Medial side of right leg



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# Materials & Methods

*Laboratory analyses*:

- Muscle histomorphometry
- Texture Profile Analysis (TPA)
- Meat colorimetry
- Meat pH
- Meat moisture, lipid & protein content



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# Materials & Methods

*Laboratory analyses*:

- Muscle histomorphometry
- Texture Profile Analysis (TPA)
- Meat colorimetry
- Meat pH
- Meat moisture, lipid & protein content

Psoas major samples (FTS: n=34 / TTS: n=42)

**Muscle fiber minimum Feret's diameter**

(ImageJ 1.53k software)



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# Materials & Methods

*Laboratory analyses*:

- Muscle histomorphometry
- Texture Profile Analysis (TPA)
- Meat colorimetry
- Meat pH
- Meat moisture, lipid & protein content

Samples from 13th rib (FTS: n=58 / TTS: n=41)

Double compression cycle tests:

- Hardness 1 → Hardness of meat samples during 1st and 2nd bite
- Hardness 2
- Springiness → Recovery after deformation
- Cohesiveness → Resistance to deformation
- Chewiness → Energy required until swallow



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*Laboratory analyses*:

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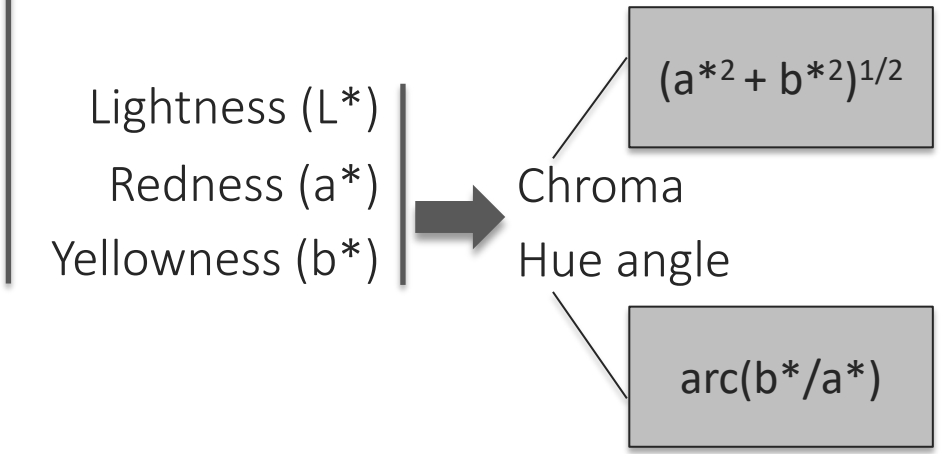
Samples from 13th rib (FTS: n=58 / TTS: n=41)



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# Materials & Methods

*Laboratory analyses*:

- Muscle histomorphometry
- Texture Profile Analysis (TPA)
- Meat colorimetry
- Meat pH
- Meat moisture, lipid & protein content

Samples from 13th rib (FTS: n=58 / TTS: n=41)

Non-destructively

Same point of incision

2 consecutive measurements → Average



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# Materials & Methods

*Laboratory analyses*:

- Muscle histomorphometry
- Texture Profile Analysis (TPA)
- Meat colorimetry
- Meat pH
- Meat moisture, lipid & protein content

Samples from thigh region
(*M. quadriceps femoris*)
(FTS: n=25 / TTS: n=18)

AOAC methods 991.36 & 928.08



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# Materials & Methods

*Statistical analyses* (R programming language v 4.1.2 – "stats", "rcompanion"):

- Mann-Whitney U tests → Compare medians of FTS and TTS
- Two-way ANOVA (& Tukey's) or Scheirer-Ray-Hare tests →
  - Sex & Interaction: Sex × Sheep population
  - or
  - SGs & Interaction: SG × Sheep population



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# Results

## Comparison of FTS with TTS

| | FTS | | TTS | | |
|---|---|---|---|---|---|
| | Median | Interquartile range | Median | Interquartile range | *p*-value |
| Carcass yield (%) | 53.74 | 0.13 | 48.77 | 0.14 | **<0.01** |
| Redness—a* | 12.44 | 1.49 | 13.13 | 1.85 | **<0.05** |



