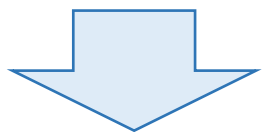


Is tributyrin a good replacement for sodium butyrate to stimulate epithelial growth in ruminants?



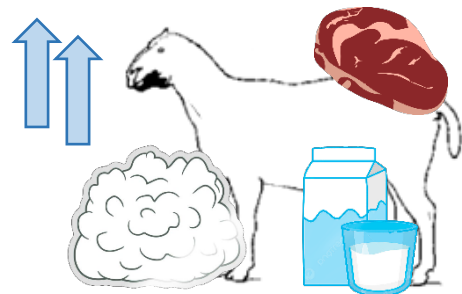
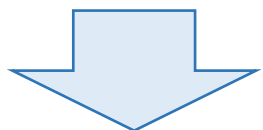
S. Świerk¹, M. Przybyło¹, K. Szczepanik², P. Górka¹

¹Department of Animal Nutrition and Fisheries, University of Agriculture in Krakow, al. Mickiewicza 24/28, 30-059 Krakow, Poland; ²Department of Animal Nutrition and Feed Science, National Research Institute of Animal Production, ul. Krakowska 1, 32-083 Balice, Poland



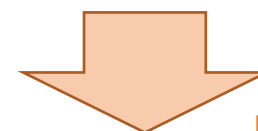
SCFA = short-chain fatty acid, DM = dry matter

<https://www.agriland.ie/farming-news/what-should-i-be-looking-out-for-when-buying-concentrates-for-in-lamb-ewes/>



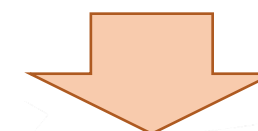
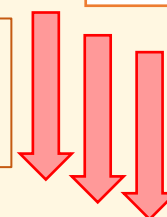
However...

> 30% of
diet DM



SCFA +++

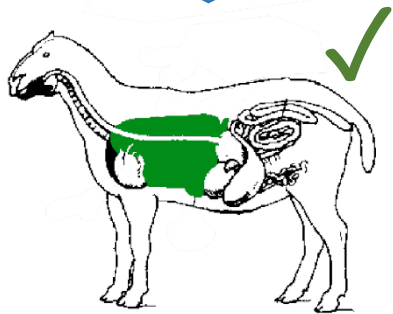
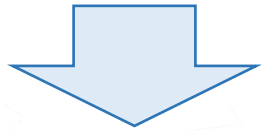
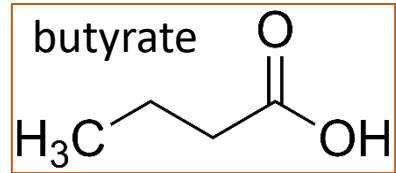
Ruminal
pH



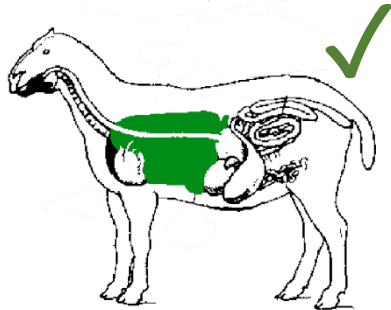
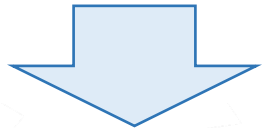
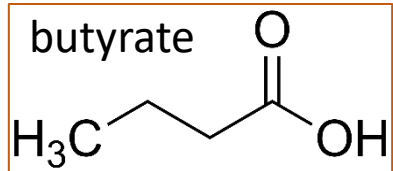
!!!



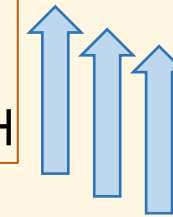
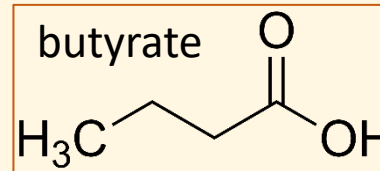
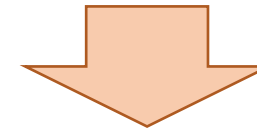
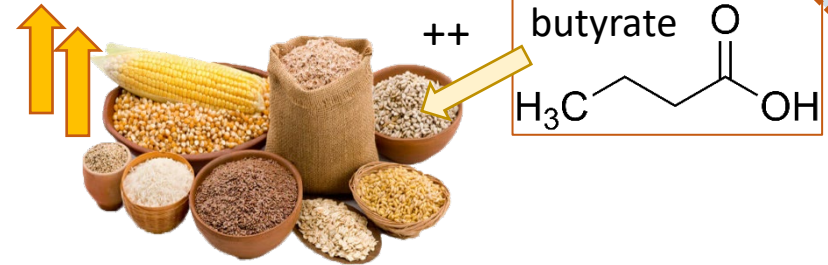
- Epithelium barrier impairment
- Fibre digestion reduction



