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Mango and Avocado Byproducts as Feed Ingredients and Additives in Ruminant diet

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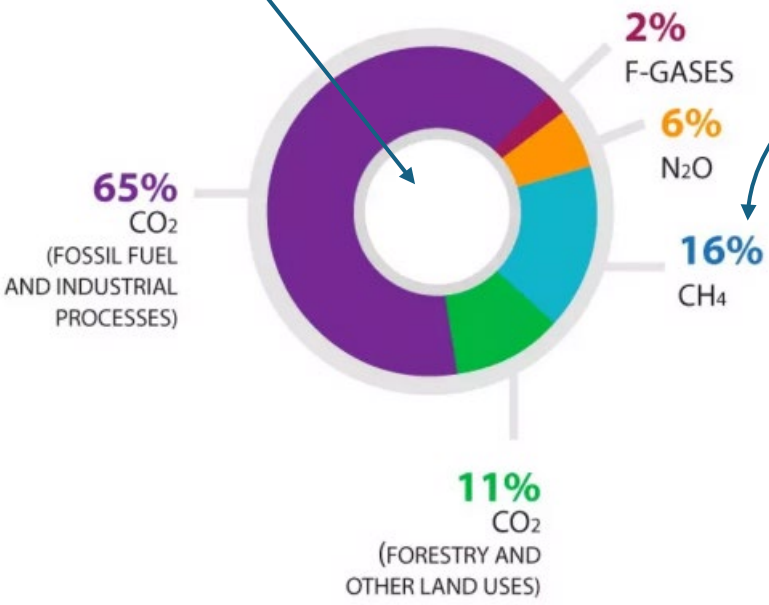
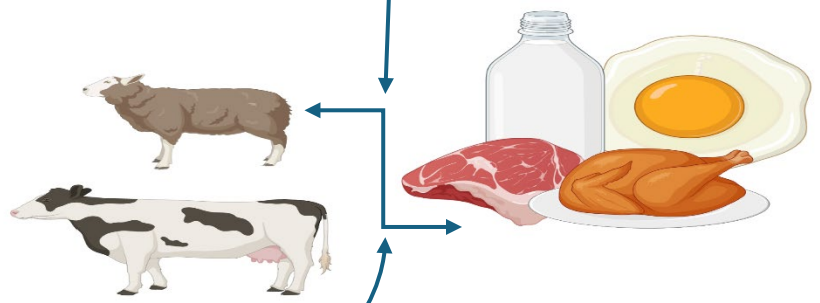


Introduction

By, 2050 the global population is projected to reach nearly 10 billion, increasing the demand for animal-based food



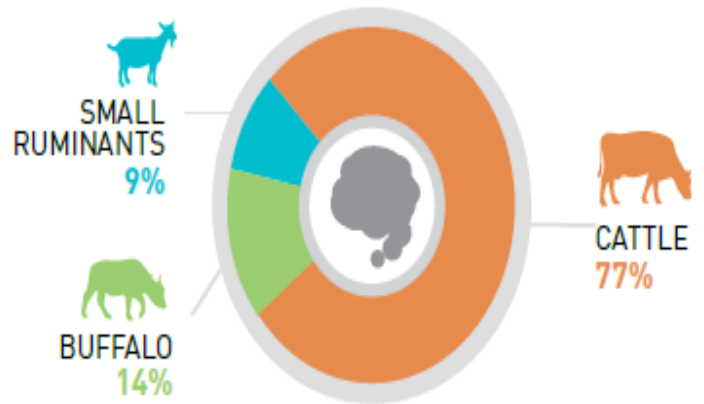
Worldwide, over one-third of food is lost or wasted, amounting to 1.3 billion tons per year



Contribution of greenhouse gasses to global warming

GLOBAL DISTRIBUTION OF ENTERIC METHANE EMISSIONS FROM RUMINANT (%)

30% Ruminants associated



Animal category proportions on enteric methane emissions

Accounts for 2-12% loss of feed energy for the animals



Traps 80 times more heat than CO₂

1/2 Rise in ozone levels

Objectives

Phase 1

Evaluate chemical composition, digestibility and fermentation characteristics of Mango and Avocado fruits by-products for potential feed use in ruminants' diet

Phase 2

Assess the effects of supplementing dairy cow diets with microencapsulated phenolic extracts derived from mango and avocado byproducts in perspective of rumen invitro fermentation and methanogenesis

