THE EFFECTS OF *SCHIZOCHYTRIUM SP.* LIPID EXTRACT OR FISH OIL ON LAMB MEAT FATTY ACIDS

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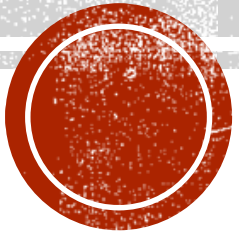

OBJECTIVES

Supplying n-3 long chain PUFA (EPA & DHA) to ruminants can be useful to:

- Disturb the rumen biohydrogenation → Increase vaccenic acid (18:1 *trans*-11) and rumenic acid (CLA)

- Increase the n-3 LC PUFA of meat/milk

OBJECTIVES

Microalgae derived n-3 long chain PUFA are an alternative source to fish oil

……and compared to fish oil, has been suggested that:

- Microalgae n-3 LC PUFA might be less hydrogenated in the rumen (Bessa et al. 2015)

- Microalgae n-3 LC PUFA might have higher deposition in neutral lipids (TAG) in muscle and adipose tissue (Cooper et al. 2004).

MATERIAL & METHODS - ANIMALS

- 36 ram lambs
  - Merino Branco Breed; ≈ 60 days of age;
  - Weaned and transported to INIAV Santarém facilities
  - Randomly allocated to 9 pens.
  - Dewormed (Ivomec®, Merial)
  - Vaccinated against enterotoxaemia (Miloxan®, Merial)

- Duration of the experiment
  - 1 week of adaptation
  - 6 weeks on feed until slaughter.

MATERIAL & METHODS - DIETS

- Treatments (Diets)
  - All diets were contained:
    - 70 % DM of dehydrated alfalfa
    - ≈ 11 % DM of wheat
    - ≈ 11 % DM of Soybean meal
    - ≈ 6 % DM of a **lipid source**
  - 3 Experimental diets (S, FS, TS)
    - **S** (sunflower) - 6% DM of Sunflower oil
    - **FS** (fish oil + sunflower) - 2% DM of fish oil + 4% DM of Sunflower oil
    - **TS** (TREVERA® + sunflower) - 3.53 % DM of fish oil + 4% DM of Sunflower oil

LIPID SOURCES

- **Sunflower oil**: very rich in linoleic acid (18:2n-6)
- **Fish oil**: Sardine oil containing both EPA(20:5n-3), DPA (22:5n-3) and DHA (22:6n-3)
- **TREVERA™, Novus International**: DHA rich lipid extract (*powder)* from *Schizochytrium sp, rich in DHA (>15% DM)*

TREVERA™ NOVUS®

COMPOSITION OF DIETS

	S	FS	TS
Dry matter (g/kg)	898	902	898
Crude protein (g/kg DM)	174	170	164
Crude fiber (g/kg DM)	214	199	208
Starch (g/kg DM)	104	142	120
Ether extract (g/kg DM)	81	79	81
n-3 LC-PUFA (% FA)			
20:5 n-3	-	1.04	0.40
22:5 n-3	-	0.33	3.46
22:6 n-3	-	0.42	7.27

MATERIAL & METHODS

- Growth and feed intake
  - Animals weighted weekly
  - Feed intake/pen monitored daily

- Post-mortem measurements
  - Carcass traits
  - Meat quality (colour, shear force)
  - Meat lipids fatty acid (FA) composition

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  - Meat quality (pH, colour, shear force)
  - Meat lipids fatty acid (FA) composition

- Statistical analysis
  - Pen as experimental unit
  - Lambs as subsampling within the pen

MATERIAL & METHODS – LIPID ANALYSIS

Muscle samples

Lipid extraction

DCM:methanol (2:1, v/v)

Lipid fractionation (SPE):

Neutral lipids

Polar lipids

Preparation of Fatty acid methyl esters

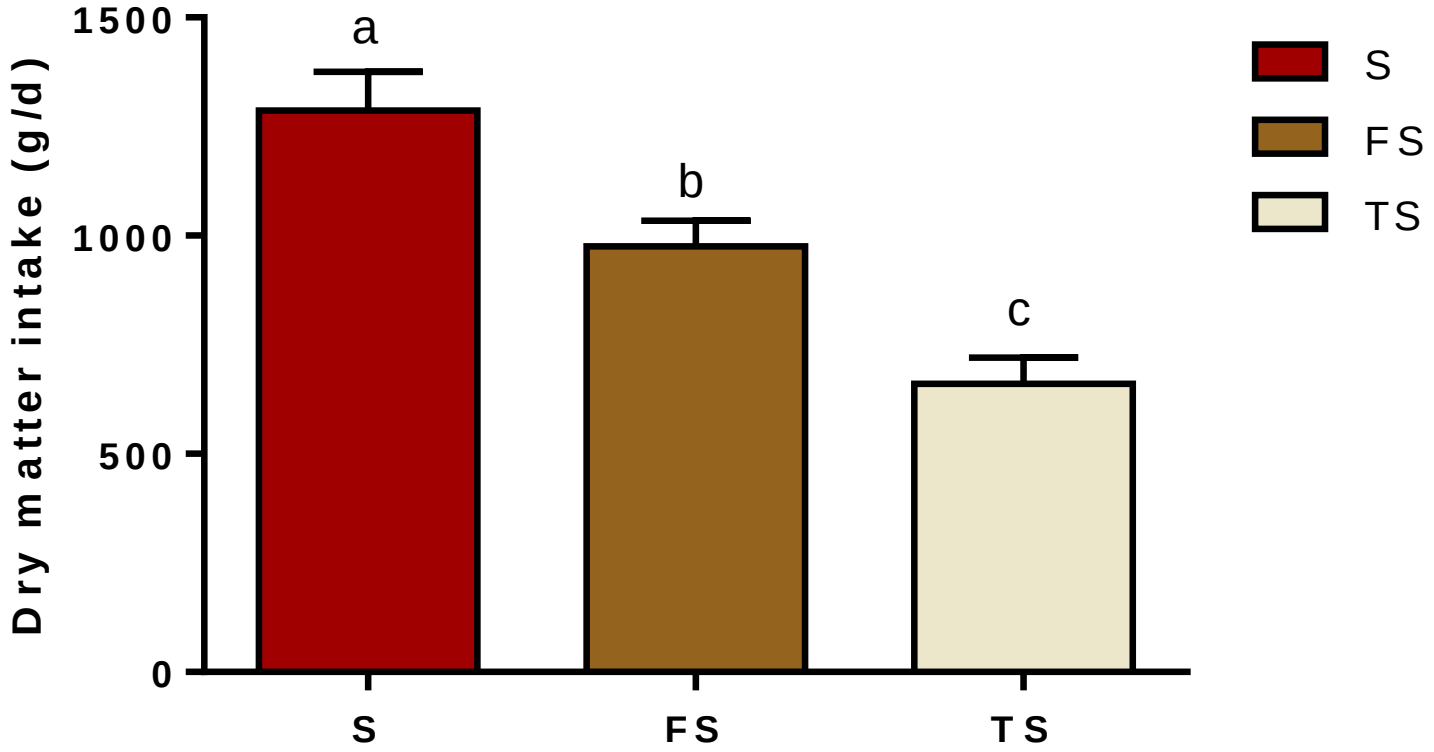
(NaOMe in methanol and HCL in methanol)

Analysis by GC-FID:

SP-2560 (100-m) GC column

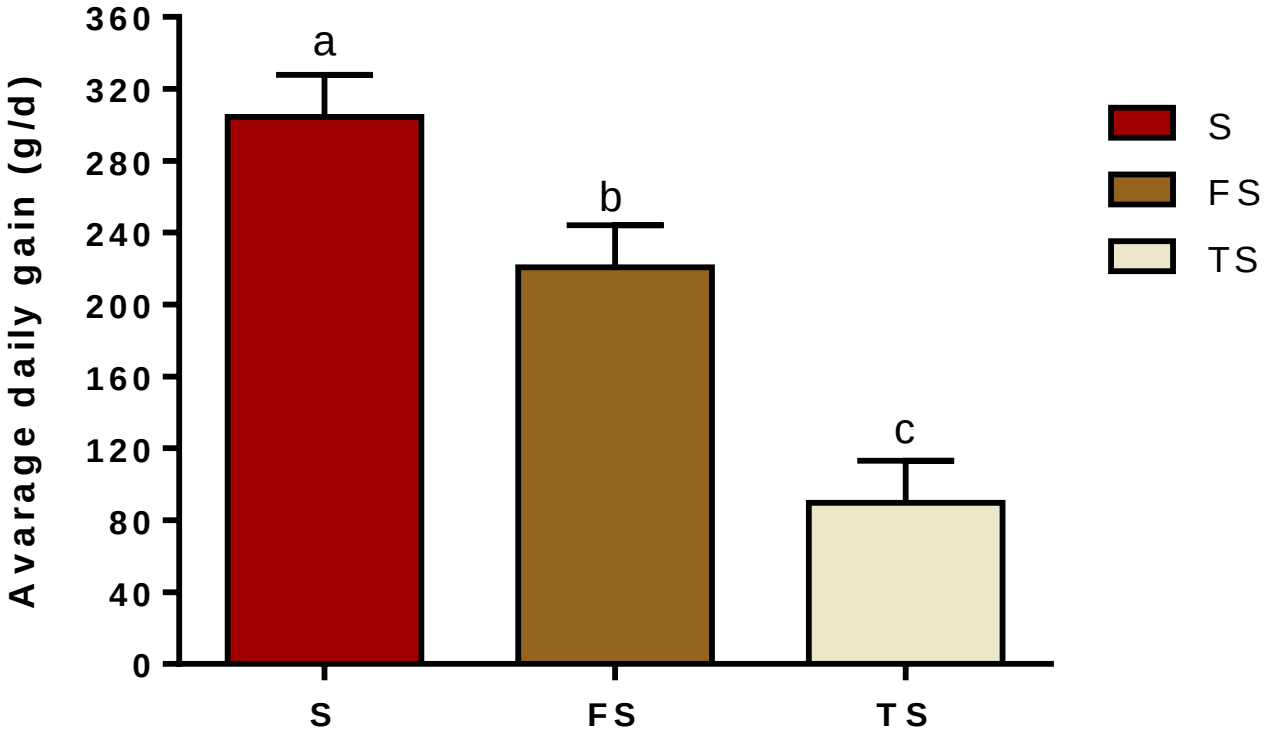
RESULTS – PRODUCTIVE PERFORMANCE

Dry matter intake (g/d)