- + Epithelium thickness and proliferation
- + SCFA absorption
- + Epithelium barrier function

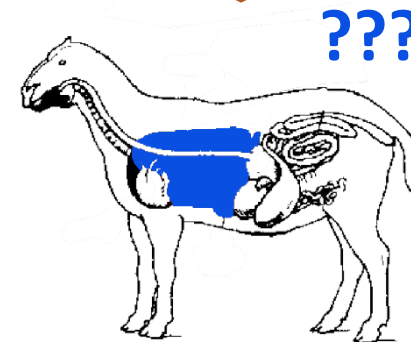
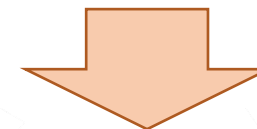
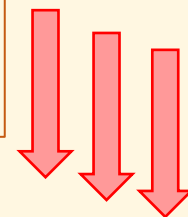


- + Epithelium thickness and proliferation
- + SCFA absorption
- + Epithelium barrier function



&

Ruminal pH



- Hyperkeratosis
- Hypoxic stress in epithelial cells
- Reduced fiber digestion

Sodium butyrate vs. tributyrin

Sodium butyrate	Tributyrin
• Most commonly used in ruminant nutrition and experimental models • Ease of administration • Highly soluble • Rapid increase of butyrate concentraion in the rumen • Sodium supply; impact on water intake and digesta passage	• Common use in monogastric nutrition • More difficult administration • Slower release in the rumen (lipase involvment necessary) • Glycerol provision





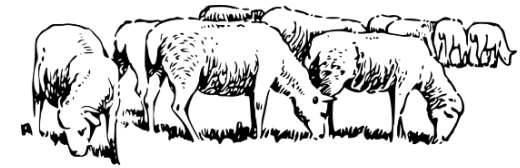
Hypothesis

1) The effect of butyrate supplementation in a high-concentrate diet depends on the source of butyrate used; and 2) Excessive ruminal butyrate may have a negative impact on the rumen epithelium.

Aim of the study

The aim of the study was to determine the effect of high-concentrate diet and sodium butyrate or tributyrin supplementation in a high-concentrate diet on reticuloruminal structure.

Materials and methods



Animals and feeding

- 32 rams (*Ovis aries*), 30.2 ± 5.4 kg, 10 to 13 months of age
- Allocated into 4 groups and fed a diet with low or high concentrate inclusion, with the latter one supplemented with sodium butyrate or tributyrin

Concentrate in a diet:

Low (22.5% DM)

High (60% DM)

Butyrate source:



L

None

Sodium butyrate (3.2% of diet DM)

Tributyrin (2.9% of diet DM)

