UNIWERSYTET PRZYRODNICZY W POZNANIU

WYDZIAŁ MEDYCYNY WETERYNARYJNEJ I NAUKI O ZWIERZĘTACH

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Potential of *Rosa rugosa* for methane mitigation through modulation of ruminal parameters - *in vitro study*

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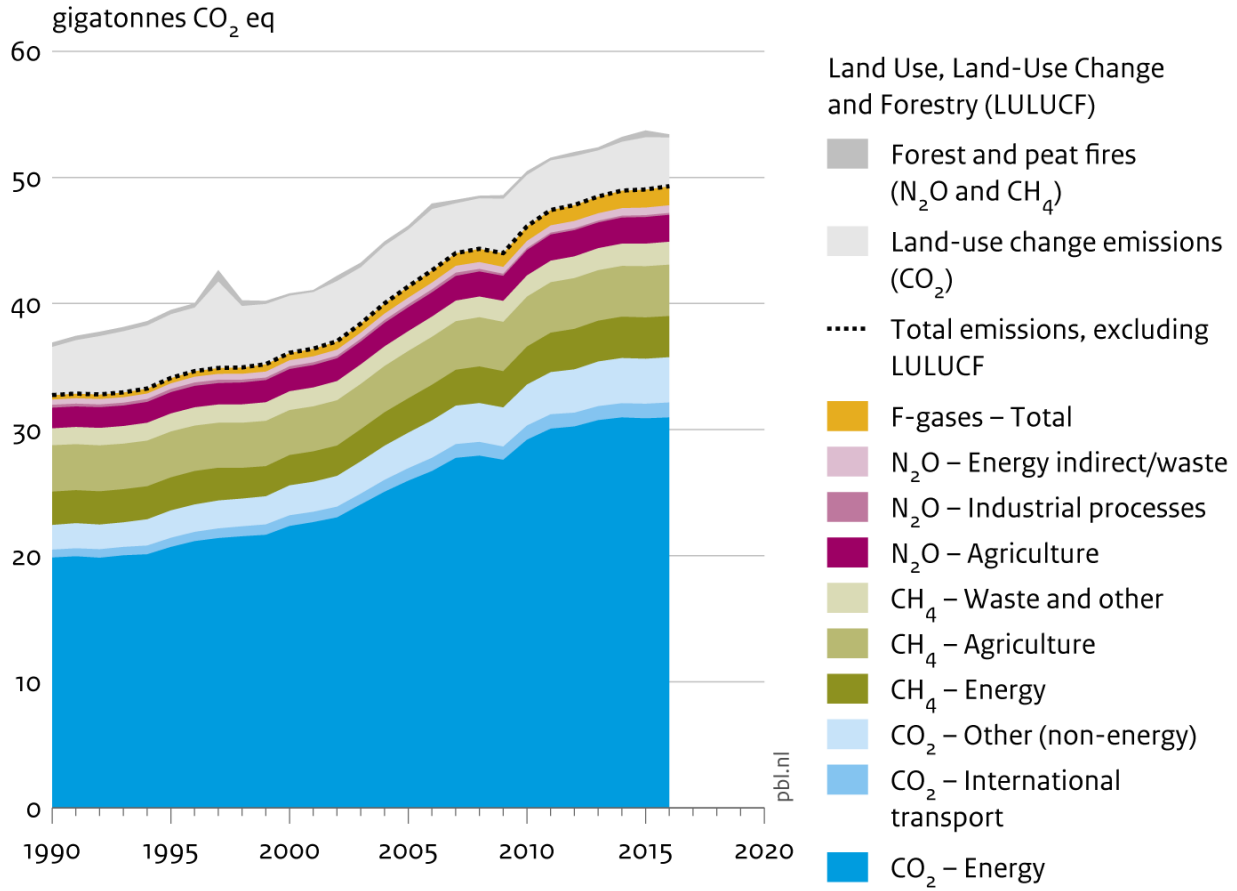
Introduction

- Rising environmental concerns demand innovative and sustainable feed solutions.
- Agro-industrial by-products (e.g., fruit pomaces) are nutrient-rich and reduce waste.