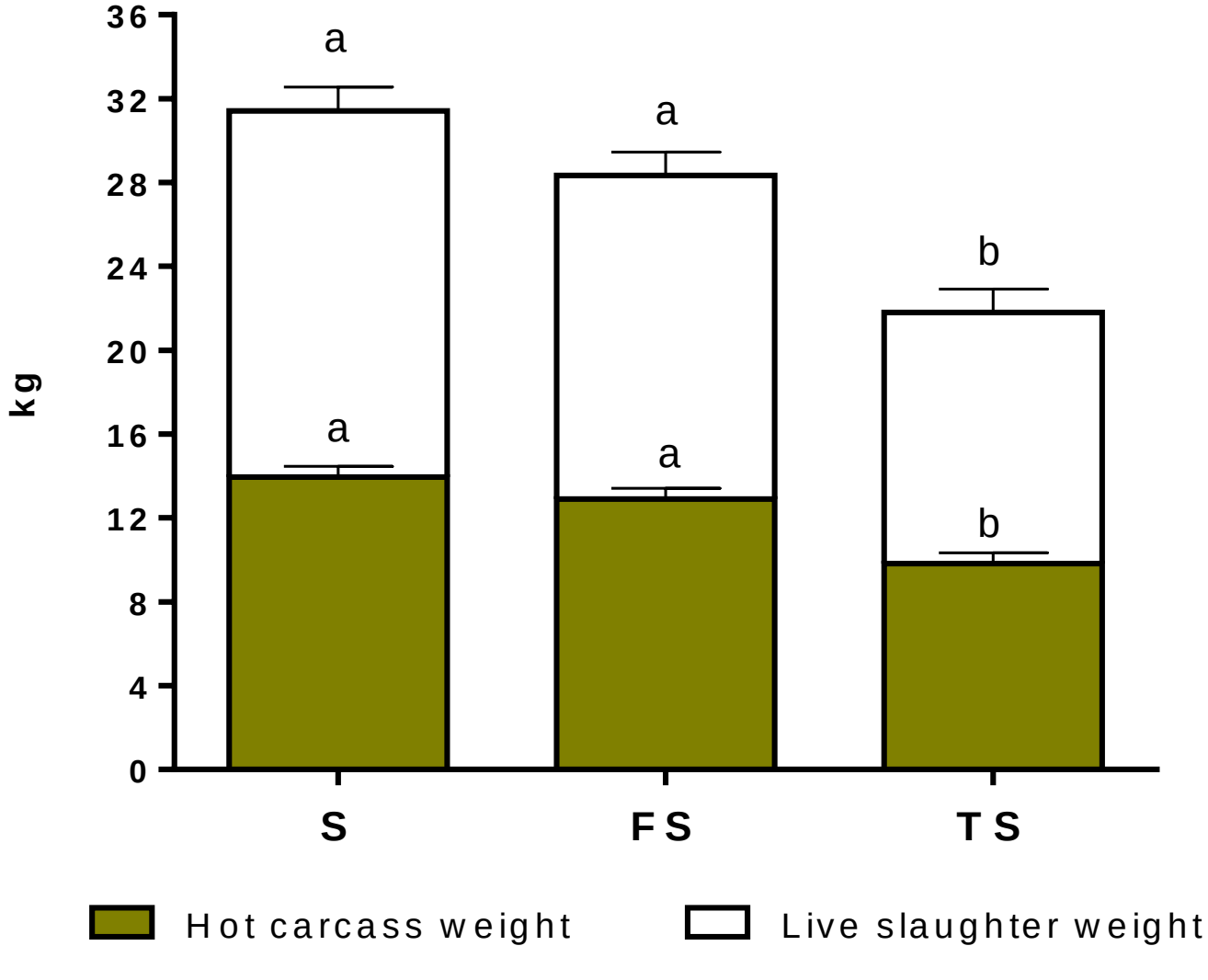
RESULTS – PRODUCTIVE PERFORMANCE

Average daily gain (g/d)



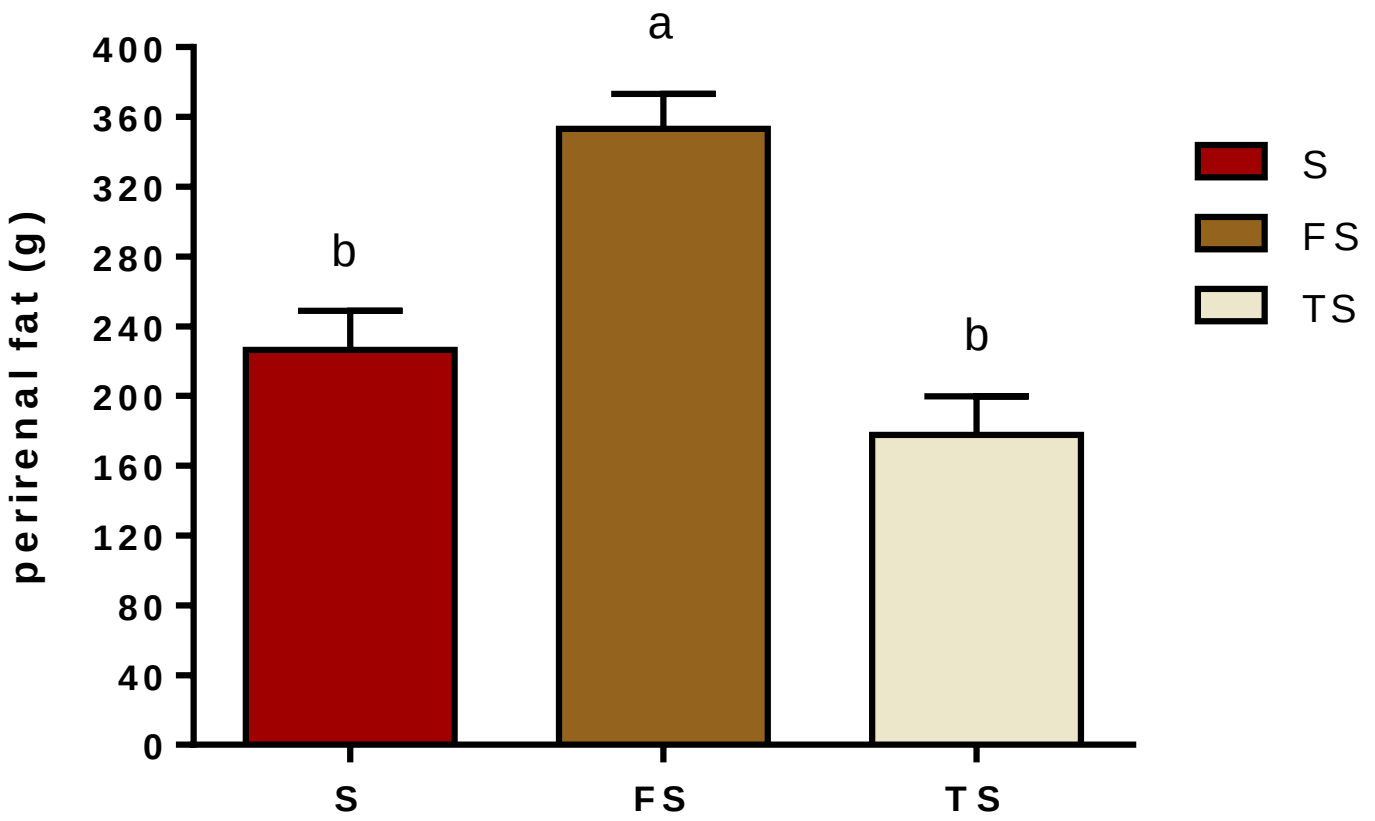
RESULTS – PRODUCTIVE PERFORMANCE

Slaughter weight and hot carcass weight (kg)



RESULTS – PRODUCTIVE PERFORMANCE

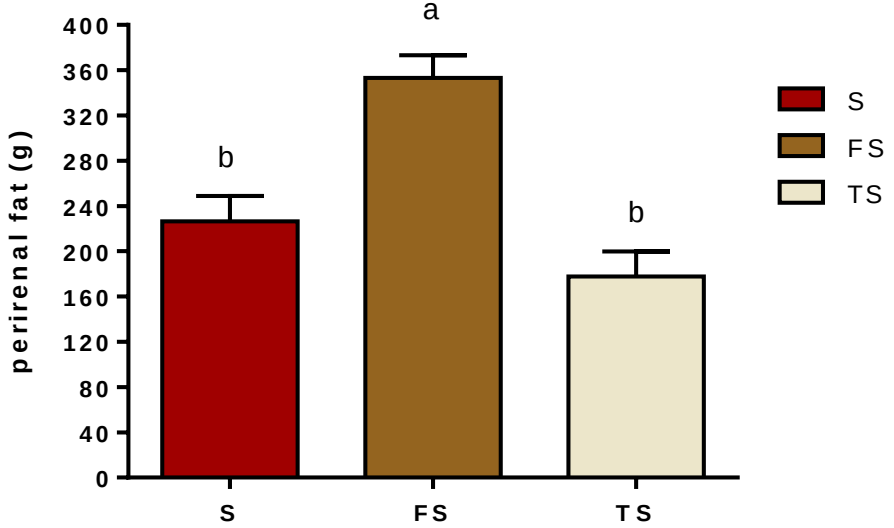
Perirenal fat (g)