H

H+SB

H+TB

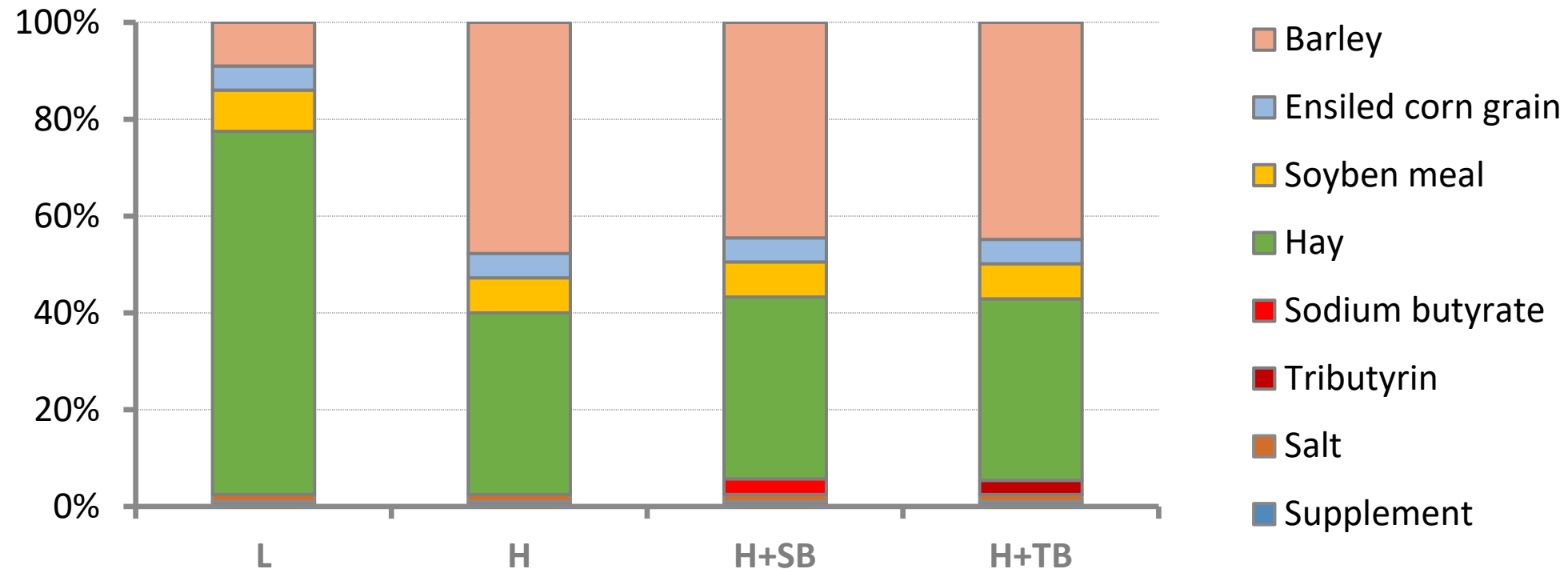


- Doses of sodium butyrate and tributyrin corresponded to 2.5% of butyrate in DM
- Feed was offered *ad libitum*

DM = dry matter

Materials and methods

Ingredient composition of diets



L = low inclusion of concentrate in the diet (22.5% of diet DM); **H** = high inclusion of concentrates in the diet (60% of diet DM)

H+SB = high inclusion of concentrate in the diet and sodium butyrate supplementation (3.2% of diet DM)

H+TB = high inclusion of concentrate in the diet and tributyrin supplementation (2.9% of diet DM)

DM = dry matter

Materials and methods

Composition	L	H	H+SB	H+TB
Dry matter (DM, %)	88.2	89.0	89.3	89.2
Crude protein (% DM)	12.3	12.2	11.9	11.9
Ash (% DM)	10.8	8.2	8.8	8.1
NDF (% DM)	46.3	33.0	32.3	32.4
ADF (% DM)	30.9	19.7	19.4	19.4
Fat (% DM)	2.4	2.2	2.2	2.2
Starch (% DM)	9.5	30.9	29.1	29.3
Na (% DM)	0.64	0.63	1.33	0.63

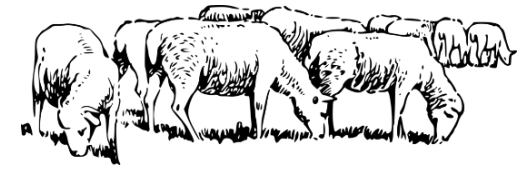
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Materials and methods