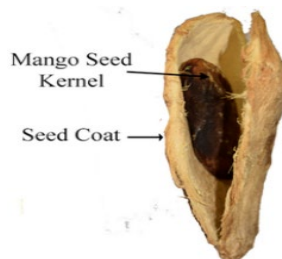
Methodology



Mango



Mango peel



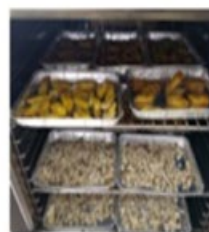
Avocado)



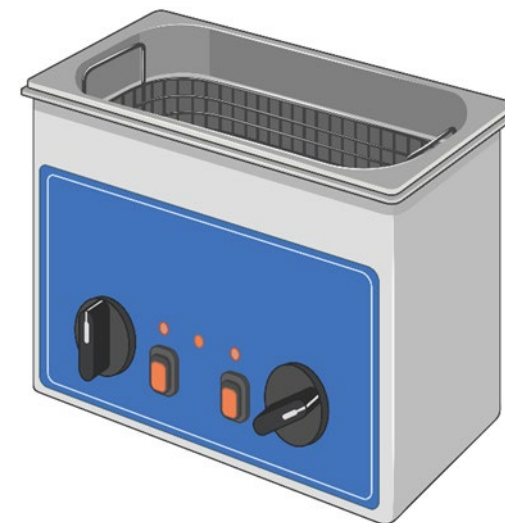
Avocado Peel



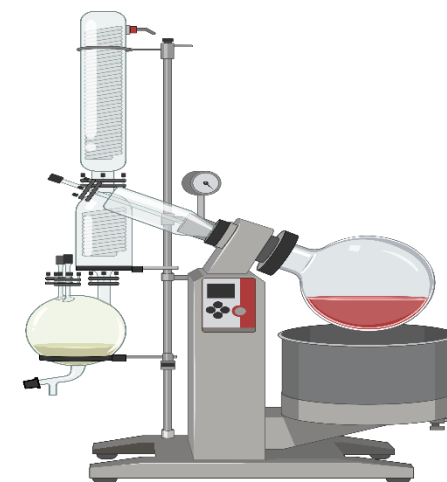
Avocado seed



Extraction of Phenolic compounds



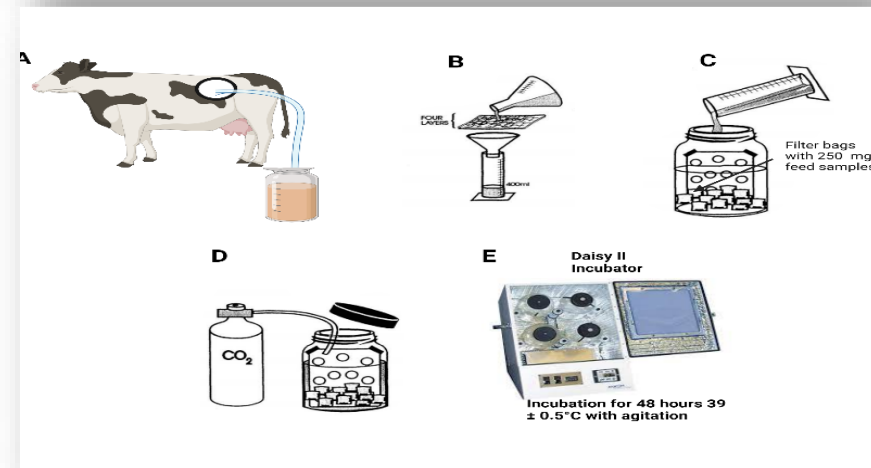
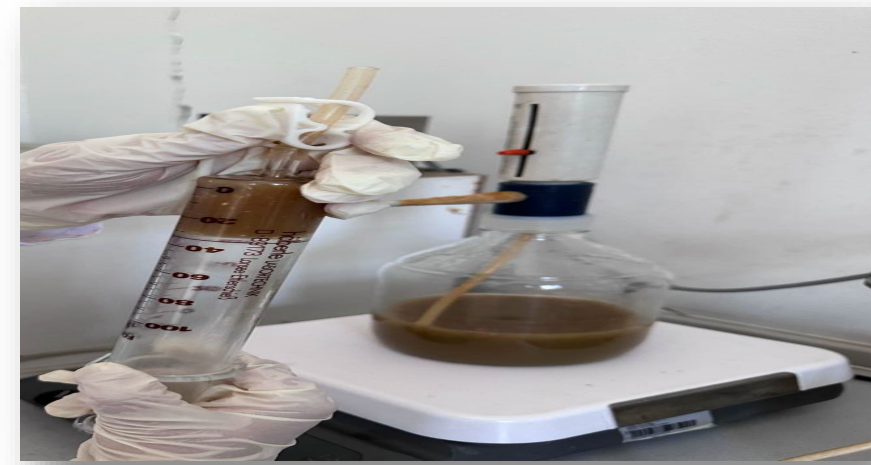
Ultrasonic water bath