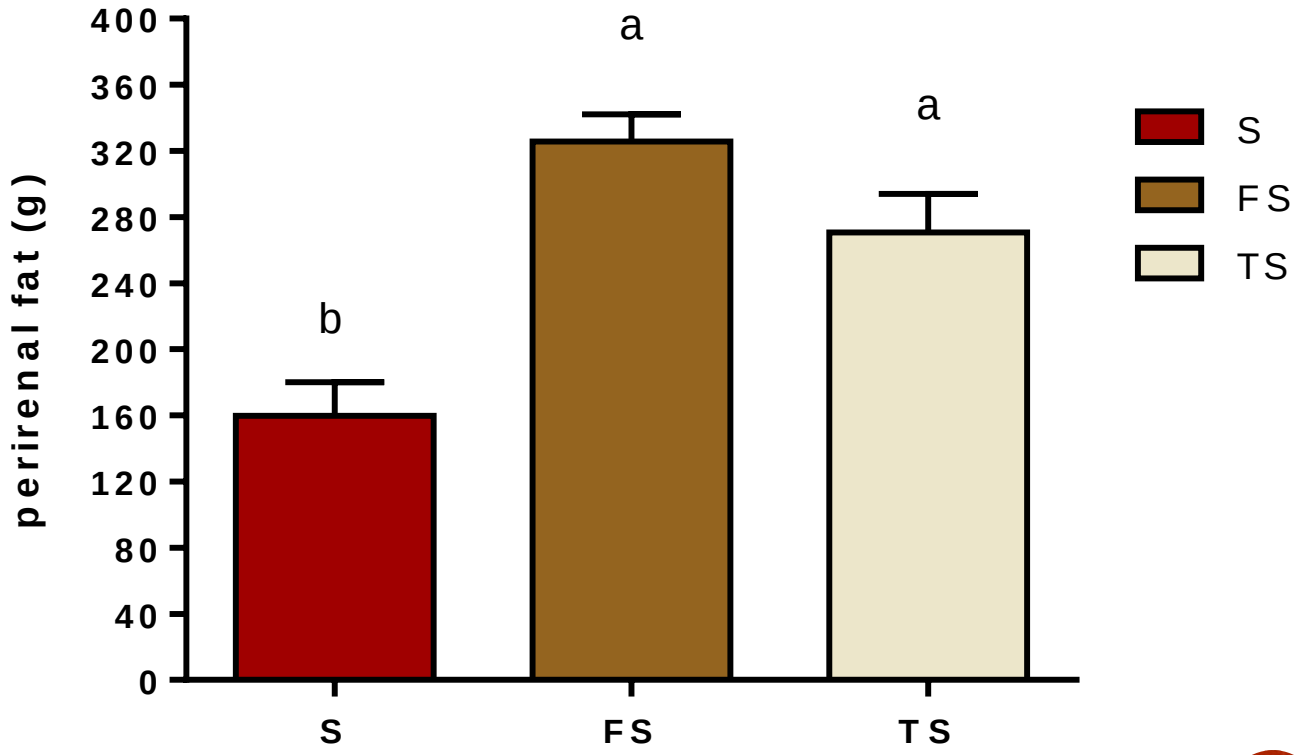
RESULTS – PRODUCTIVE PERFORMANCE

Perirenal fat (g)

unadjusted

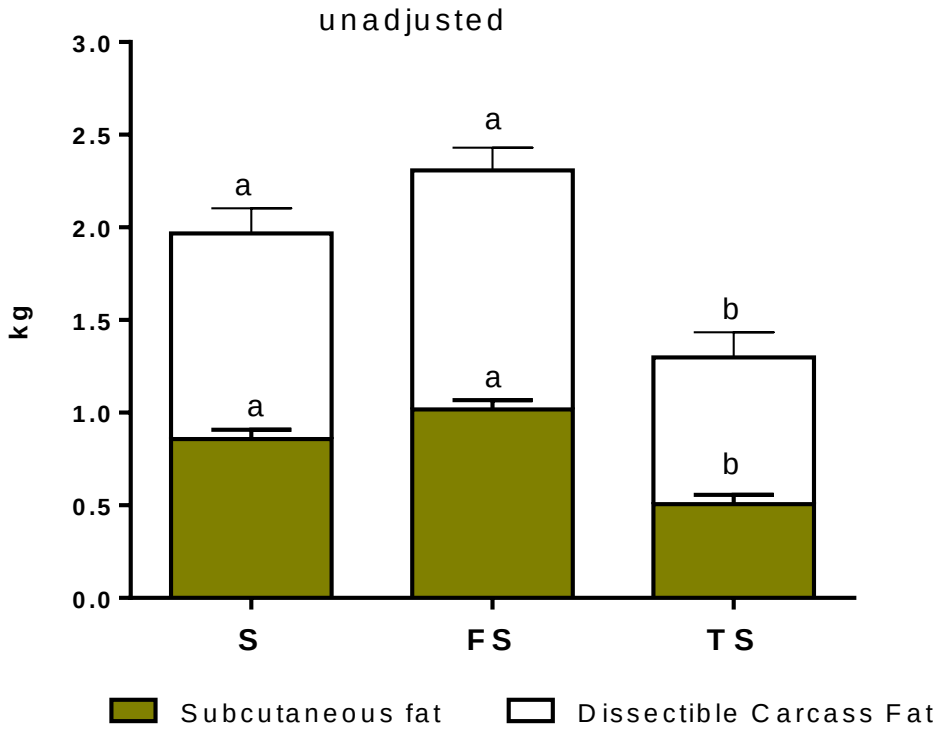


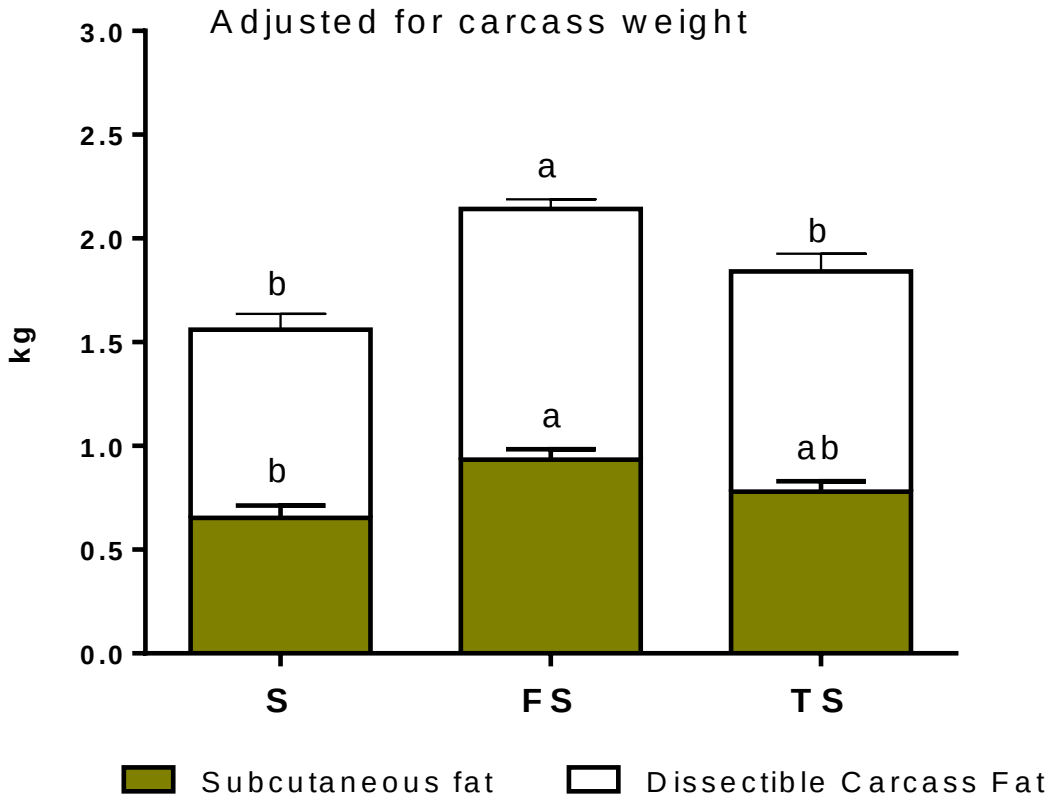
Adjusted for carcass weight



RESULTS – PRODUCTIVE PERFORMANCE

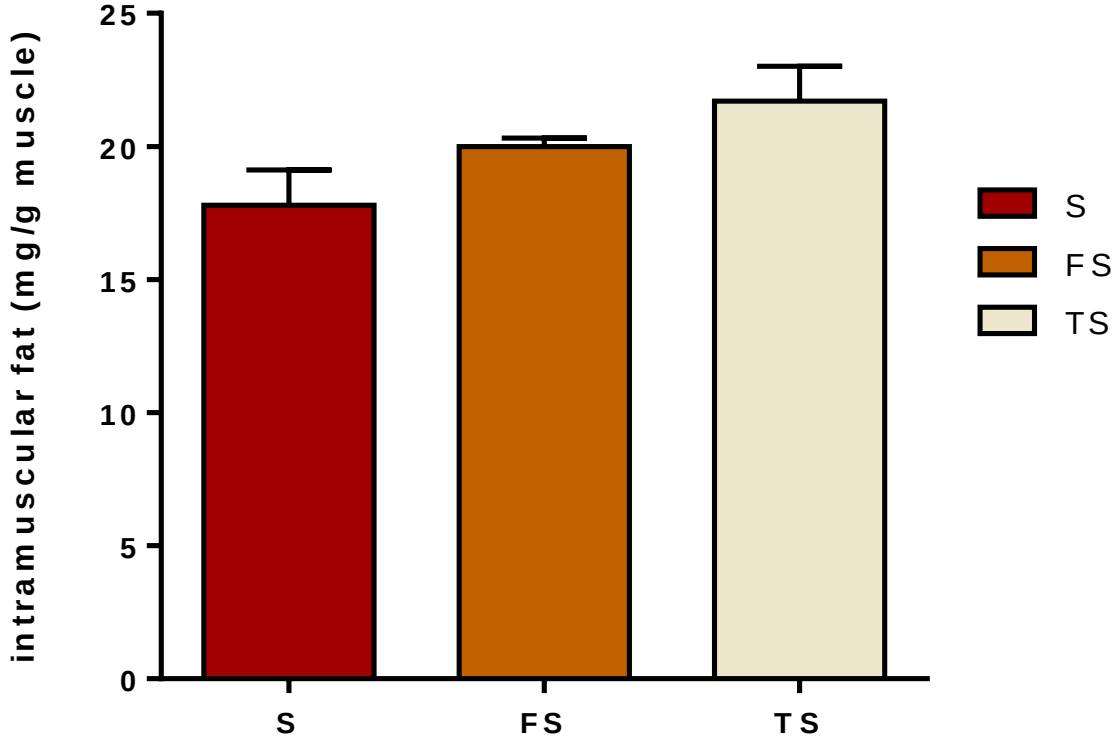
Subcutaneous fat and dissectable carcass fat (kg)