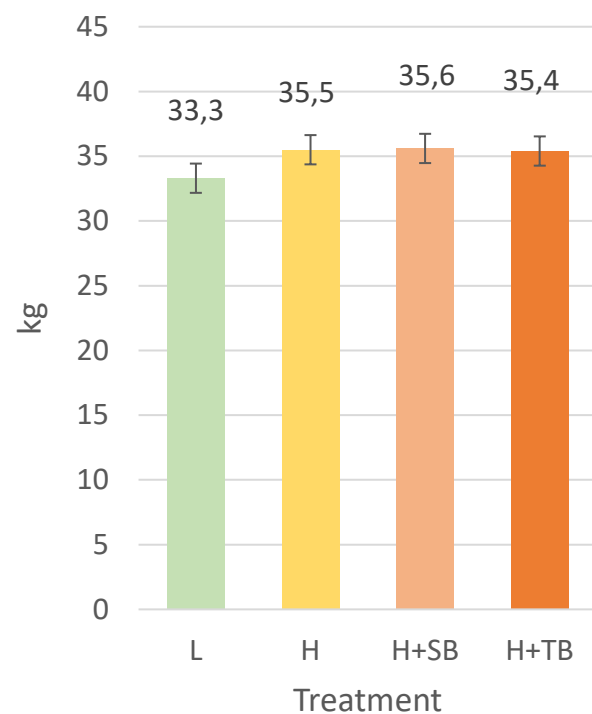


Sampling and statistical analysis

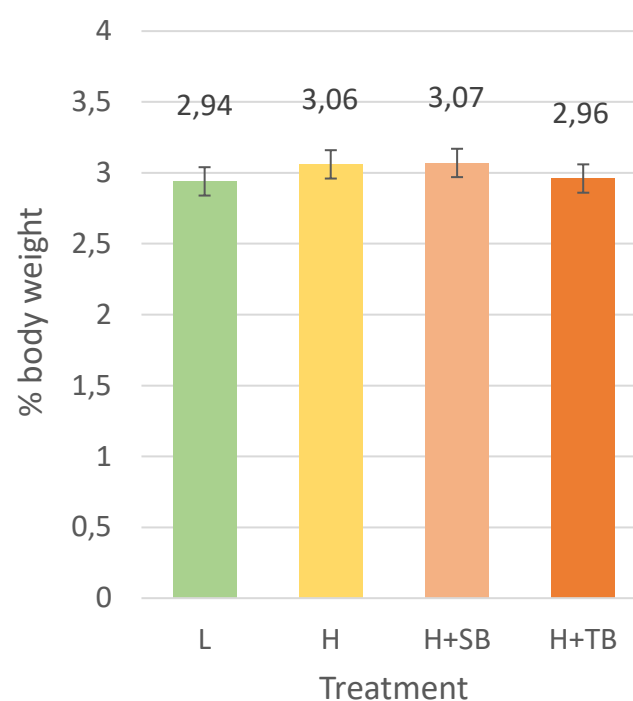
- Body weight was monitored weekly and feed and water intake daily
- After 21 days and 3 h after feeding animals were slaughtered
- Reticuloruminal digesta was sampled for pH and short-chain fatty (SCFA) acid analysis
- Tissue samples were collected for:
 - Epithelium dry matter mass
 - Histology and histometry
 - Selected gene expression (SCFA transporters)
- Results were analyzed using PROC MIXED in SAS (ver. 9.4) and pre-planned contrasts (L vs. H, H vs. H+SB and H vs. H+TB)