Rotary vapour

Phase 1 setup:

- **Sample Preparation:** 200 mg of mango and avocado byproducts incubated in 100 mL glass syringes in triplicates with 30 mL buffered ruminal inoculum at 39 °C for 24 hours.
- **Gas Production Measurement:** Monitored at 3, 6, 12, and 24 hours.
- **Methane Concentration:** Measured in real time using the Gas Endeavour in-vitro fermentation system.
- **Post-Incubation Analysis:** Rumen fluid pH measured; samples centrifuged and analyzed for VFA using HPLC and NH₃-N using Kjeltech auto-analyzer.
- **In-vitro Digestibility (IVDMD):** Investigated using ANKOM DaisyII Incubator; 250 mg samples in F57 bags incubated in 2 L buffered rumen fluid at 39 °C with continuous rotation for 48 hours.



Phase 2 setup:

- **Objective:** Assess in-vitro fermentation of microencapsulated extracts of mango and avocado byproducts.
- **Microencapsulation of extracts:** Dissolved in 25 mL water with 0.75 g β -cyclodextrin, stirred for 2 hours, evaporated at 30 °C.
- **Treatment Groups:** . Alfalfa hay served as a control group and used as basal substrate in all treatment groups (Geerkens et al. 2013; Giller et al. 2022). Alfalfa hay (AAHAY) supplemented with microencapsulated extracts of mango peel (AA+ MPE), Avocado Peel (AA+ APE), mango seed kernel (AA+ MSKE), avocado seed (AA+ ASE), at 0.667 g/L of buffered ruminal fluid (Rajaraman et al. 2017).
- **Fermentation Analysis:** Followed the methodology of Phase 1 for ruminal fluid collection, preparation, and analysis.