Megías et al., 2002; Del Prado et al., 2013

Global greenhouse gas emissions, per type of gas and source, including LULUCF



Source: EDGAR v4.3.2 (EC-JRC/PBL 2017); Houghton and Nassikas (2017); GFED 4.1s (2017)

Introduction

- Rosa rugosa fruit pomace (RFP) is abundant, rich in polyphenols, tannins, and unsaturated fatty acids (UFAs).
- Biologically active compounds in RFP may positively influence rumen fermentation, biohydrogenation, and methane emissions.

Bryszak et al., 2019; Nguyen et al., 2023; Vasta et al., 2019

Hypothesis

- The biologically active components in RFP, whether fresh or ensiled, modulate *in vitro* rumen fermentation processes, thereby mitigating methane emission and the biohydrogenation process.

Aim

- To investigate the effect of fresh and ensiled RFP on basic ruminal parameters (pH, ammonia, VFAs) as well as methane production in an incubated dairy cow's rumen fluid using a short-term system

Materials & Methods

- Polish Holstein-Friesian cows;
- 3 groups; 200 mg substrate; 20 ml buffered rumen fluid;
- Groups - CON (n=18), RFPF (n=18), and RFPS (n=18);
- 3 treatments; 6 syringes each; 3 runs on different days.

Materials & Methods

- Nutrient analysis (AOAC 2007 & Van Soest *et al., 1991*)
- FA analysis (gas chromatography)
- Phytochemical analysis

Materials & Methods

- pH
- NH_3 concentration
- *In vitro* dry matter digestibility
- VFA concentration
- Gas and CH_4 production
- Data – Rstudio V2022, ANOVA, Tukey's post-hoc test

Results

Table 1 – Chemical composition of grass silage, RFPF, and RFPS (g/kg DM unless specifically stated)

Constituent (g/kg DM)	Grass silage	RFPF	RFPS
Dry matter (g/kg as fed)	413	501	496
Organic matter	873	967	965
Crude protein	149	158	161
Ether extract	216	119	122
Neutral detergent fibre	517	529	569
pH	4.56	-	4.52

RFPF: rugosa rose pomace – fresh; RFPS: rugosa rose pomace – ensiled

Results

Table 2 – Fatty acid profile of grass silage, RFPF, and RFPS (g/100 g)

Constituent (g/100 g)	Grass silage	RFPF	RFPS
C18:0	4.33	1.49	1.59
C18:1 c9	4.43	14.8	13.1
C18:2 n-6	14.4	48.3	49.6
C18:3 n-3	45.5	29.1	29.6
C18:3 n-6	0.27	0.61	0.58
Others*	5.80	5.73	5.57

RFPF: rugosa rose pomace – fresh; RFPS: rugosa rose pomace – ensiled; Others: C12:0, C14:0, C16:0, C16:1