Results

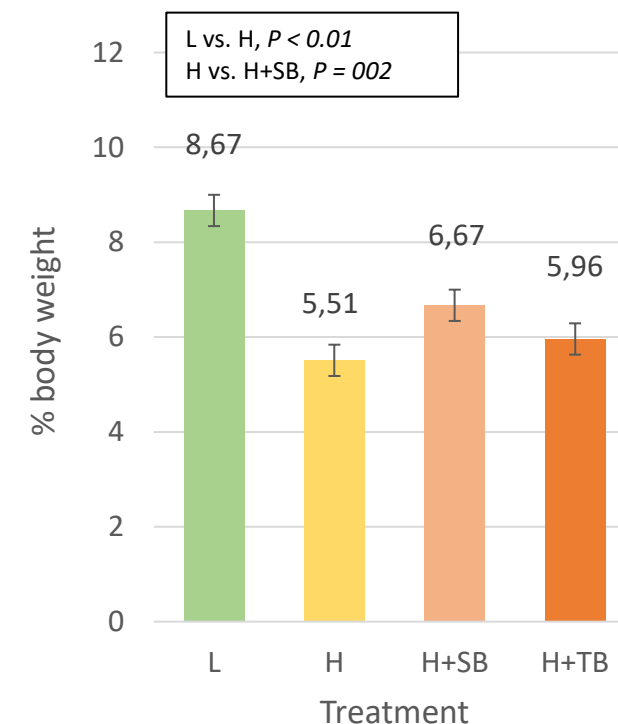
Final body weight



Dry matter intake



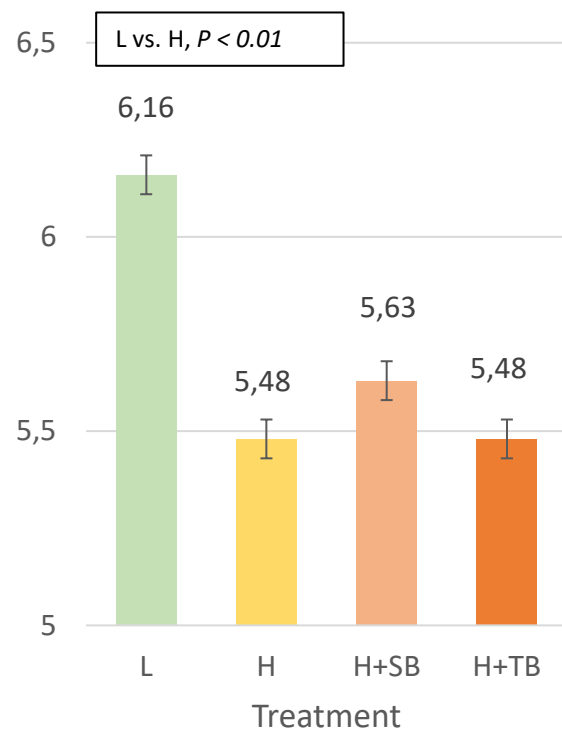
Water intake



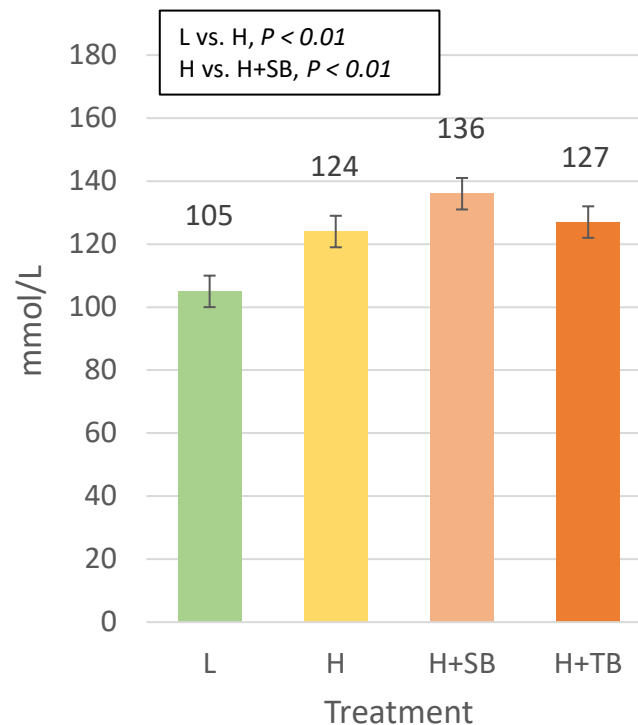
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Results