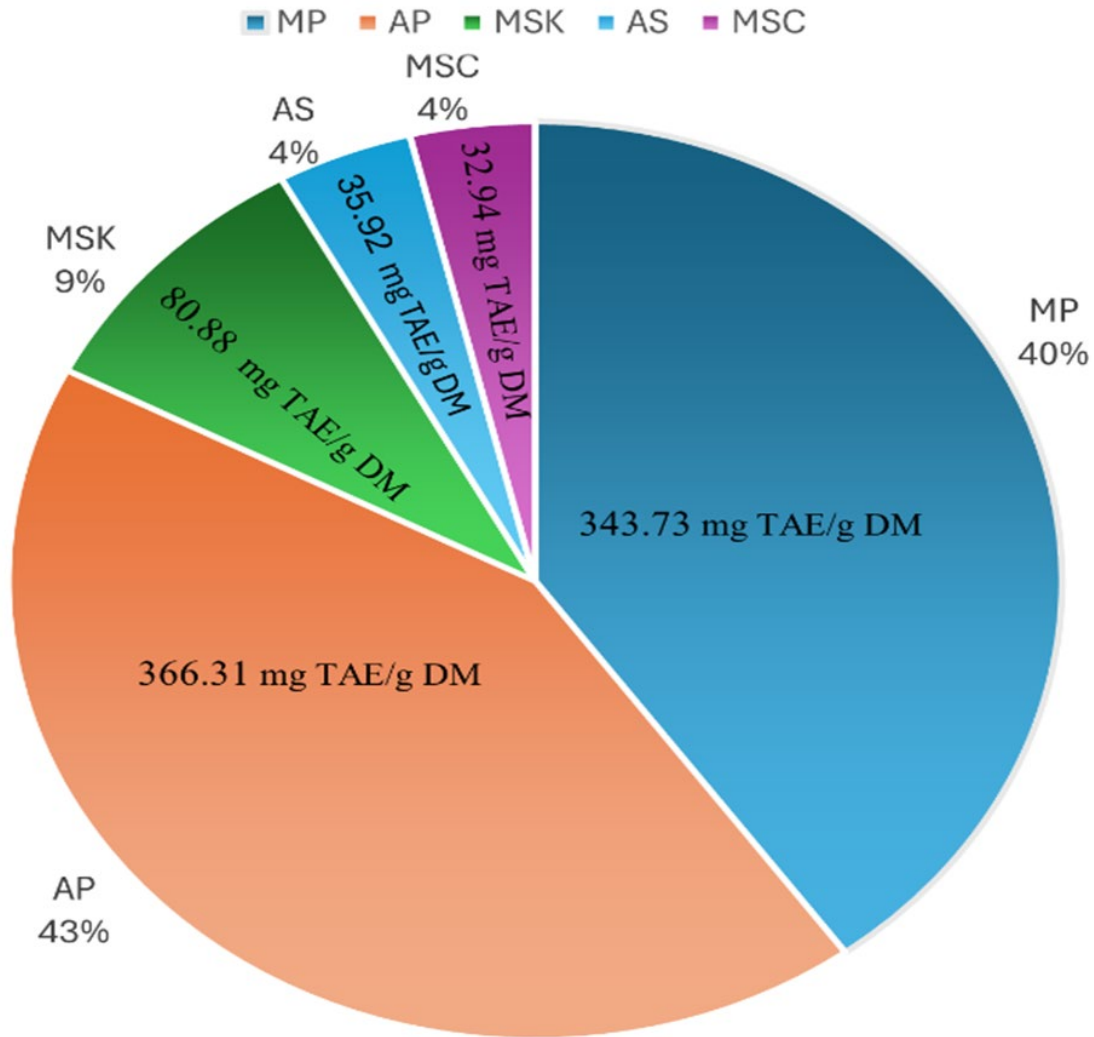
Statistical analysis

- **Data Analyzed:**
Gas production, CH₄ production, Ph, VFA, NH₃-N content, and digestibility
- **Normality Test:**
Shapiro-Wilk test conducted (SPSS v29.0.1.0)
- **Statistical method:**
One-way ANOVA (n=9 per group)
Fixed factor: Treatment
- **Post-hoc Test:**
Tukey's test (Significance: $p < 0.05$)
- **Results Presentation:**
Group means with pooled SEM