RESULTS – MEAT QUALITY

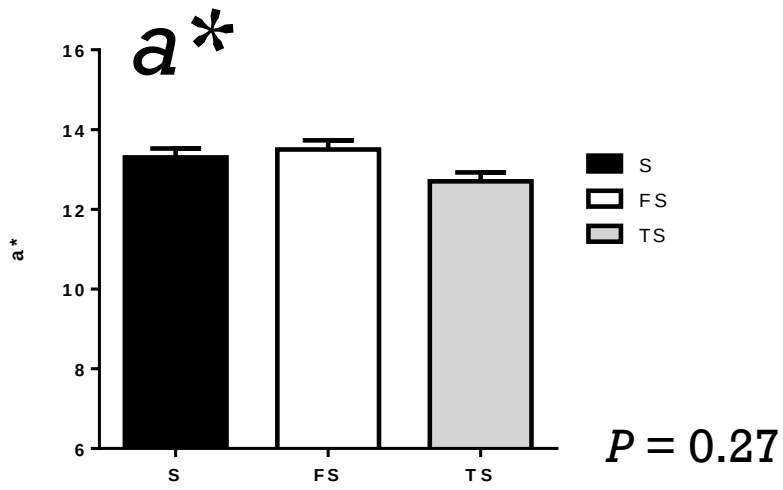
Intramuscular fat (mg/g muscle)



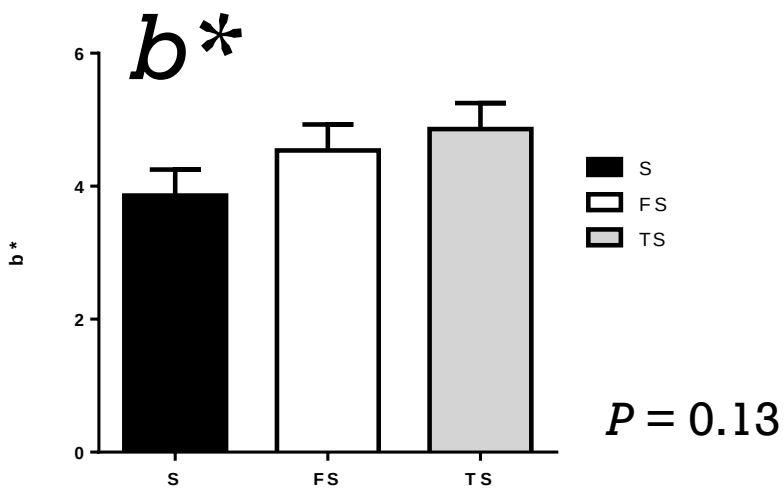
$P = 0.22$

RESULTS – MEAT QUALITY

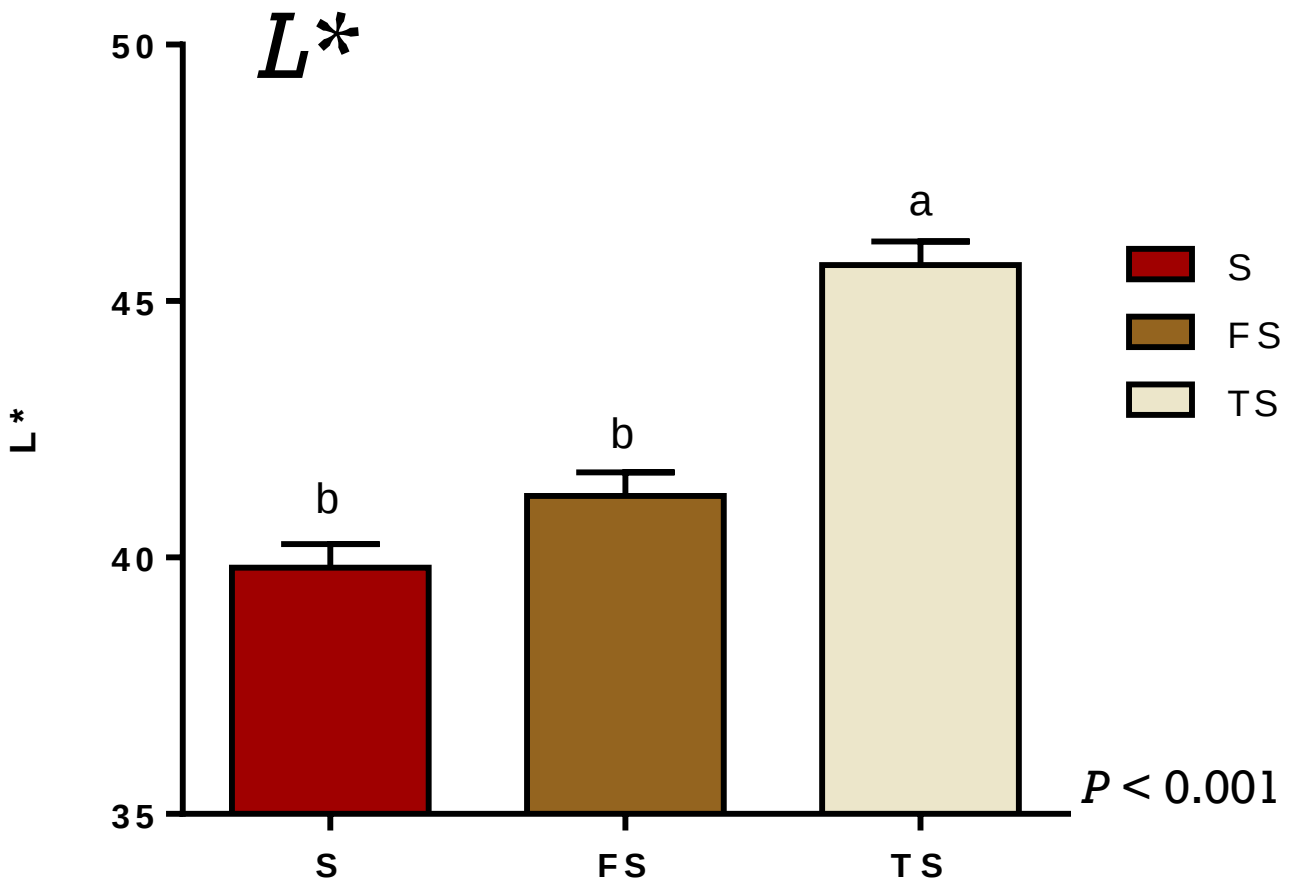
LD muscle color (L*, a*, b*)



$P = 0.27$



$P = 0.13$

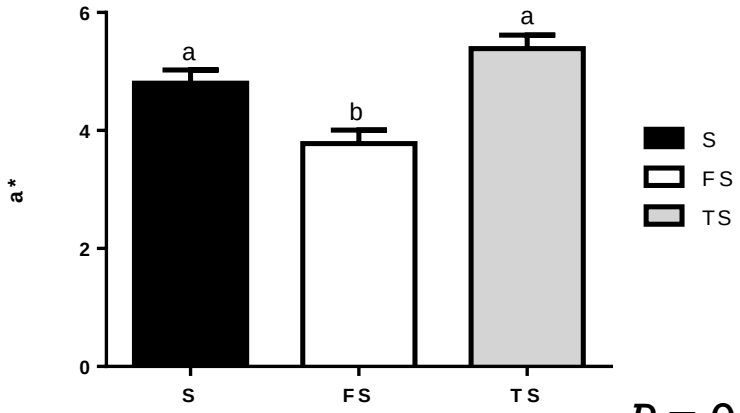


$P < 0.001$

RESULTS – MEAT QUALITY

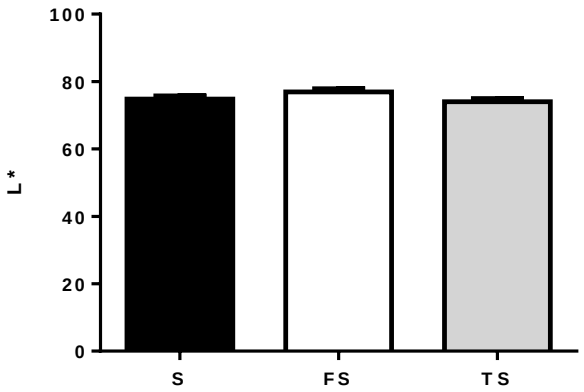
Subcutaneous fat color (L*, a*, b*)