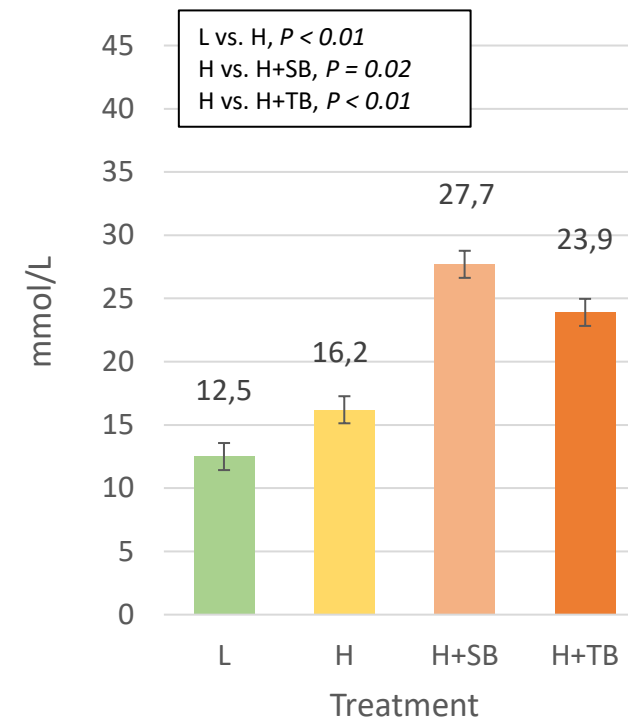
Reticuloruminal pH



Total SCFA



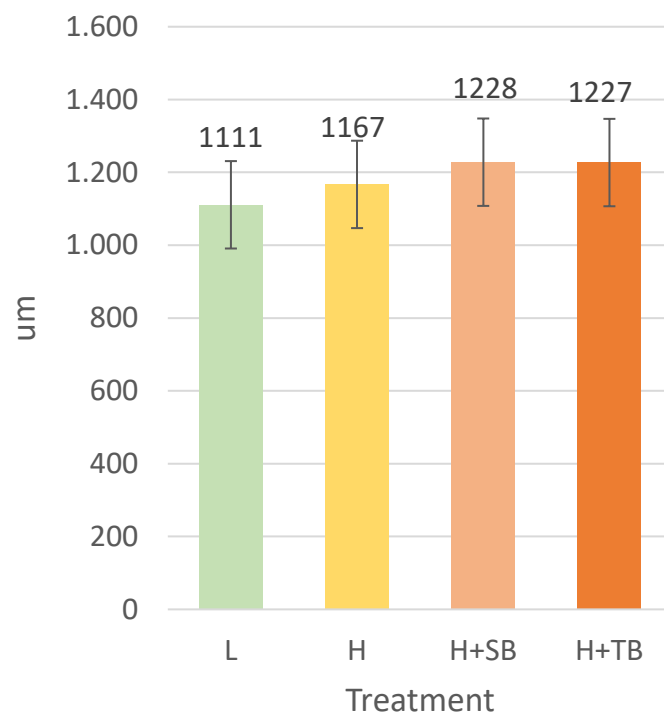
Butyrate



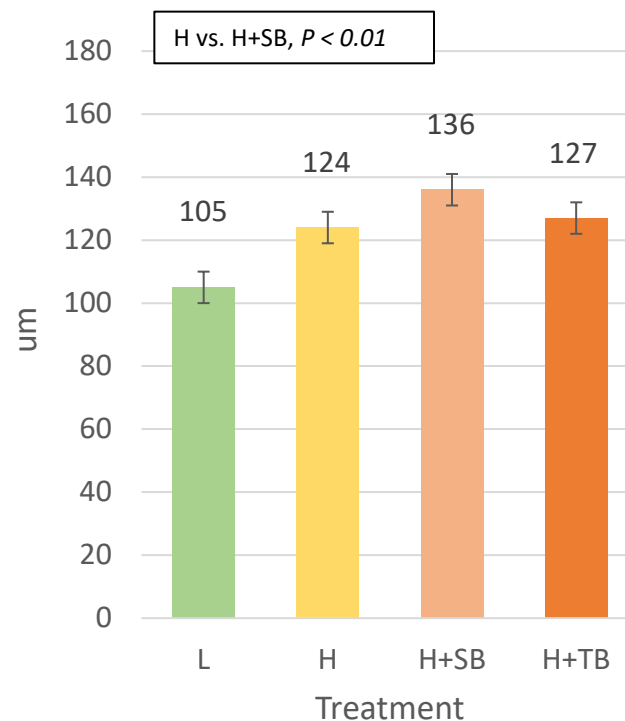
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Results