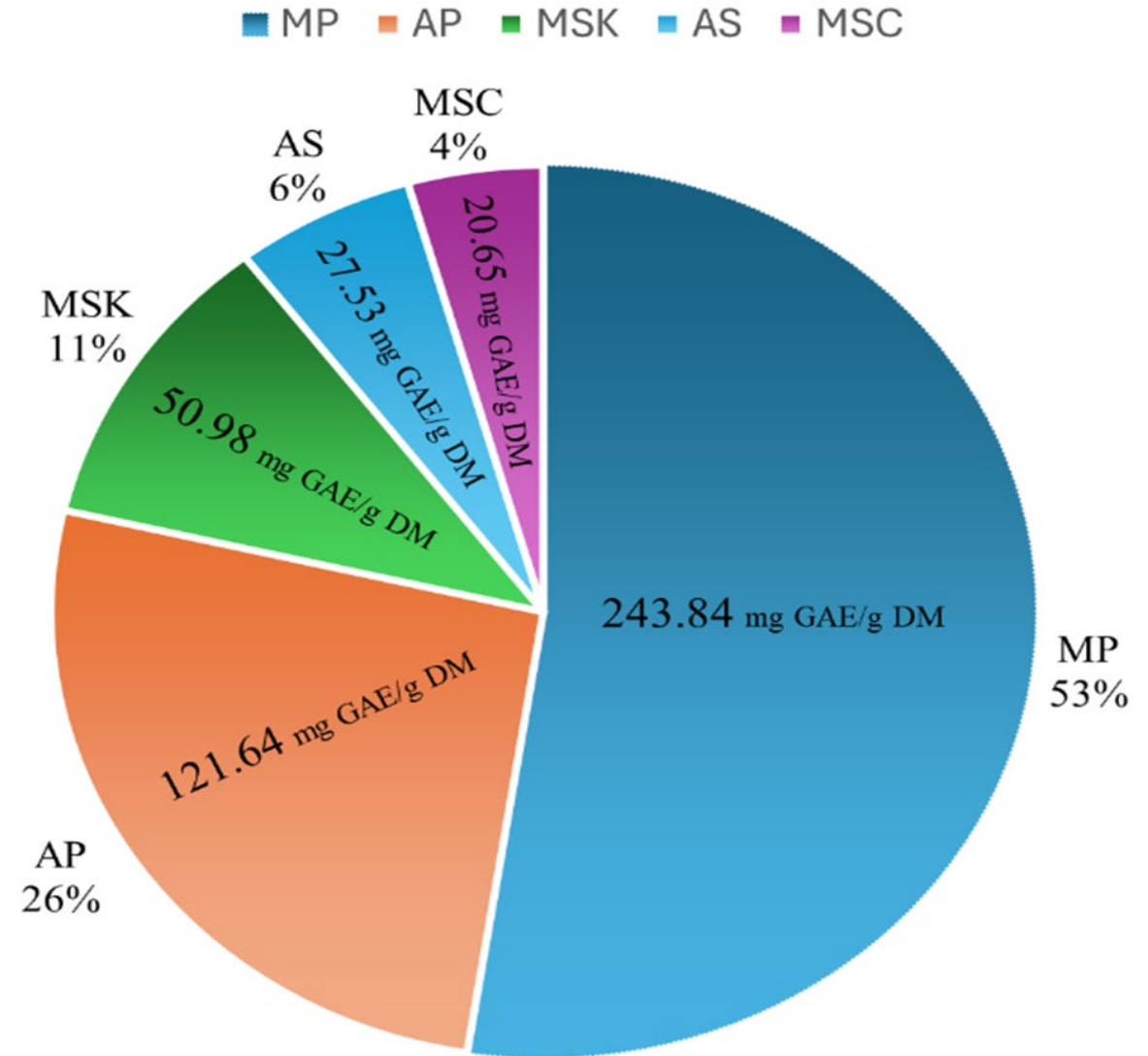
Chemical composition of mango and avocado fruits by-products

Ingredients	Alfalfa hay	Mango peel	Avocado peel	Mango seed kernel	Avocado seed	Mango seed coat
DM(%)	91.47	93	95	92.8	91.5	97.9
CP(%)	13.9	4.07	5.95	7.59	5.13	1.62
EE(%)	2.11	2.04	17.03	6.36	1.29	0.49
NDF(%)	55.35	14.8	49.0	12.2	16.9	78.9
ADF(%)	44.56	13.56	40.27	8.66	11.26	63.21
ADL(%)	10.14	6	20.1	2.02	6.09	22
Ash (%)	7.40	3.14	2.78	2.07	1.46	0.79