*a**



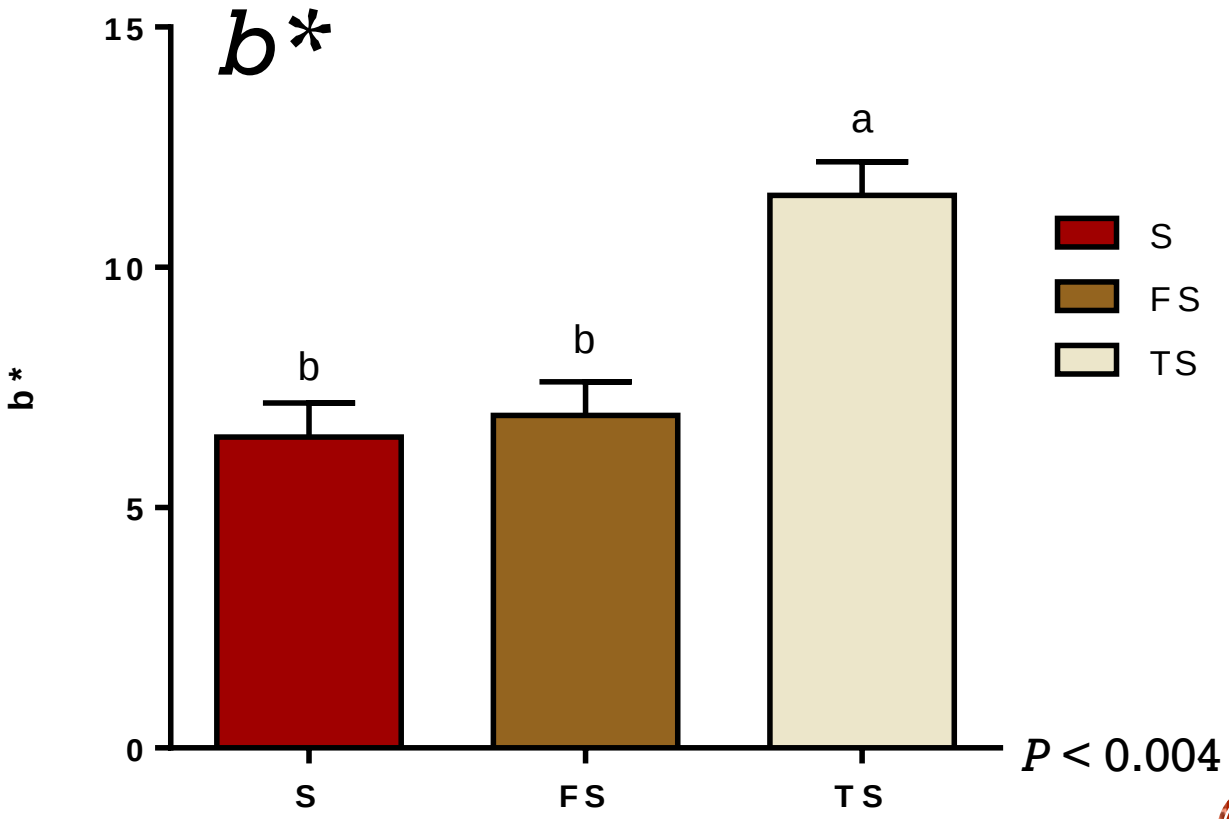
$P = 0.017$

*L**



$P = 0.17$

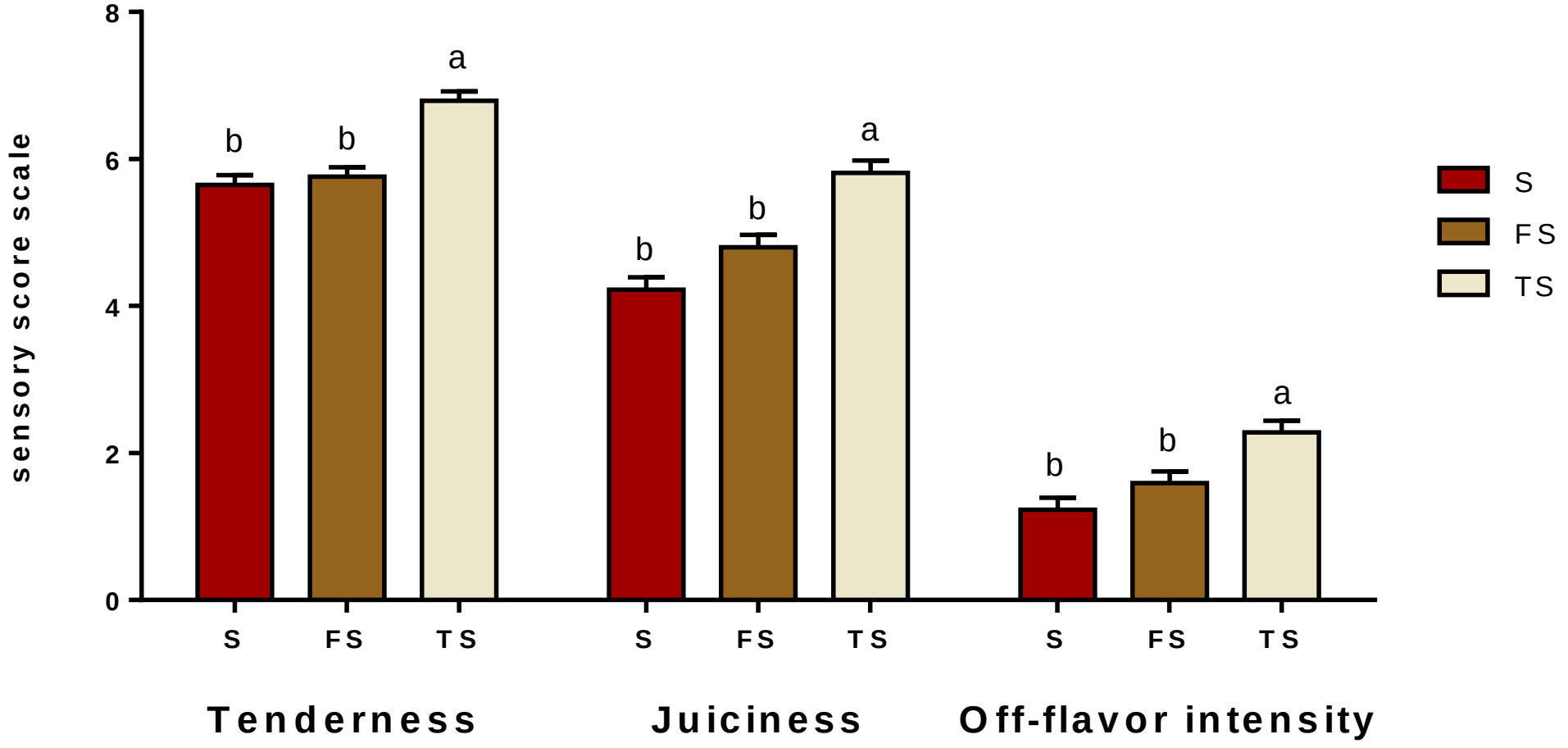
*b**



$P < 0.004$

RESULTS – MEAT SENSORY EVALUATION

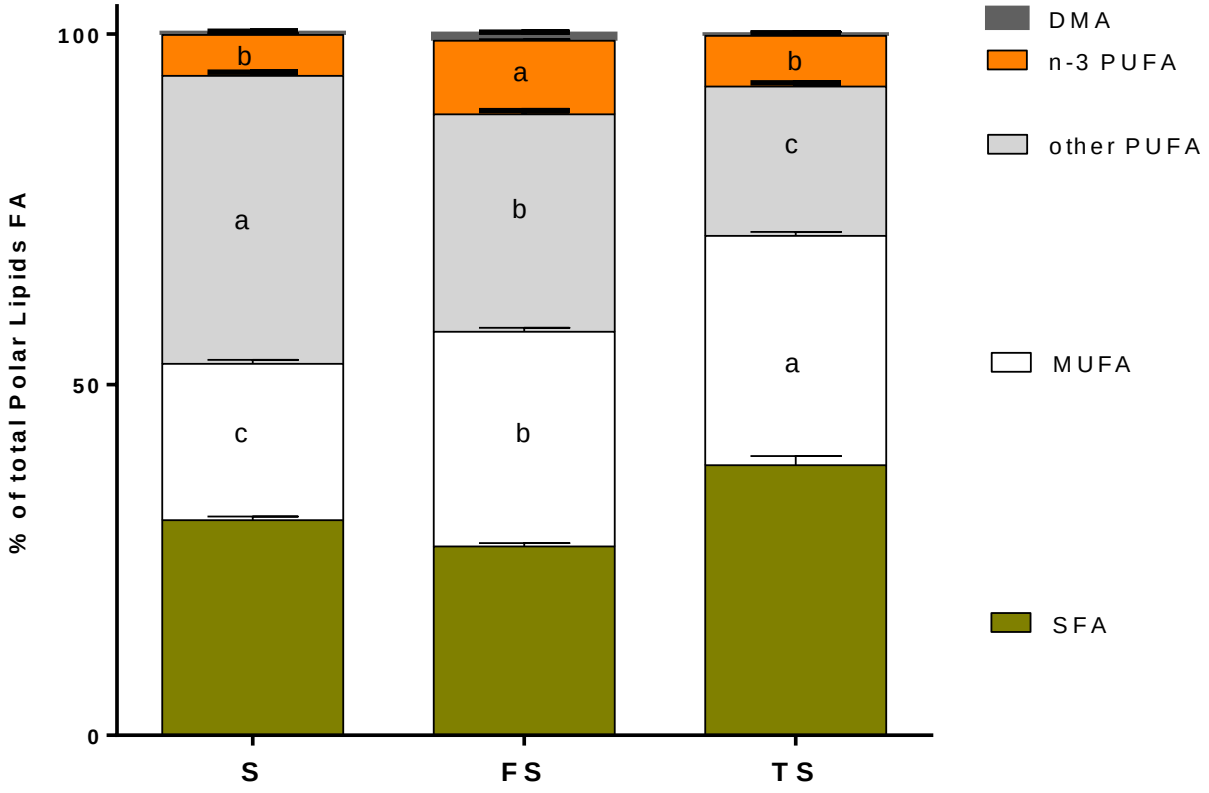
Tenderness, juiceness and off-flavor (8 point sensory scale)