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# Results

## Effect of SG & SG × Sheep population (2-way ANOVA)

| Trait | Effect | Sum of Squares | df | Mean Square | F | *p*-value |
|---|---|---|---|---|---|---|
| Wither height (m) | Sheep population | 0.01 | 1 | 0.01 | 5.53 | <0.05 |
| | SG | 2.28 | 4 | 0.57 | 269.96 | <0.001 |
| | SG × Sheep population | 0.03 | 4 | 0.01 | 3.45 | <0.01 |
| Yellowness—b* | SG × Sheep population | 11.80 | 4 | 2.95 | 2.56 | <0.05 |
| Hue angle | SG × Sheep population | 0.07 | 4 | 0.02 | 4.63 | <0.01 |
| Springiness | SG × Sheep population | 0.14 | 4 | 0.03 | 3.77 | <0.01 |



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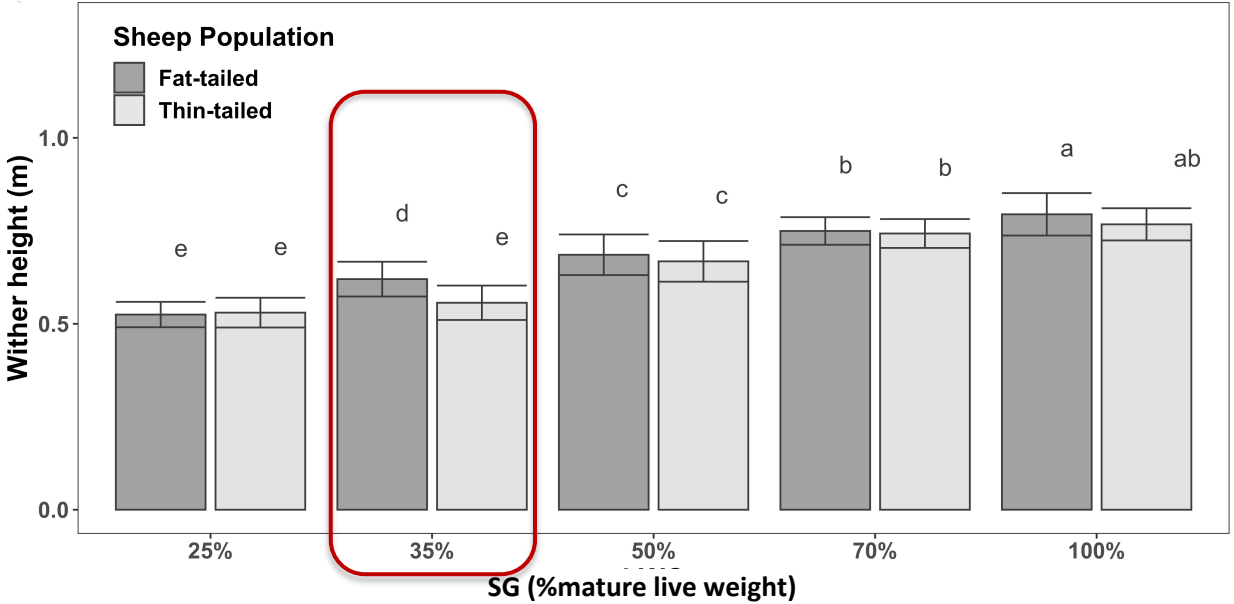
# Results

## Effect of SG & SG × Sheep population (Tukey's post hoc tests)

Significant pairwise comparisons ($p$<0.05)