Results

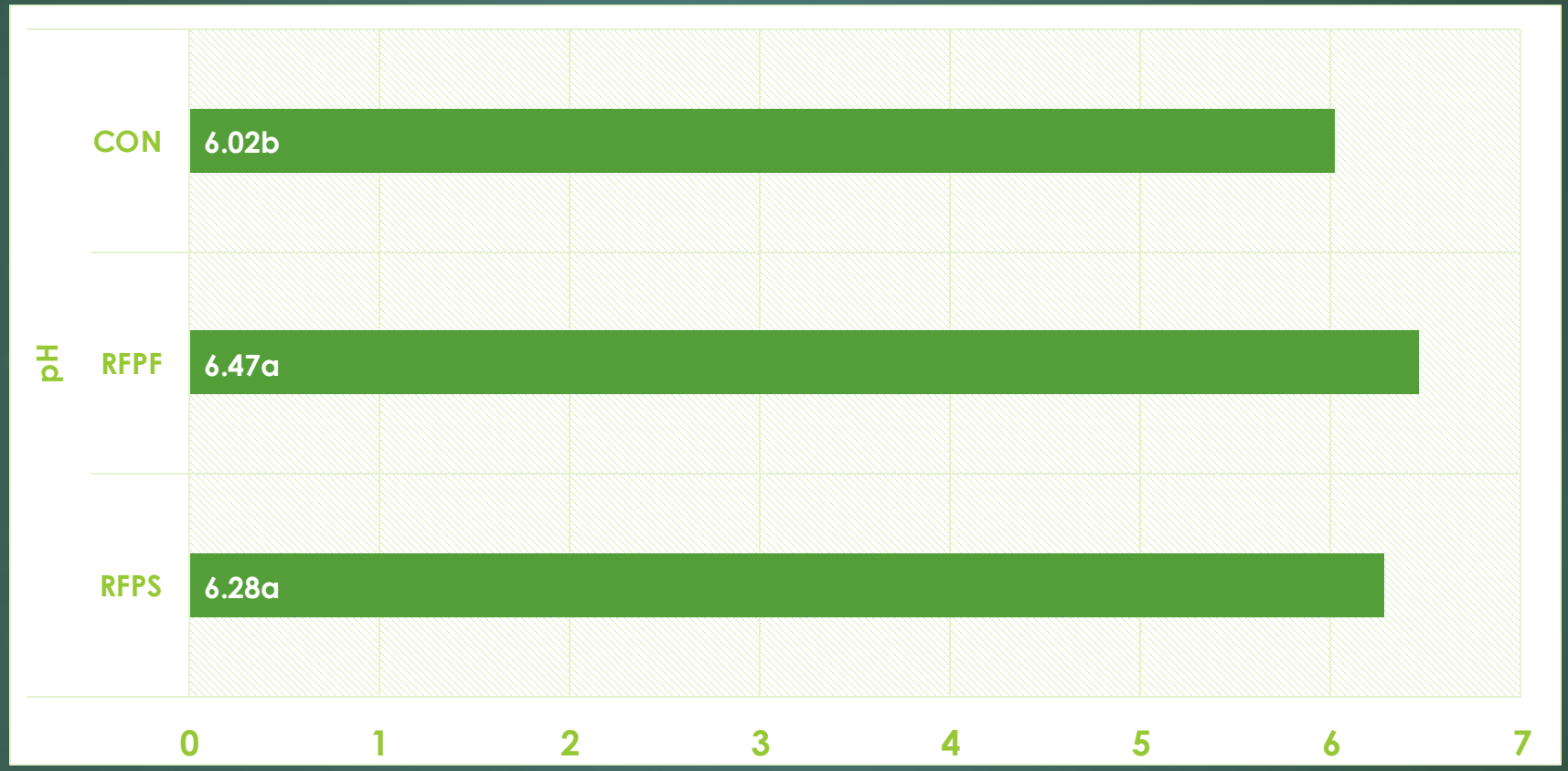
Table 3 –Total polyphenols and tannins compositions in RFPF and its silage RFPS

Item	Total Polyphenols (GAE)[2] mg/g extract	Total Polyphenols (GAE) mg/100 g DM	Polyphenols without Tannins (GAE) mg/100 g DM	Tannins (GAE) mg/100 g DM
RFPF extract	155 ± 12.2	465 ± 22.2	201 ± 17.9	264 ± 16.2
RFPS extract	170 ± 11.8	509 ± 56.8	281 ± 33.0	228 ± 21.4

RFPF: rugosa rose pomace – fresh; RFPS: rugosa rose pomace – ensiled; GAE - gallic acid equivalent