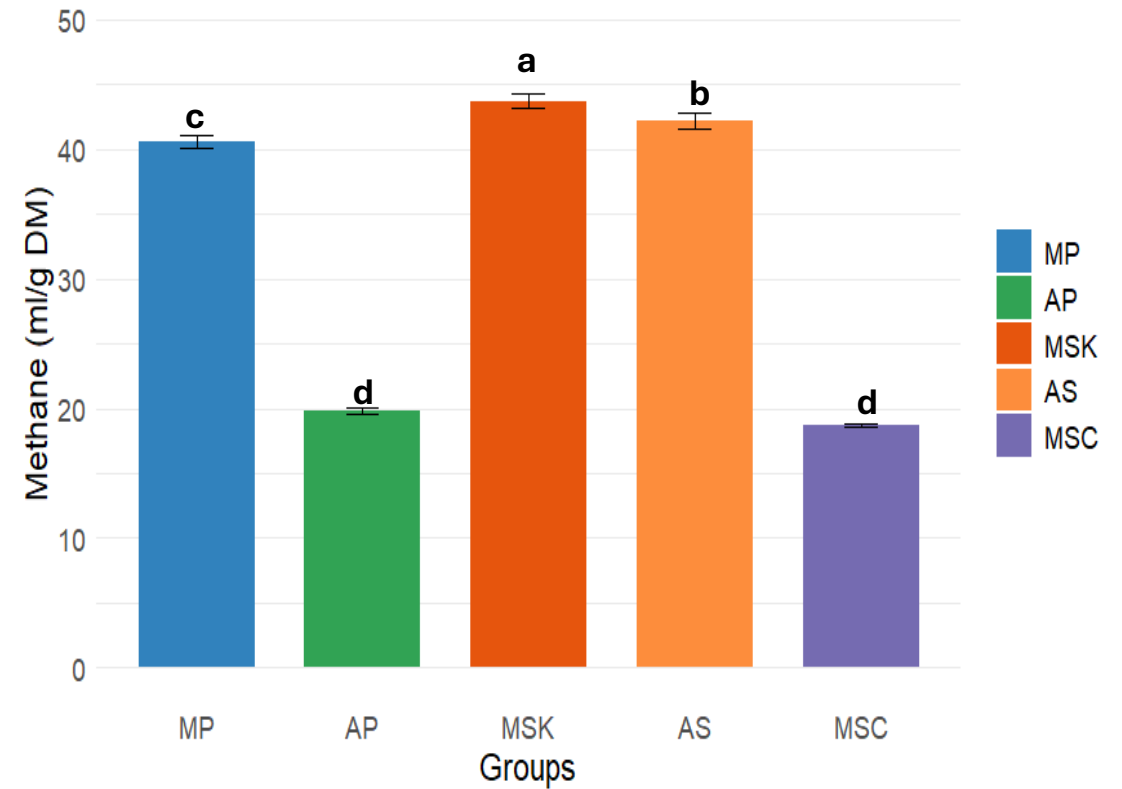
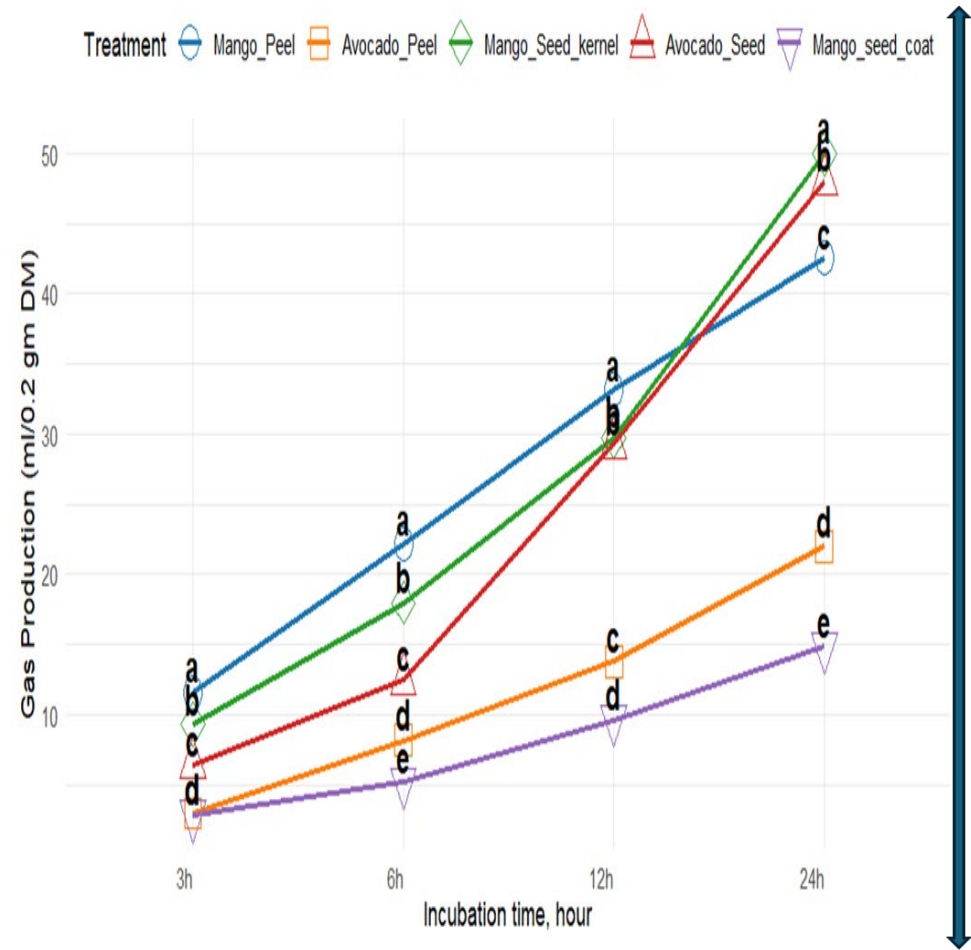
Antioxidant activity (mg TAE/g DM)