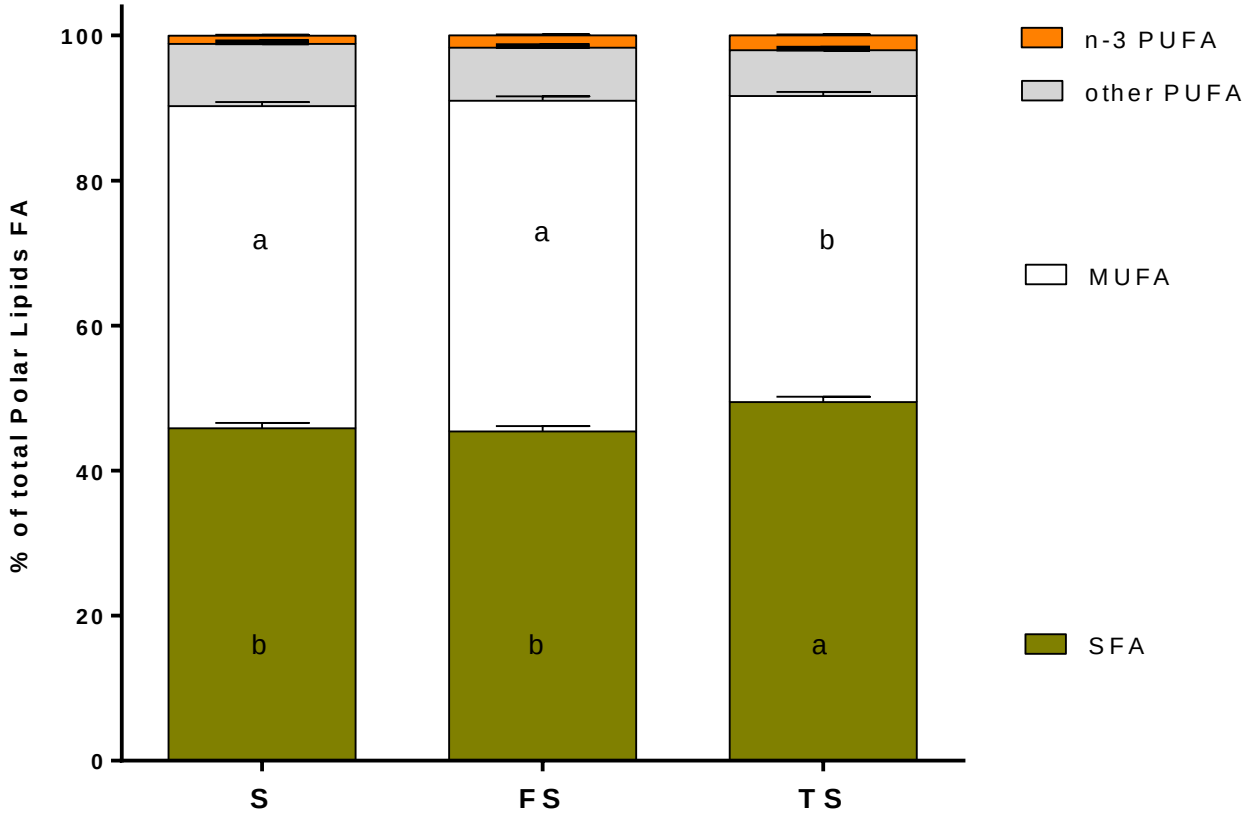
RESULTS – MEAT LIPIDS

Polar & Neutral lipids fatty acid profile (% FA)

Polar lipids



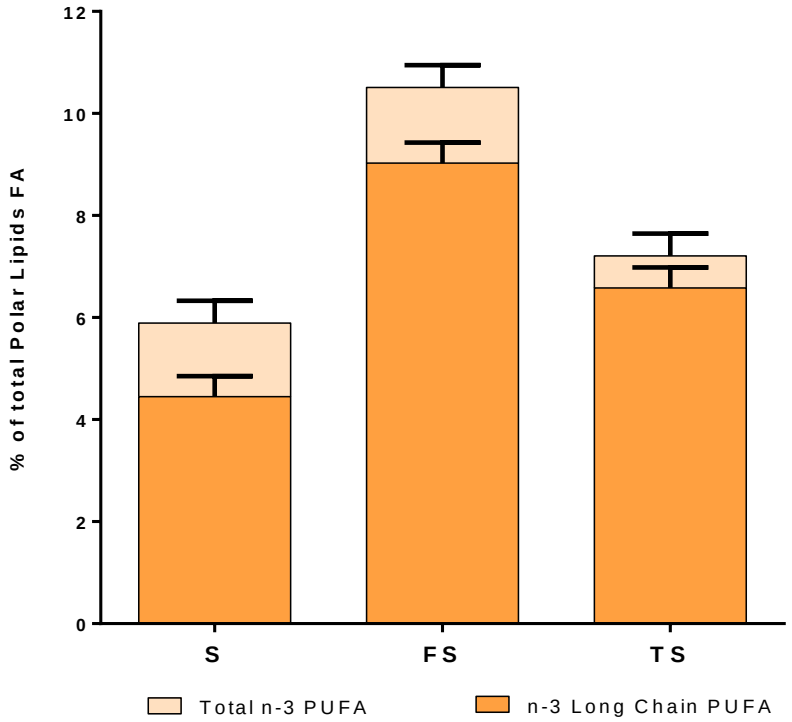
Neutral lipids



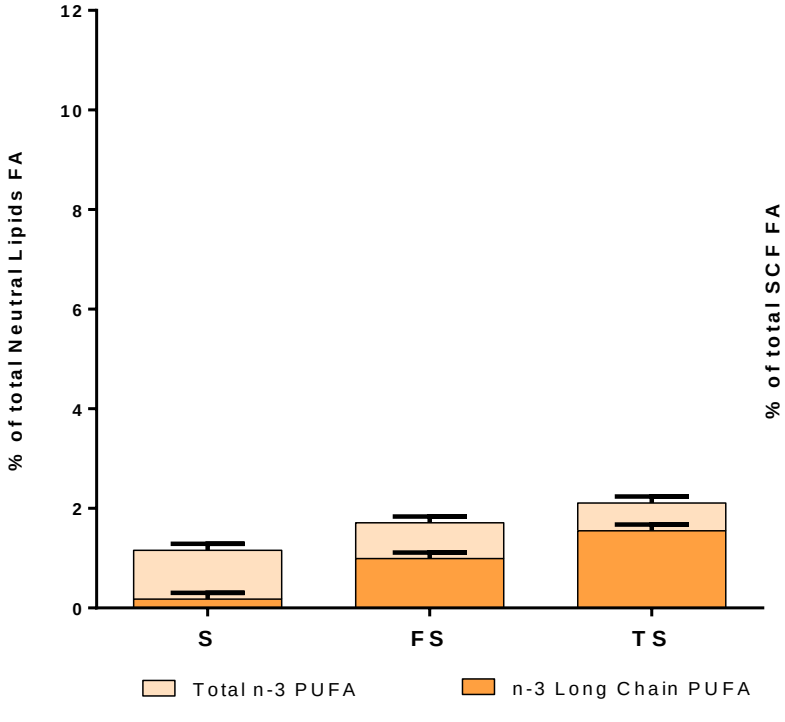
RESULTS – MEAT LIPIDS

N-3 PUFA: Muscle (PL and NL) and subcutaneous fat (SCF)