Results

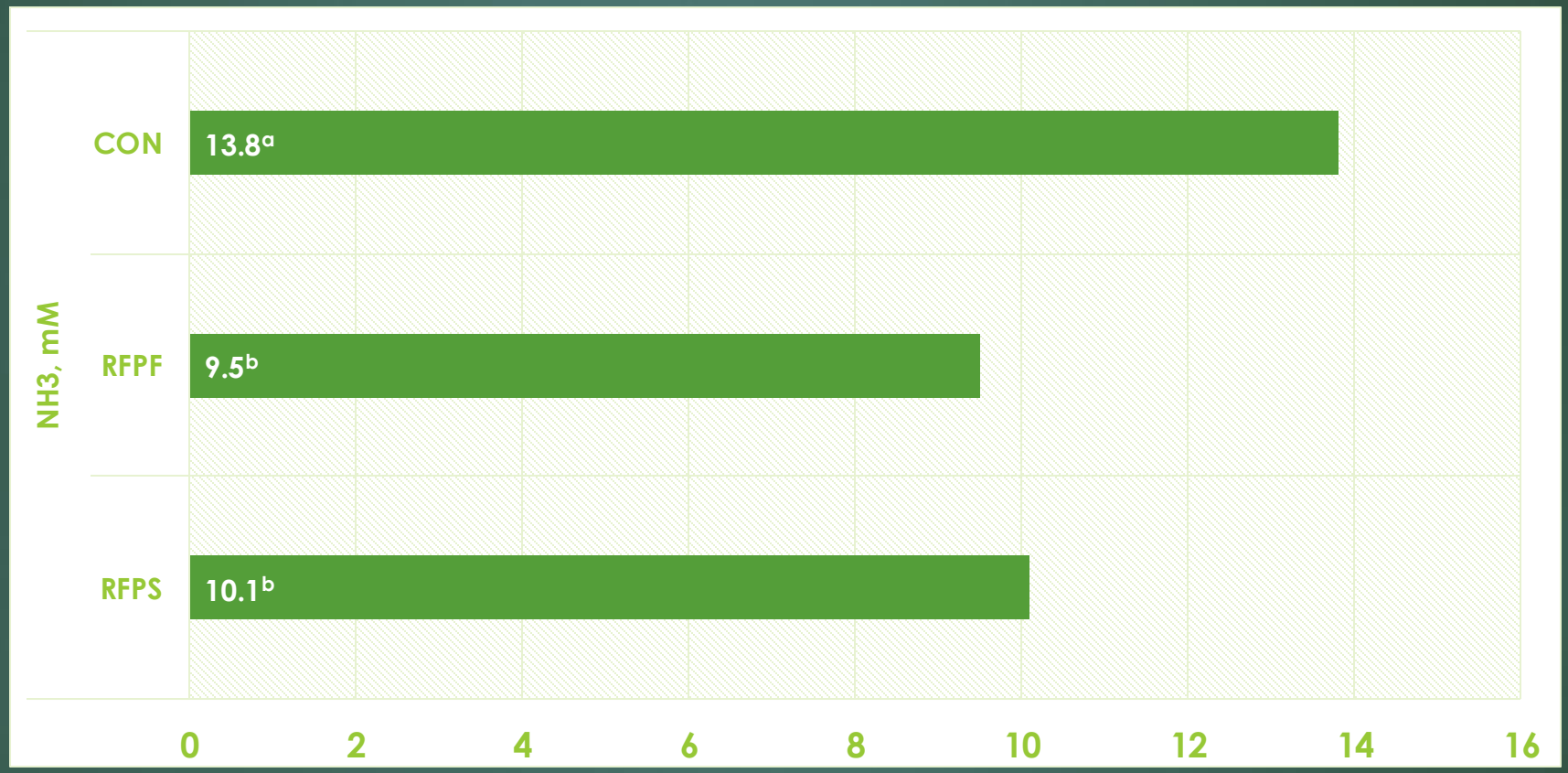
Figure 1 - RFPF and RFPS effect on rumen pH



a,b,c Values within each bar within the same category marked with different superscripts indicate significant differences (p < 0.05) pH SEM= 0.060, NH3 SEM= 0.676 CON: control, RFPF: rugosa rose pomace - fresh, RFPS: rugosa rose pomace - ensiled