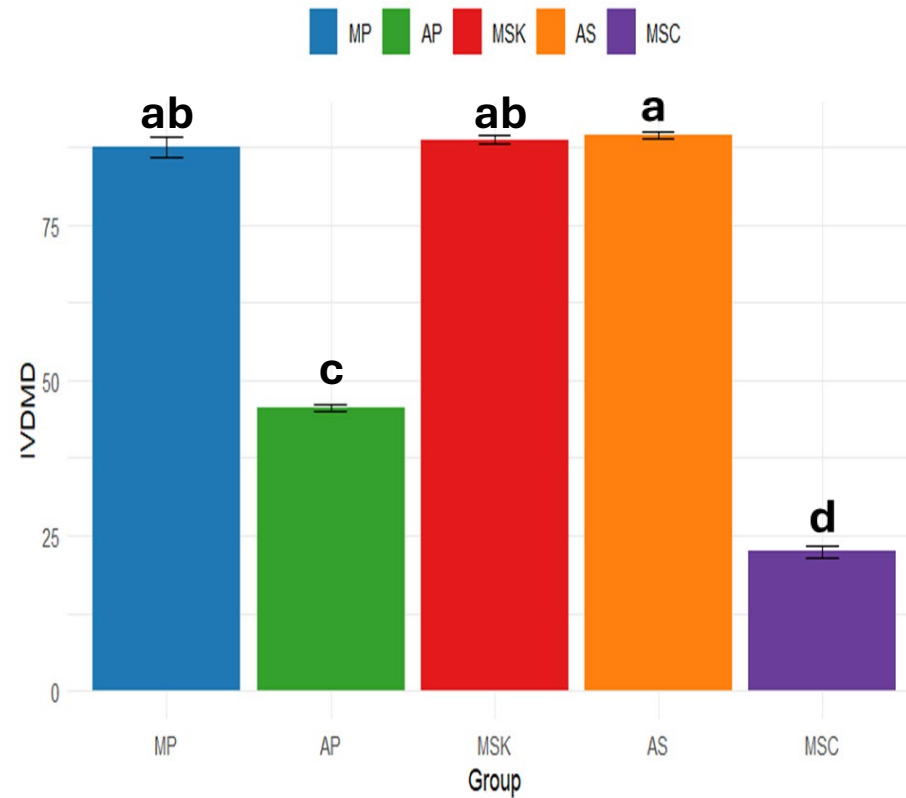
Total Phenolic Content (mg GAE/g DM)