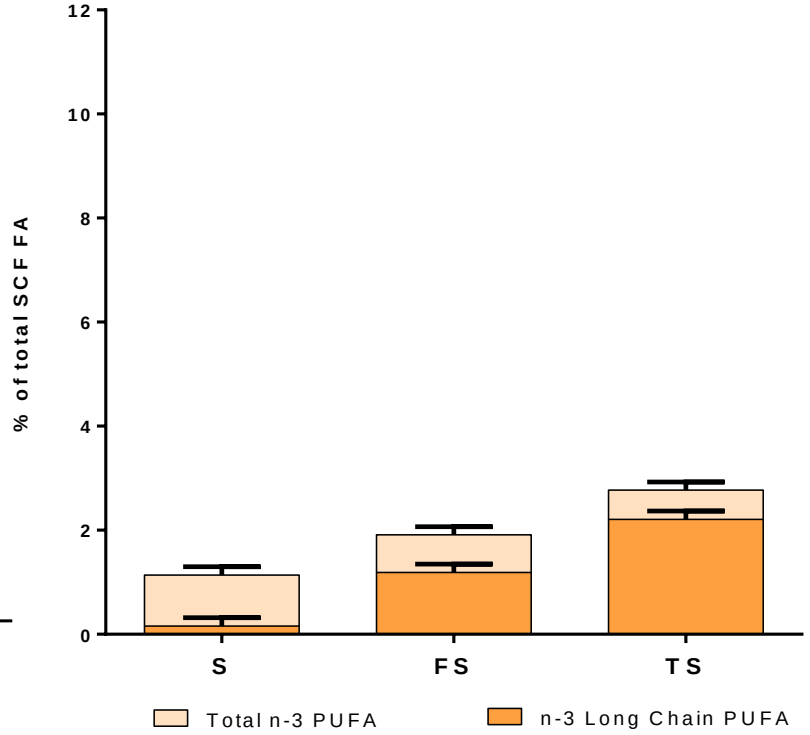
Muscle PL



Muscle NL

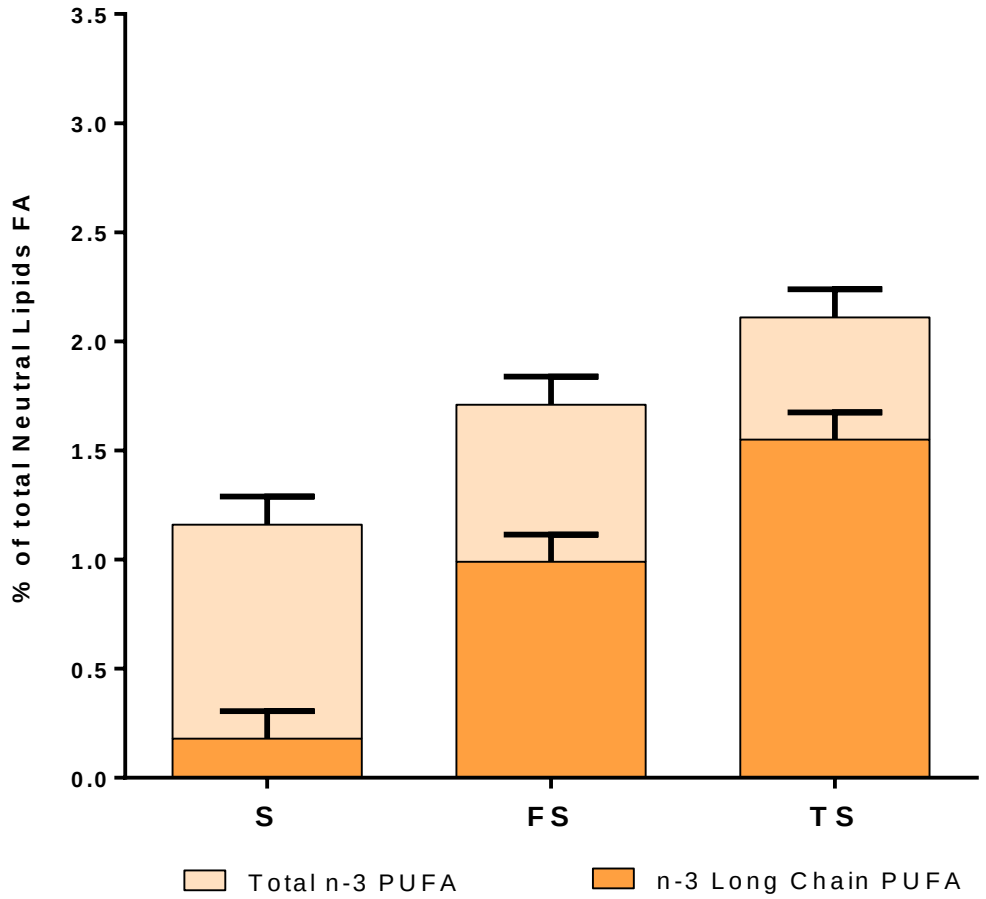


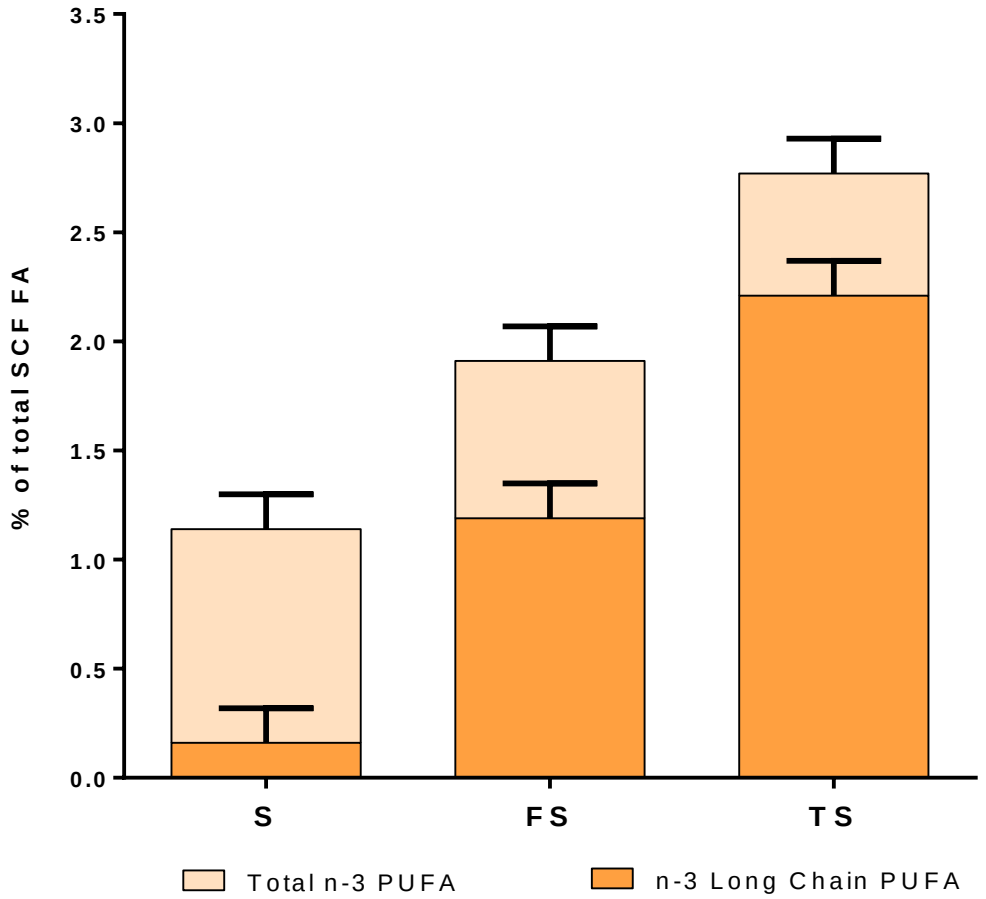
SCF



RESULTS – MEAT LIPIDS

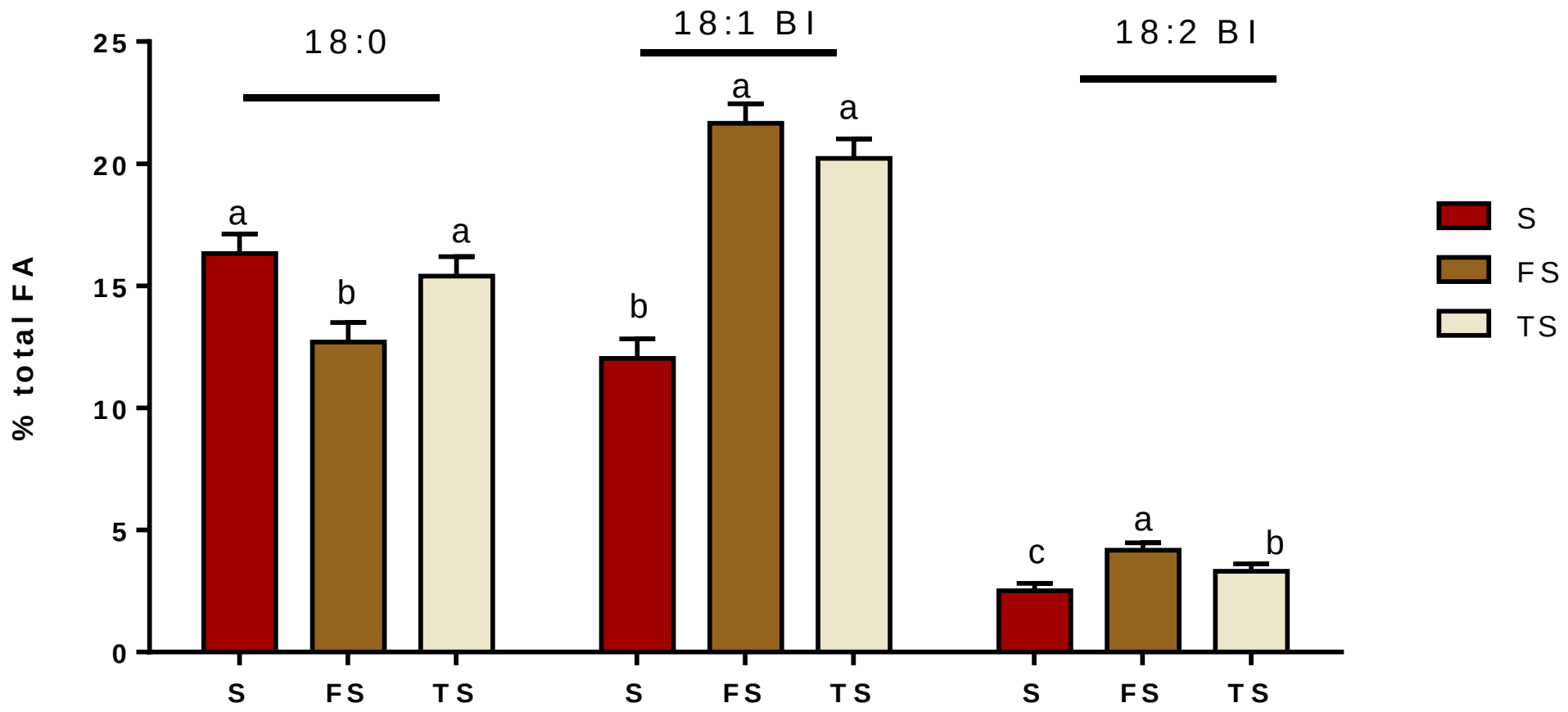
N-3 PUFA Neutral muscle lipids vs. SCF





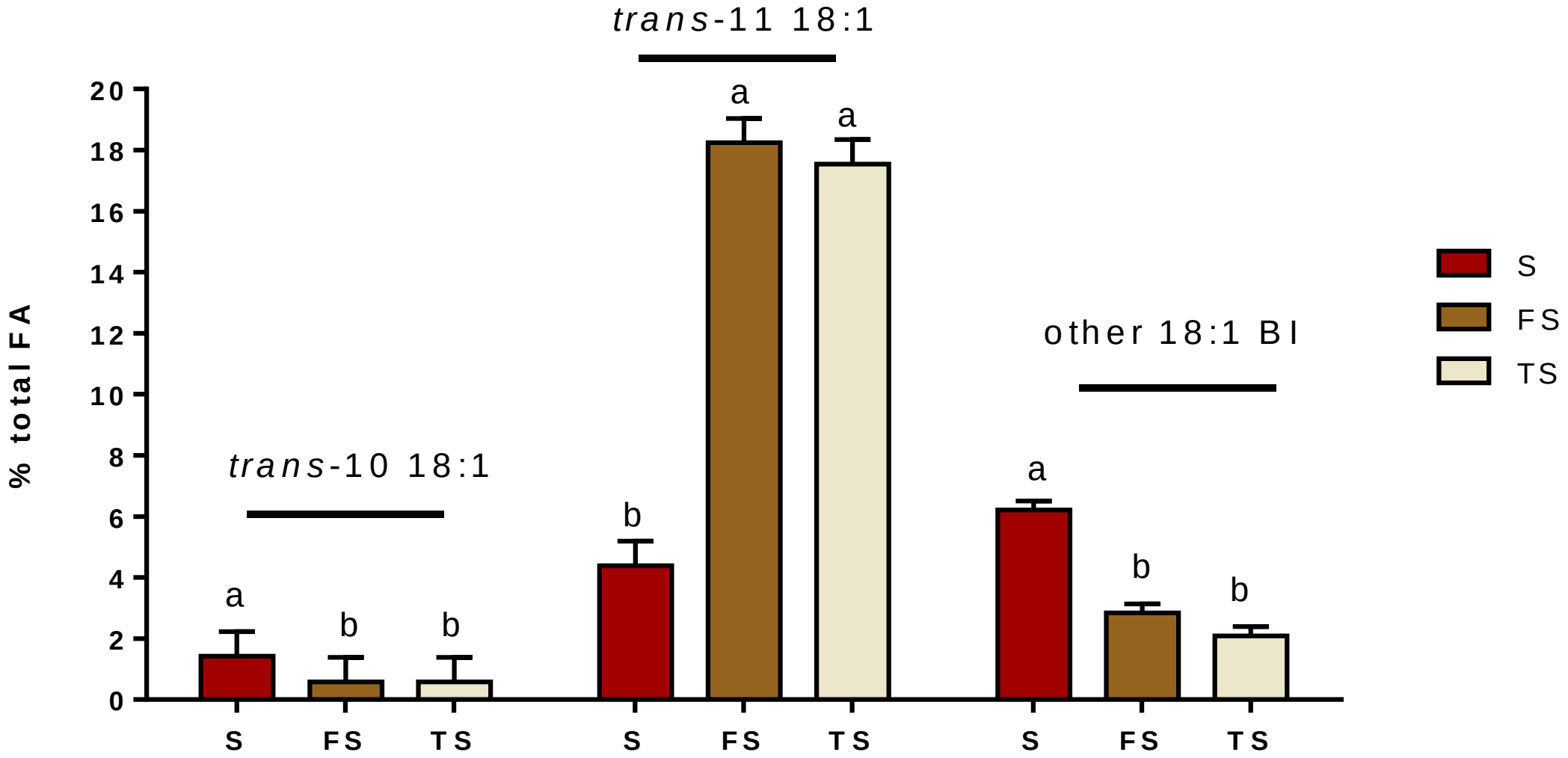
RESULTS – MEAT LIPIDS

Subcutaneous fat:
18:0 and Biohydrogenation Intermediates (BI)



RESULTS – MEAT LIPIDS

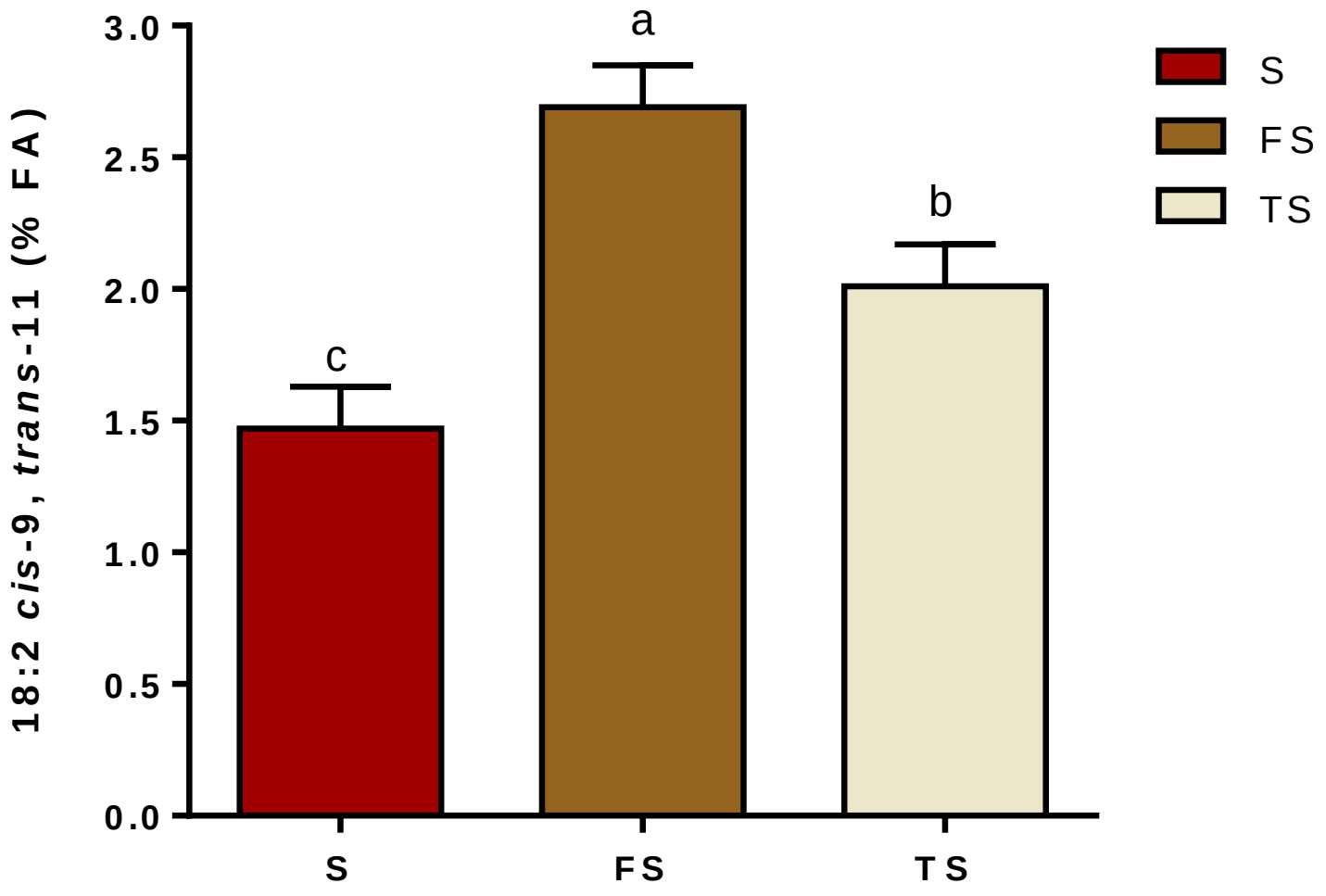
Subcutaneous fat: BI 18:1 isomers



RESULTS – MEAT LIPIDS

Subcutaneous fat:

CLA (18:2 cis-9, trans-11)



CONCLUSIONS

Compared to fish oil Schizochytrium lipid extract was:

- *similar effects in promoting the accumulation 18:1 trans-11.*