Results

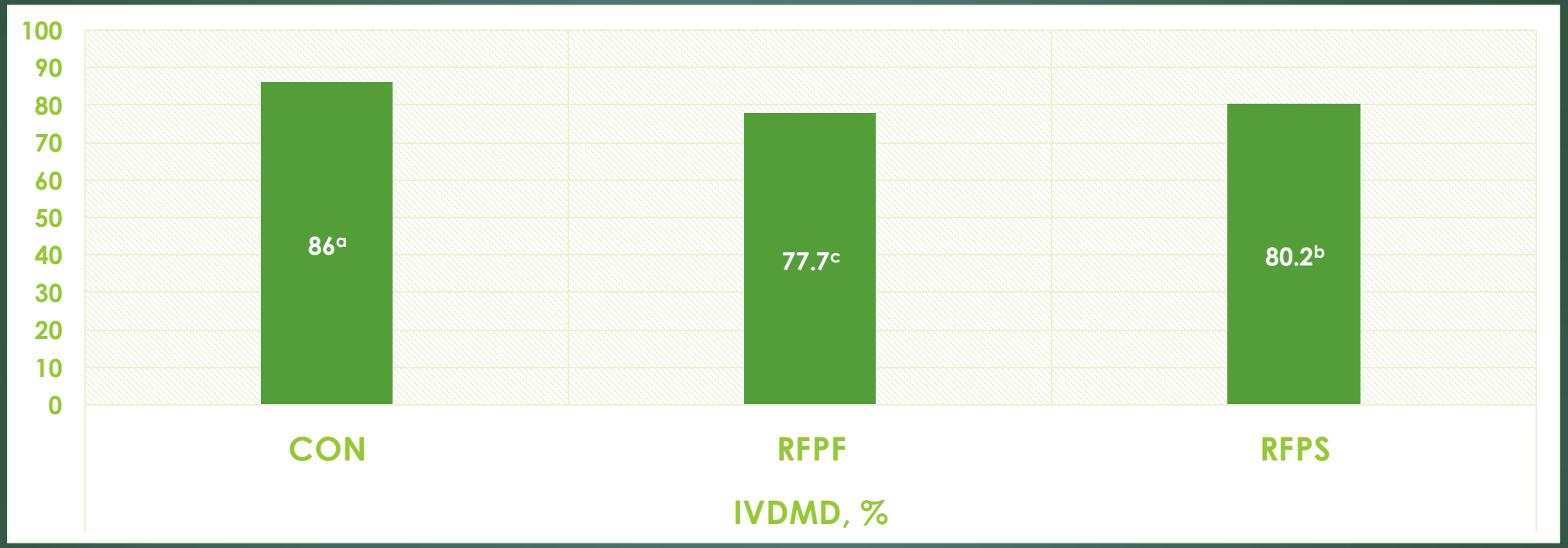
Figure 2 - RFPF and RFPS effect on NH3 concentration



a,b,c Values within each bar within the same category marked with different superscripts indicate significant differences ($p < 0.05$) pH SEM= 0.060, NH3 SEM= 0.676 CON: control, RFPF: rugosa rose pomace - fresh, RFPS: rugosa rose pomace - ensiled

Results

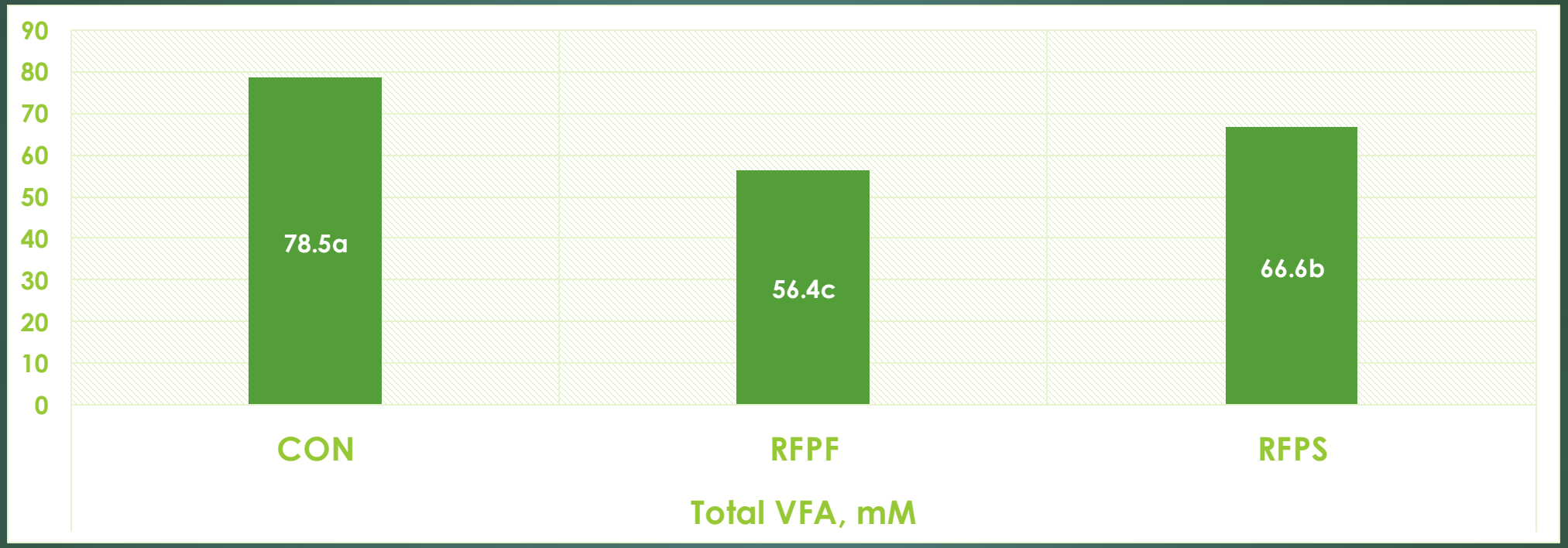
Figure 3 - RFPF and RFPS effect on IVDMD