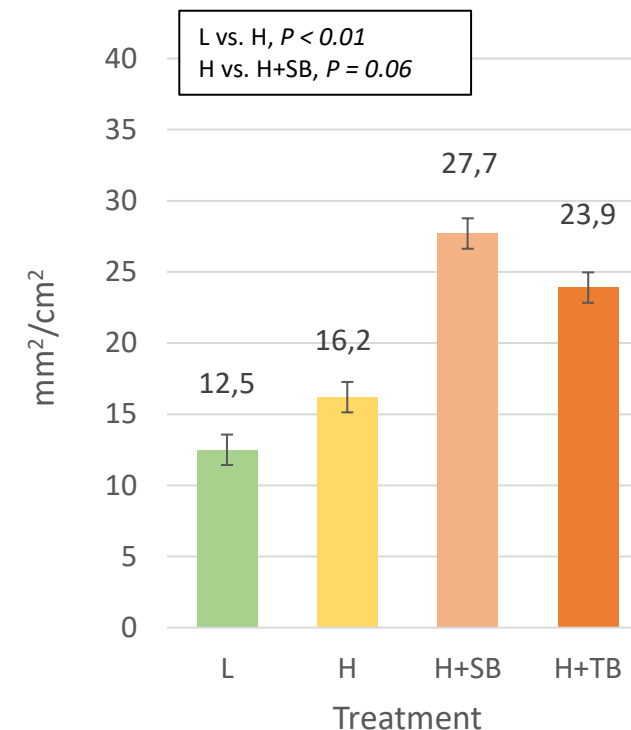
Papillae length



Papillae width



Mucosa surface



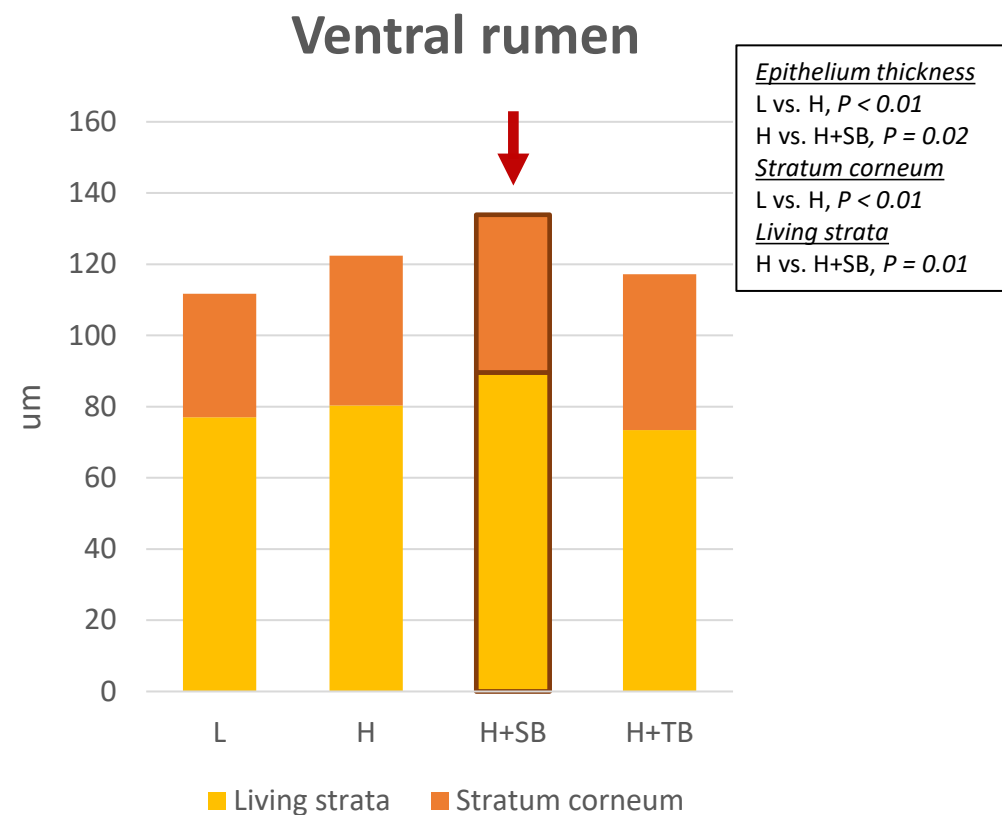
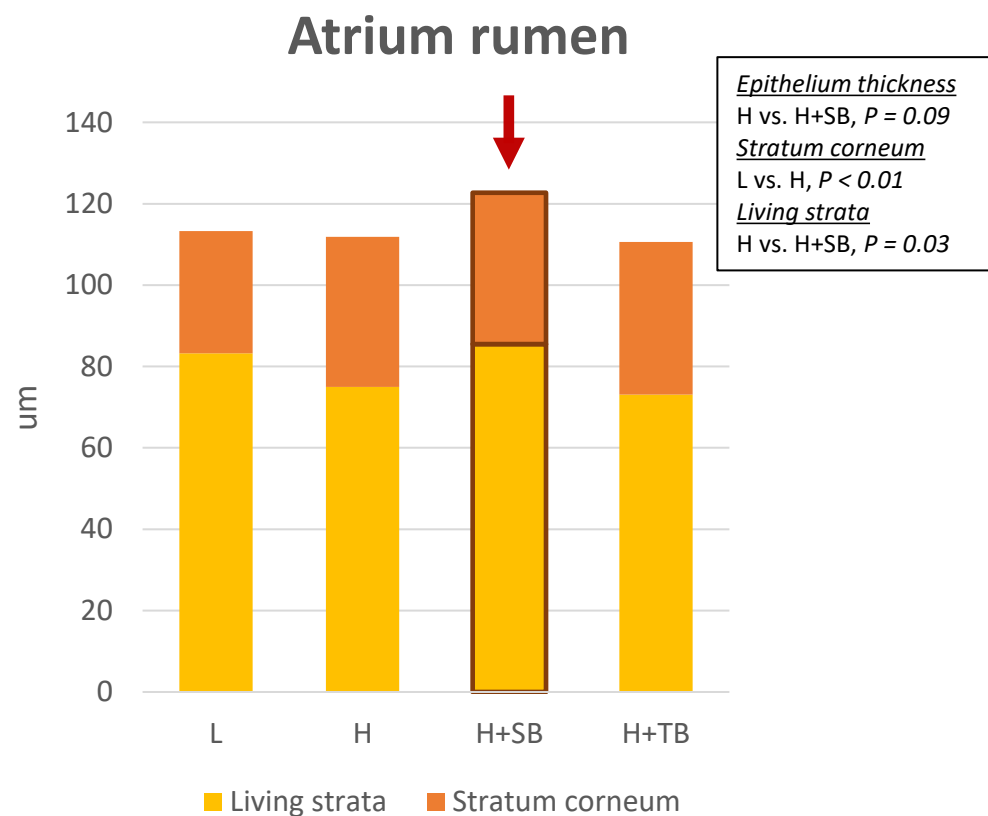
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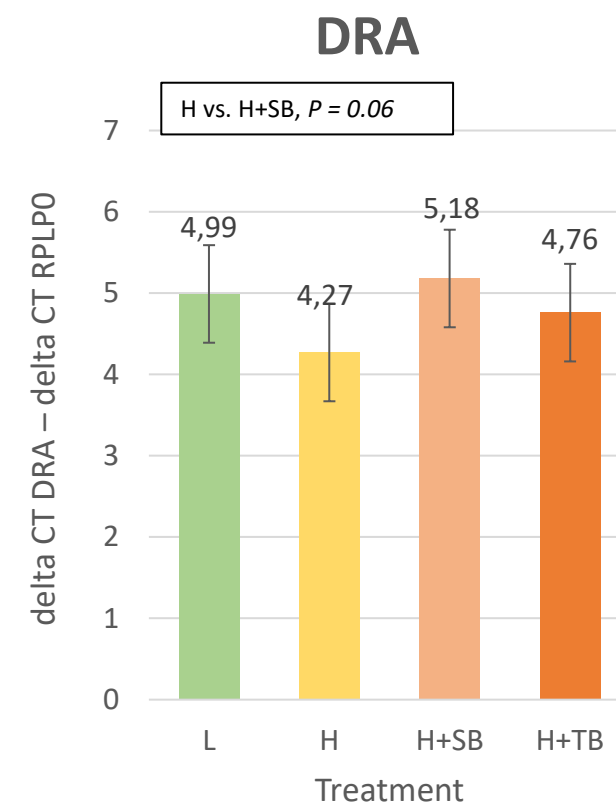
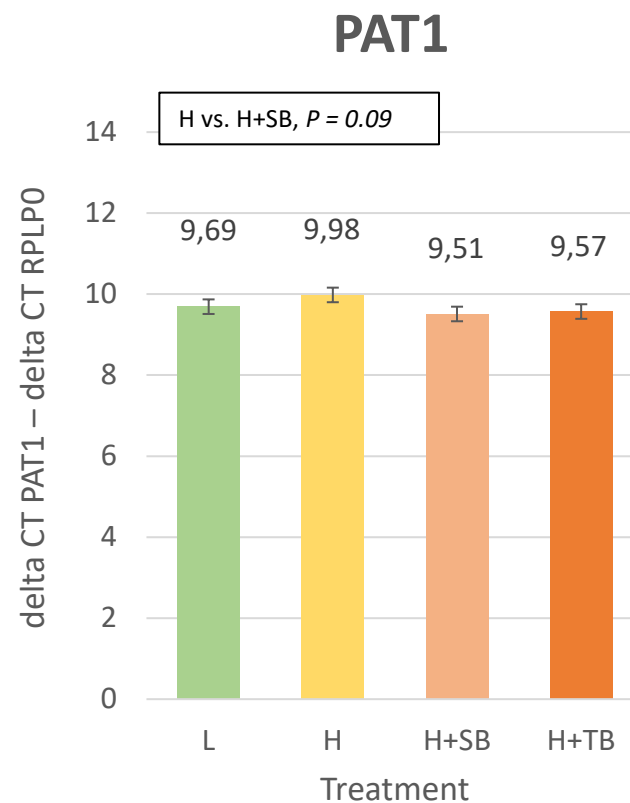
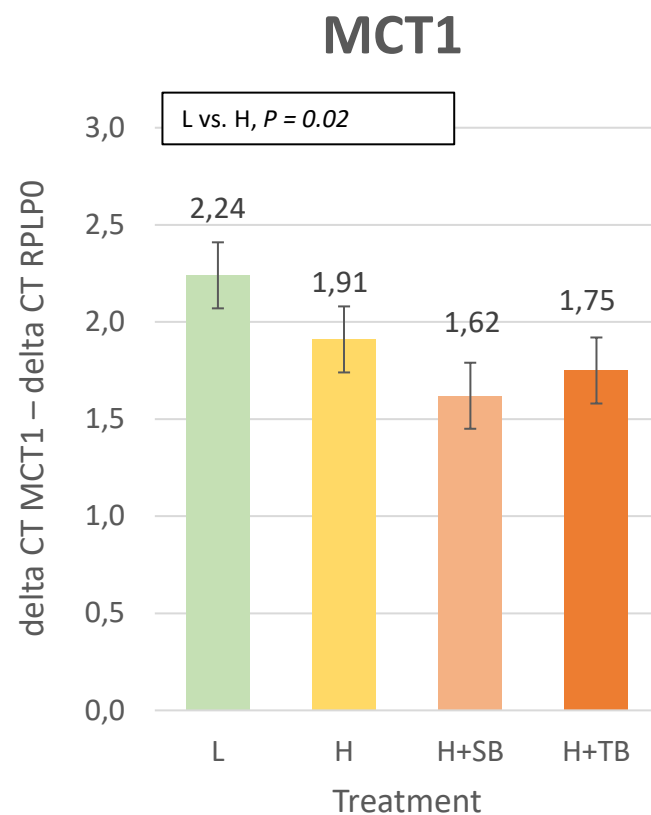
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Results



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MCT1 = monocarboxylate transporter 1; **PAT1** = putative anion transporter-1; **DRA** = downregulated in adenoma

DM = dry matter

Conclusions

- Impact of butyrate on ruminal epithelium depends on the butyrate source that is used in the diet
- Sodium butyrate supplementation in a high-concentrate diet, but not tributyrin, stimulated ruminal epithelium growth
- Sodium butyrate supplementation in a high-concentrate diet, but not tributyrin, affected selected ruminal epithelium function
- Sodium butyrate is much more potent stimulator of the rumen epithelium growth in growing sheep than tributyrin



Is tributyrin a good replacement for sodium butyrate to stimulate epithelial growth in ruminants?



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