FTS-TTS within SGs

✓ Wither height







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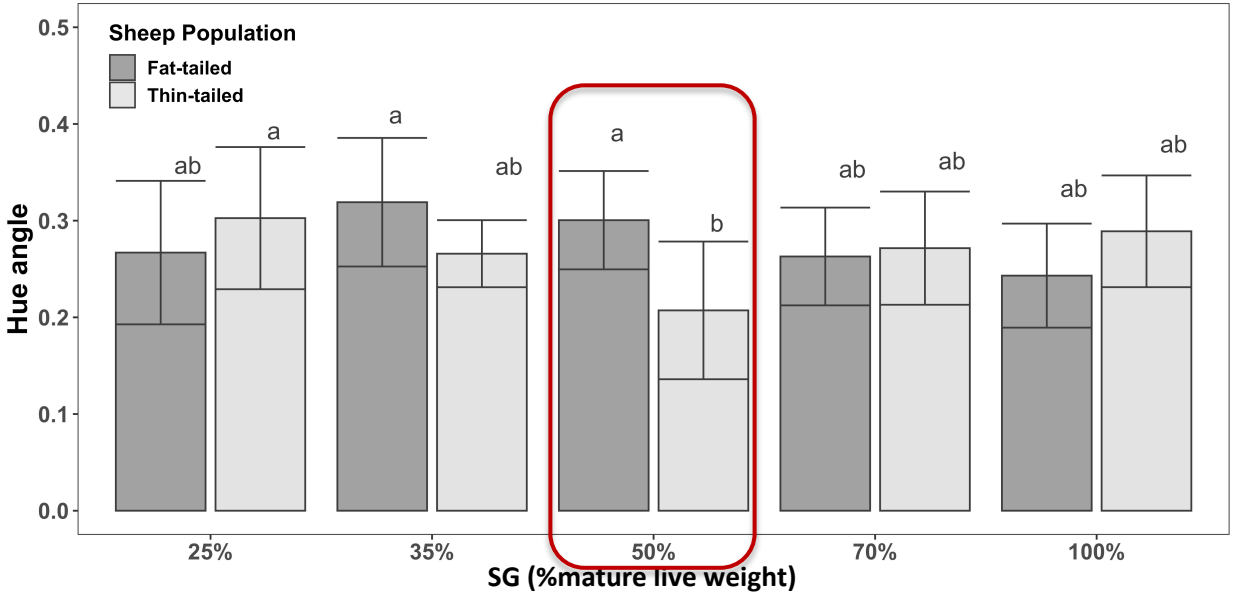
↓

FTS-TTS within SGs

✓ Hue angle







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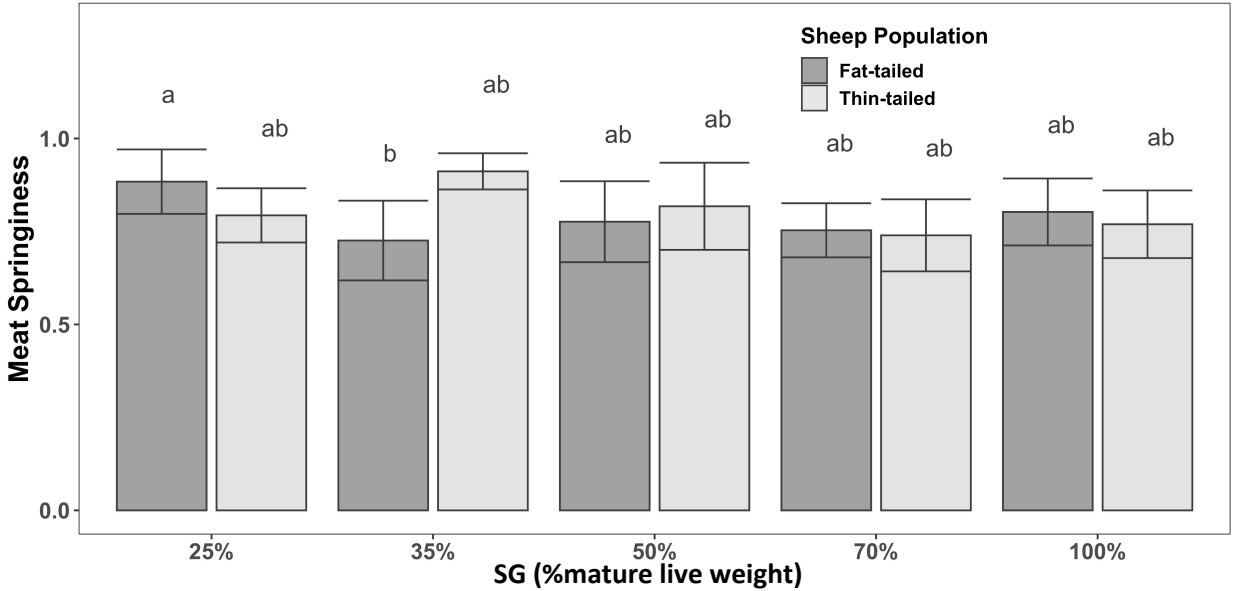