a,b,c Values within each bar within the same category marked with different superscripts indicate significant differences ($p < 0.05$); Total VFA SEM= 2.674, IVDMD SEM= 1.219; CON: control, RFPF: rugosa rose pomace - fresh, RFPS: rugosa rose pomace – ensiled

Results

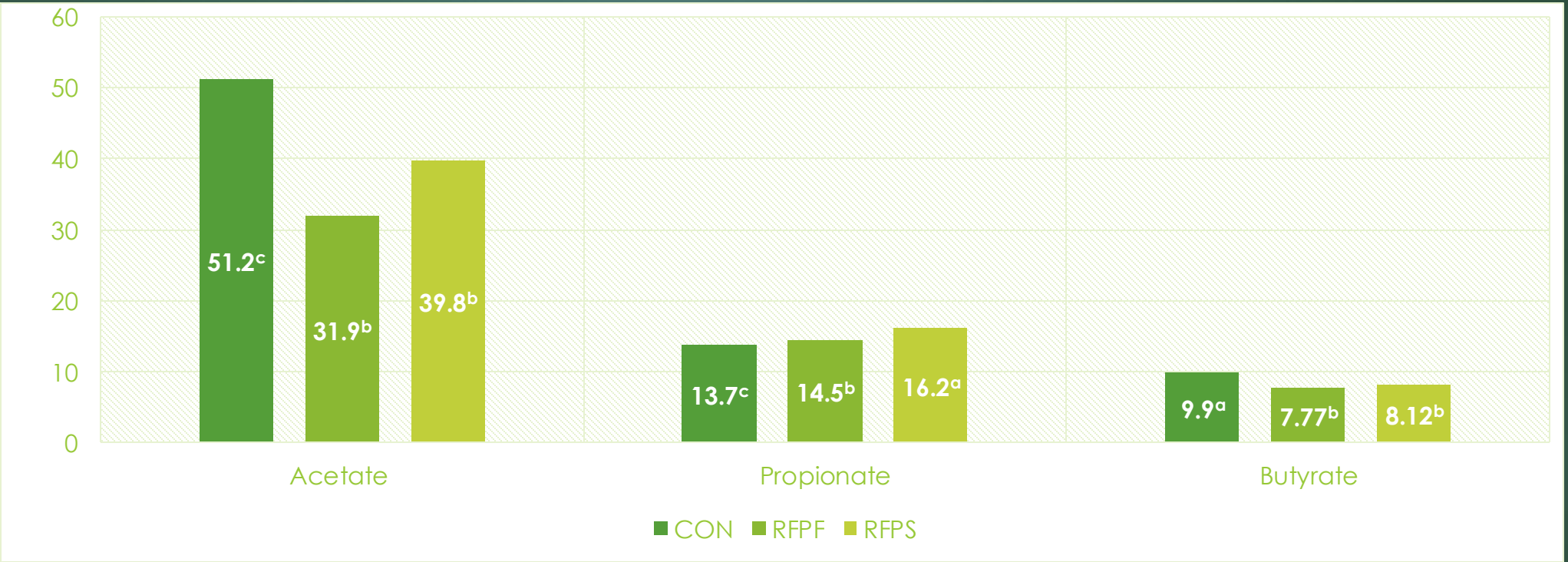
Figure 4 - RFPF and RFPS effect on total VFAs



a,b,c Values within each bar within the same category marked with different superscripts indicate significant differences ($p < 0.05$); Total VFA SEM= 2.674, IVDMD SEM= 1.219; CON: control, RFPF: rugosa rose pomace - fresh, RFPS: rugosa rose pomace – ensiled