  - Disruption of the last reductive step of rumen biohydrogenation

- *But less effective in increasing CLA ?!*

CONCLUSIONS

Compared to fish oil Schizochytrium lipid extract was:

- *less effective in increasing n-3 LC PUFA in meat phospholipids*

  - eventual oxidative damage of membrane PUFA

- *more effective in increasing n-3 LC PUFA in meat neutral lipids and adipose tissue. ?!!!*

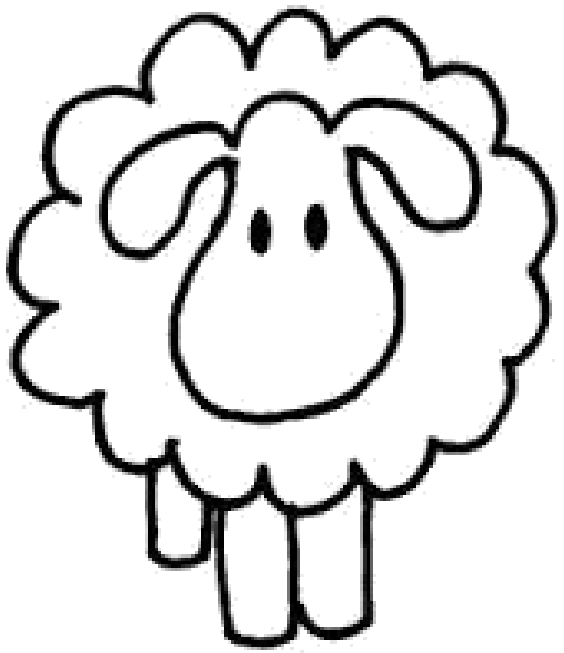
  - potential to deposit more n-3 LC PUFA outside of the membrane phospholipid pool

CONCLUSIONS

However, Schizochytrium lipid extract ***severely depress****:*

- *the feed intake*

- *growth of lambs*



Thank you for your attention