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# Results

## Effect of SG & SG × Sheep population (Scheirer-Ray-Hare test)

| Trait | Effect | Sum of Squares | df | H | *p*-value |
|---|---|---|---|---|---|
| Live weight (kg) | SG | 1,142,662.00 | 4 | 231.27 | <0.001 |
| Carcass length (m) | SG | 787,969.00 | 4 | 192.88 | <0.001 |
| Hot carcass weight (kg) | SG | 1,093,735.00 | 4 | 221.39 | <0.001 |
| Carcass yield (%) | Sheep population | 36,751.00 | 1 | 7.44 | <0.01 |
| | SG | 705,885.00 | 4 | 142.86 | <0.001 |



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# Results

## Effect of SG & SG × Sheep population (Scheirer-Ray-Hare test)

| Trait | Effect | Sum of Squares | df | H | *p*-value |
|---|---|---|---|---|---|
| Carcass pH | SG | 48,815.00 | 4 | 10.75 | <0.05 |
| | SG × Sheep population | 44,529.00 | 4 | 9.80 | <0.05 |
| Lightness – L* | SG | 32,178.00 | 4 | 38.23 | <0.001 |
| Redness – a* | Sheep population | 3560.00 | 1 | 4.23 | <0.05 |
| Meat pH | SG | 13,493.00 | 4 | 16.07 | <0.01 |
| Cohesiveness | SG × Sheep population | 9767.00 | 4 | 11.84 | <0.05 |



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# Results

## Effect of Sex & Sex × Sheep population (2-way ANOVA)

| Trait | Effect | Sum of Squares | df | Mean Square | F | *p*-value |
|---|---|---|---|---|---|---|
| Wither height (m) | Sex | 0.06 | 1 | 0.06 | 4.97 | <0.05 |
| Lightness—L* | Sex | 64.00 | 1 | 64.03 | 7.69 | <0.01 |
| Redness—a* | Sex | 12.79 | 1 | 12.79 | 6.14 | <0.05 |
| | Sex × Sheep population | 8.40 | 1 | 8.40 | 4.03 | <0.05 |
| Yellowness—b* | Sex | 13.40 | 1 | 13.40 | 12.46 | <0.001 |
| Chroma | Sex | 19.85 | 1 | 19.85 | 8.07 | <0.01 |
| | Sex × Sheep population | 10.76 | 1 | 10.76 | 4.37 | <0.05 |
| Hue angle | Sex | 0.04 | 1 | 0.04 | 9.39 | <0.01 |