Results

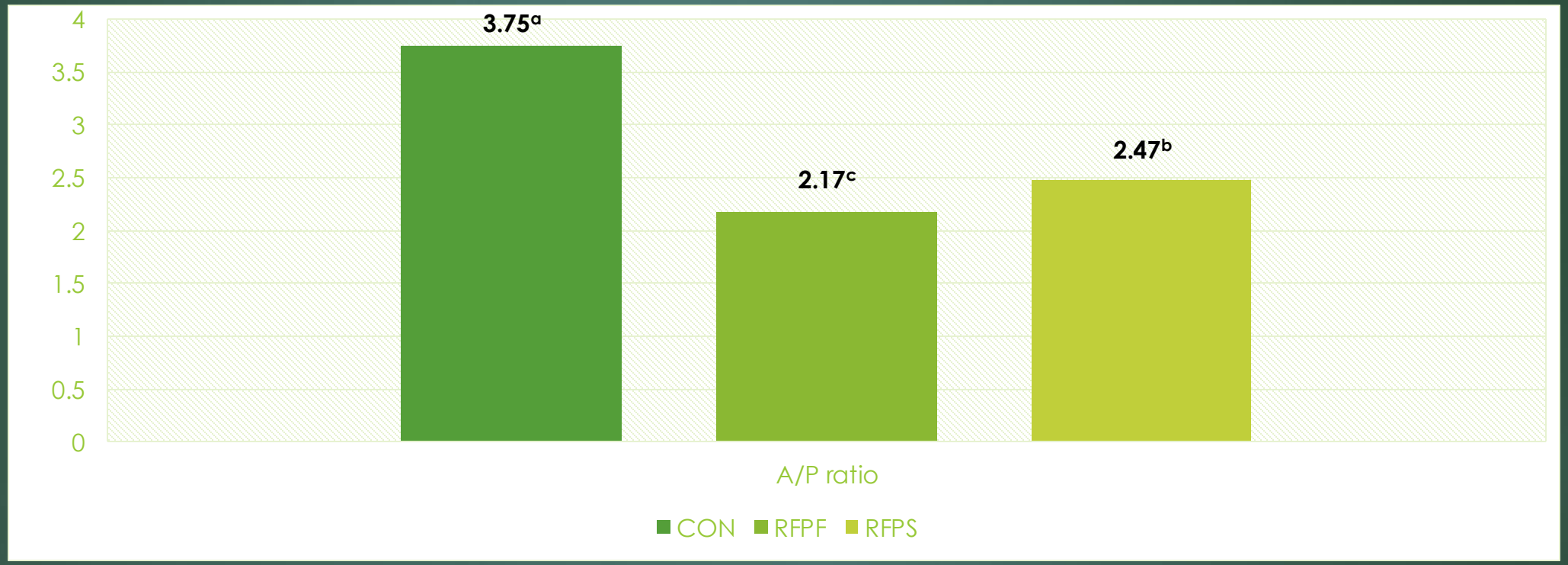
Figure 5 - RFPF and RFPS effect on acetic, propionic, and butyric acids (mM) in incubated rumen fluid



a,b,c Values within each bar within the same category marked with different superscripts indicate significant differences ($p < 0.05$); SEM: standard error of the mean; CON: control, RFPF: rugosa rose pomace - fresh, RFPS: rugosa rose pomace - ensiled