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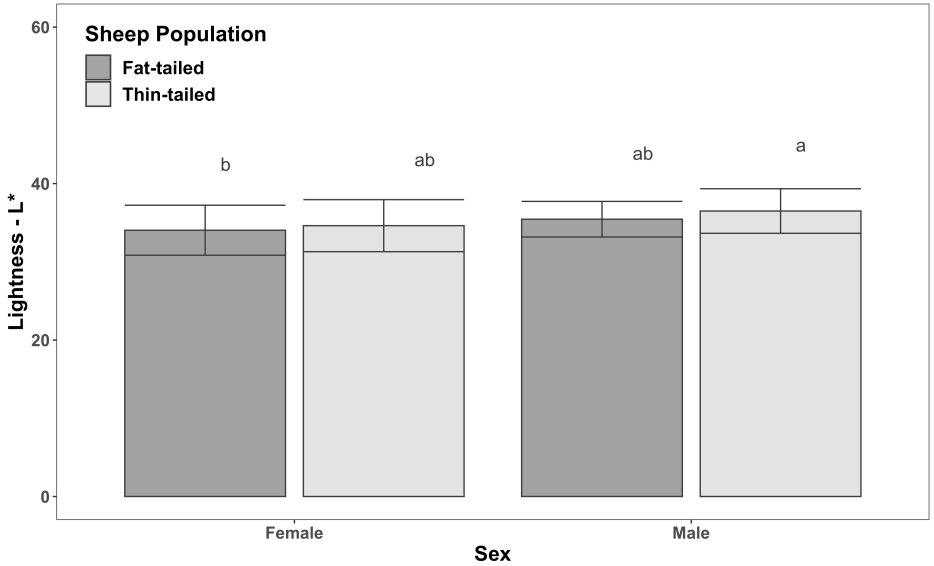
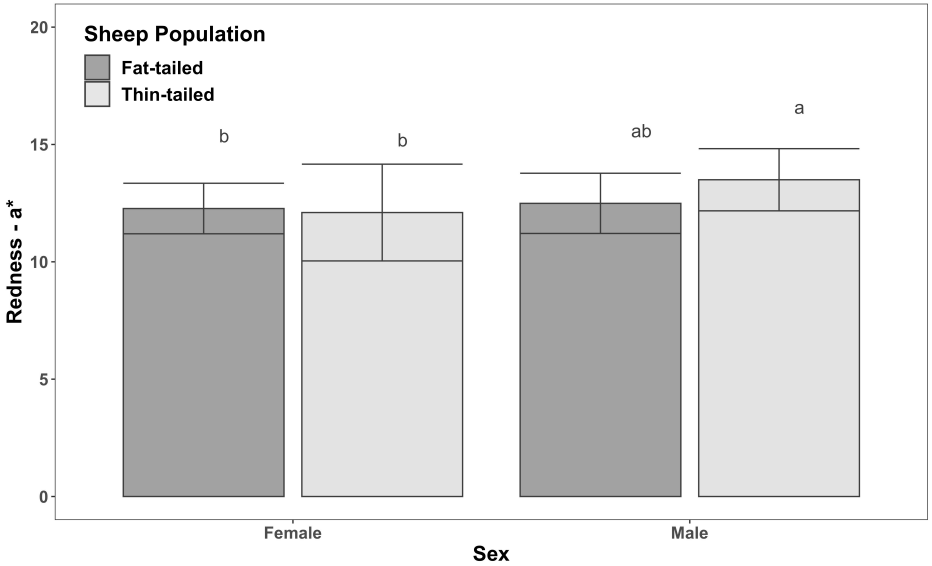
# Results