Results

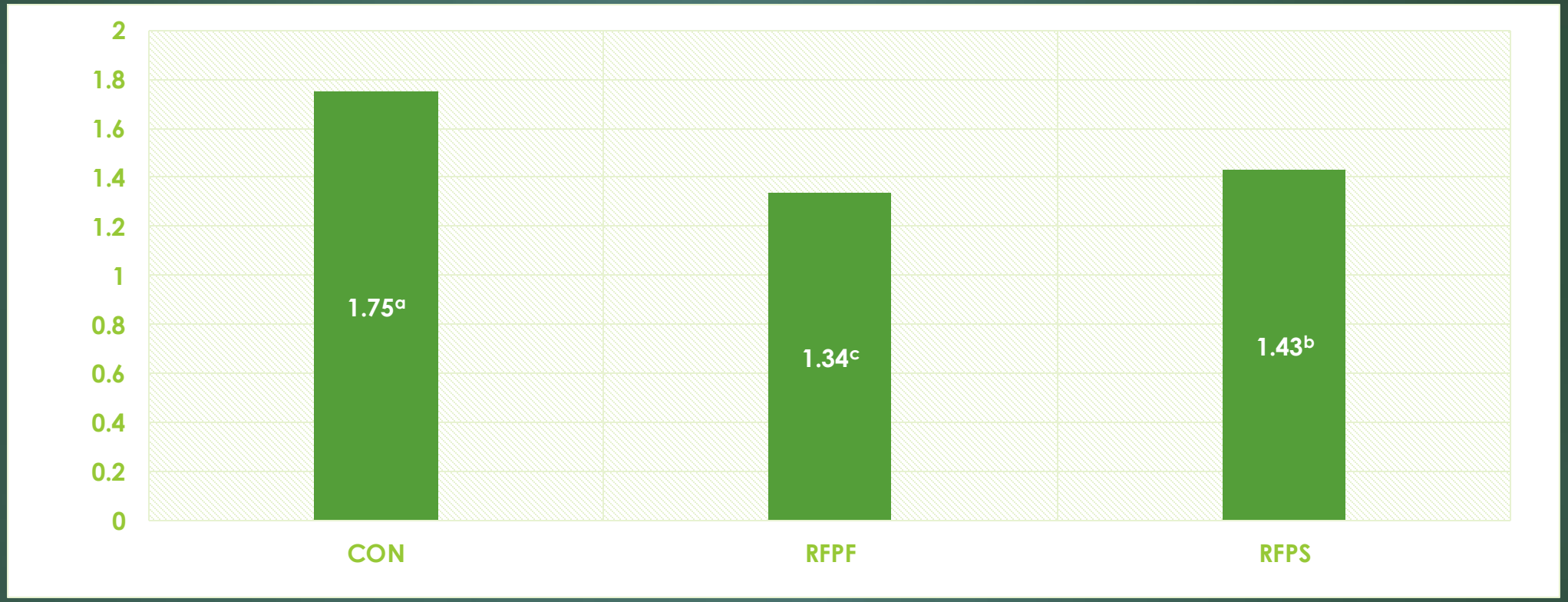
Figure 6 - RFPF and RFPS effect on acetic to propionic acid ratio in incubated rumen fluid



a,b,c Values within each bar within the same category marked with different superscripts indicate significant differences (p < 0.05); SEM: standard error of the mean; CON: control, RFPF: rugosa rose pomace - fresh, RFPS: rugosa rose pomace - ensiled

Results

Figure 7 - RFPF and RFPS effect on methane production



a,b,c Values within each bar marked with different superscripts indicate significant differences ($p < 0.05$); CH4. mmole/g DM SEM=0.005; CON: control, RFPF: rugosa rose pomace - fresh, RFPS: rugosa rose pomace - ensiled

Results

Table 4 - Effects of RFPF and RFPS on fatty acids profile in incubated rumen fluid

Item	Treatments[1]			SEM[2]	p-value
	CON	RFPF	RFPS		
g/100 g, FA					
C18:0	38.3[a]	34.7[b]	34.4[b]	0.52	0.03
C18:1 cis9	7.03[b]	8.78[a]	9.12[a]	0.13	0.01
C18:2 n-6	2.18[b]	2.95[a]	2.41[a]	0.23	0.71
C18:3 n-3	0.94[b]	1.08[a]	1.36[a]	0.05	0.01
C18:2 cis9trans11	0.74[b]	0.91[a]	1.06[a]	0.05	0.05
PUFA	5.05[b]	6.11[a]	6.93[a]	0.16	0.01
n-3/n-6	3.68[a]	3.43[b]	2.66[c]	0.10	0.02
Others[3]	11.4[a]	8.80[b]	9.47[c]	0.17	0.04

a,b,c Values within the same row with different superscripts indicate significant differences ($p < 0.05$); CON: control, RFPF: rugosa rose pomace - fresh, RFPS: rugosa rose pomace – ensiled; SEM: standard error of the mean; Others: C14:1, C15:1. C17:0, C17:1, C18:1 trans-6-8, C18:1 trans-9, C18:1 cis-11, C18:1 cis-12, C18:1 cis-13, C18:1 cis-14, C20:0, C20:1 trans, C18:3 n-

Conclusion

- Seeds content influenced the result by reducing IVDMD
- RFP has the potential to enhance the nutritive value of ruminant feed, help mitigate environmental pollution, and thereby promote sustainable livestock production practices.

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Thank you for your attentive listening!