## Effect of Sex & Sex × Sheep population (Tukey's post hoc tests)

### Significant pairwise comparisons ($p$<0.05)







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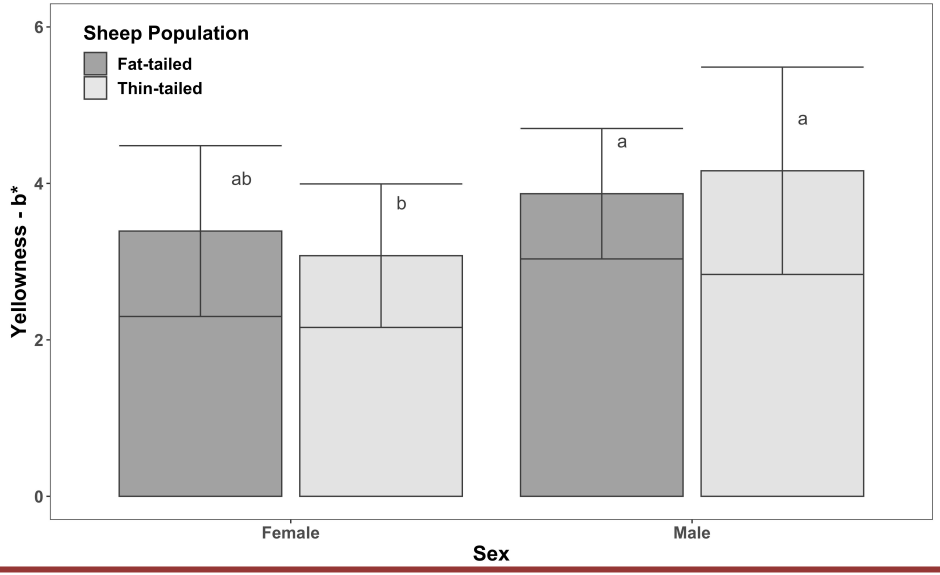
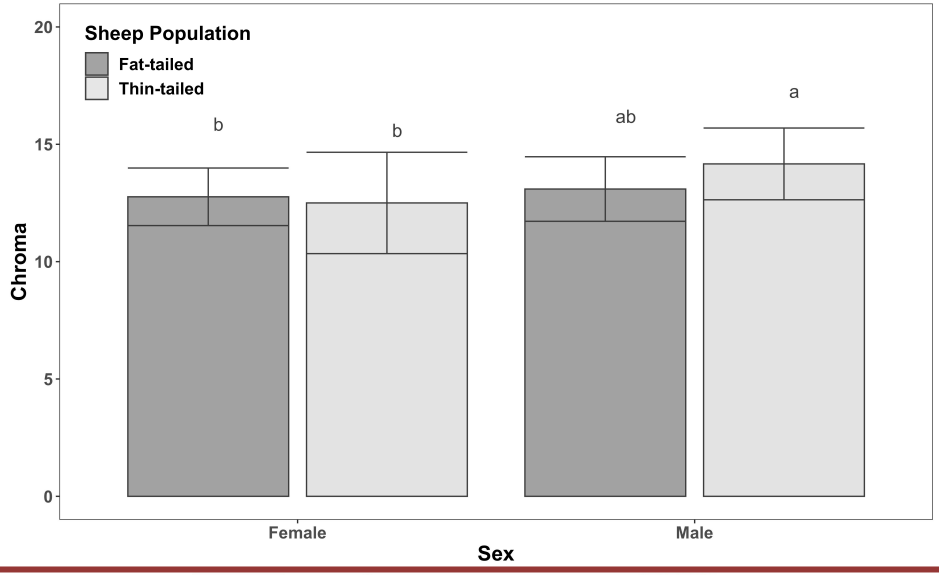
# Results

## Effect of Sex & Sex × Sheep population (Tukey's post hoc tests)

Significant pairwise comparisons ($p$<0.05)







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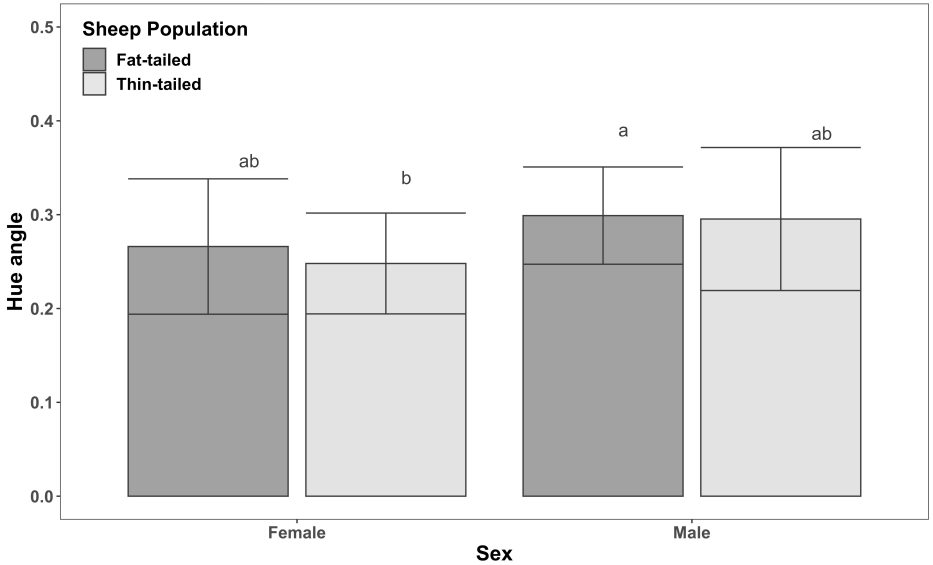
# Results

## Effect of Sex & Sex × Sheep population (Tukey's post hoc tests)

Significant pairwise comparisons ($p$<0.05)







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# Results

## Effect of Sex & Sex × Sheep population (Scheirer-Ray-Hare test)

| Trait | Effect | Sum of Squares | df | H | *p*-value |
|---|---|---|---|---|---|
| Live weight (kg) | Sex | 36,855.00 | 1 | 7.46 | <0.01 |
| Hot carcass weight (kg) | Sex | 20,769.00 | 1 | 4.20 | <0.05 |
| Carcass yield (%) | Sheep population | 36,751.00 | 1 | 7.44 | <0.01 |
| | Sex | 93,536.00 | 1 | 18.93 | <0.001 |
| Muscle fiber minimum Feret's diameter (μm) | Sex | 2569.00 | 1 | 5.27 | <0.05 |
| Carcass pH | Sex × Sheep population | 21,223.00 | 1 | 4.67 | <0.05 |



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# Conclusion

**Sheep population** affects **carcass and meat quality**

**FTS**

- ✓ Higher carcass yield
- ✓ More tender meat

**TTS**

- ✓ More desirable meat color

**SGs** affected most studied traits

**Slaughter weight** is key

Meat production maximization

Waste minimization

Better capitalization



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# Acknowledgements

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animals

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https://doi.org/10.3390/ani12151998

Article

## A Comprehensive Study of the Quality of Fat-Tailed Sheep Carcasses in Greece

Angeliki Argyriadou [1,*], Anestis Tsitsos [2], Ioanna Stylianaki [3], Sotiria Vouraki [1], Theodoros Kallitsis [1], Vangelis Economou [2] and Georgios Arsenos [1]

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[2] Laboratory of Hygiene of Food of Animal Origin—Veterinary Public Health, School of Veterinary Medicine, Faculty of Health Sciences, Aristotle University, 54124 Thessaloniki, Greece
[3] Laboratory of Pathology, School of Veterinary Medicine, Faculty of Health Sciences, Aristotle University, 54124 Thessaloniki, Greece
* Correspondence: argyrian@vet.auth.gr; Tel.: +30-231-099-9977

**Simple Summary:** Sheep meat in Greece is considered a by-product of dairy production, associated with undefined quality and low revenues. Production is based on slaughtering of young lambs and consists of light carcasses. Heavy carcasses are scarce and mainly derived from rams and ewes that are no longer appropriate for dairy farming due to age, health or productivity issues; no dietary treatments or fattening protocols are implemented prior to slaughter. Improving production sustainability implies more efficient use of available resources, including local fat-tailed sheep that are reared in high numbers for their milk, although their carcasses are undervalued; supportive research data are scarce. Hence, we used objective methods to assess the quality of carcasses of fat-tailed sheep slaughtered at different live weights (representing five developmental stages, from young lambs to adult sheep) and to compare them with carcasses of thin-tailed sheep, which are considered superior. We found that quality of fat-tailed sheep carcasses was equal or higher compared to thin-tailed. Differences between sexes and developmental stages existed. Slaughtering of fat-tailed sheep at higher live weights (50–70% of the average adult sheep weight) will benefit production quality and quantity, improving profitability and sustainability of the sector.

**Abstract:** Sheep farming in Greece is focused on milk production. Meat is considered a by-product

check for updates

**Citation:** Argyriadou, A.; Tsitsos, A.; Stylianaki, I.; Vouraki, S.; Kallitsis, T.; Economou, V.; Arsenos, G. A Comprehensive Study of the Quality of Fat-Tailed Sheep Carcasses in

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Thank you for your attention!



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