Invitro Gas volume and methane after 24-hour incubation

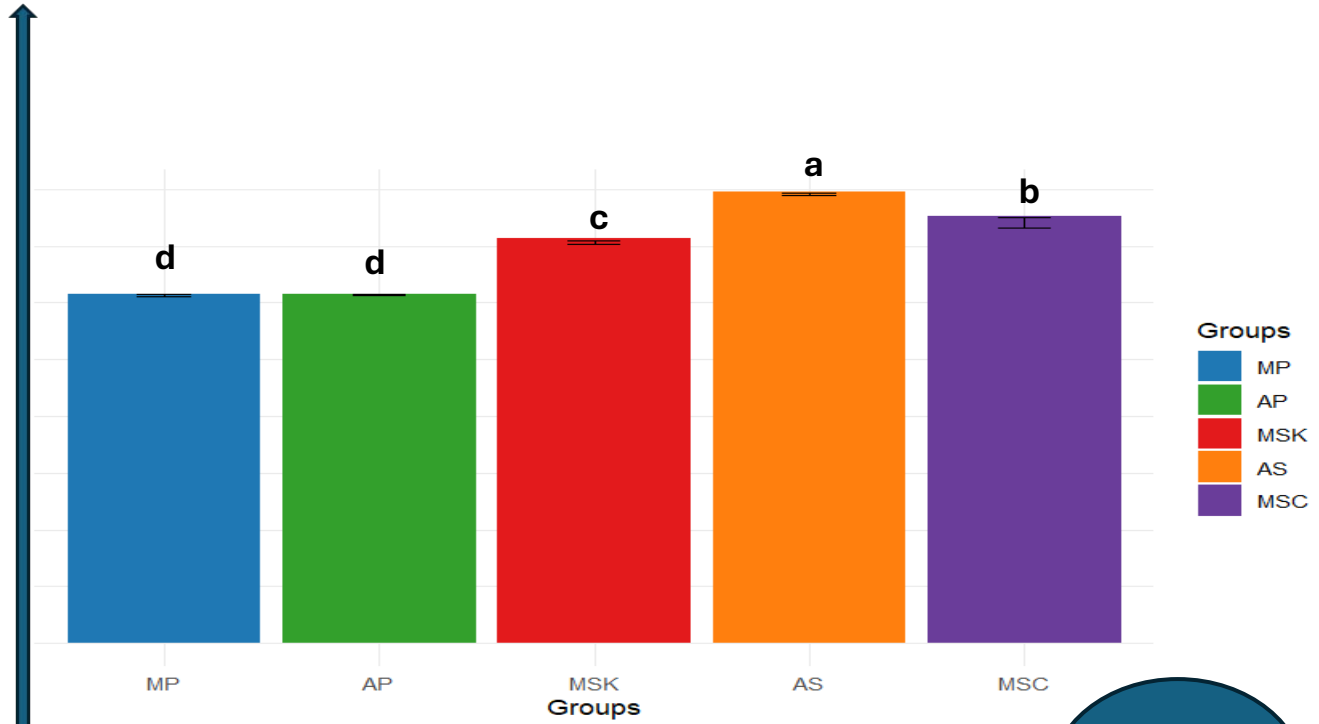
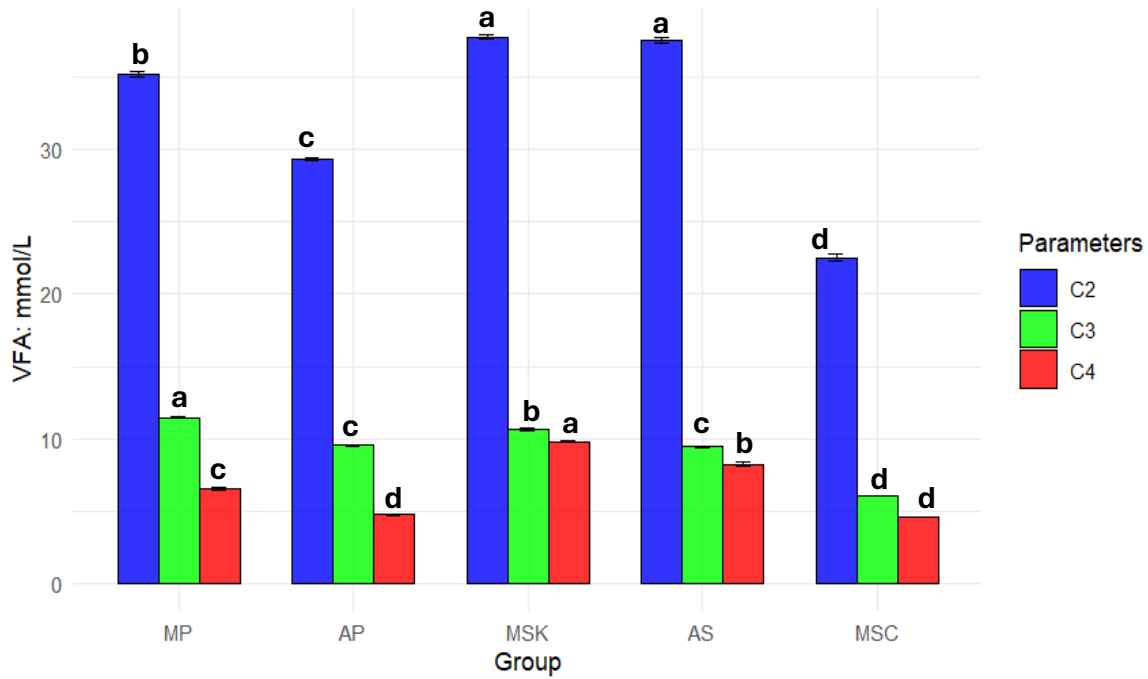


MP; Mango peel, AP; Avocado peel, MSK; Mango seed kernel; AS; Avocado seed, MSC; Mango seed coat



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Invitro dry matter digestibility after 48hours of incubation of mango and avocado byproducts.

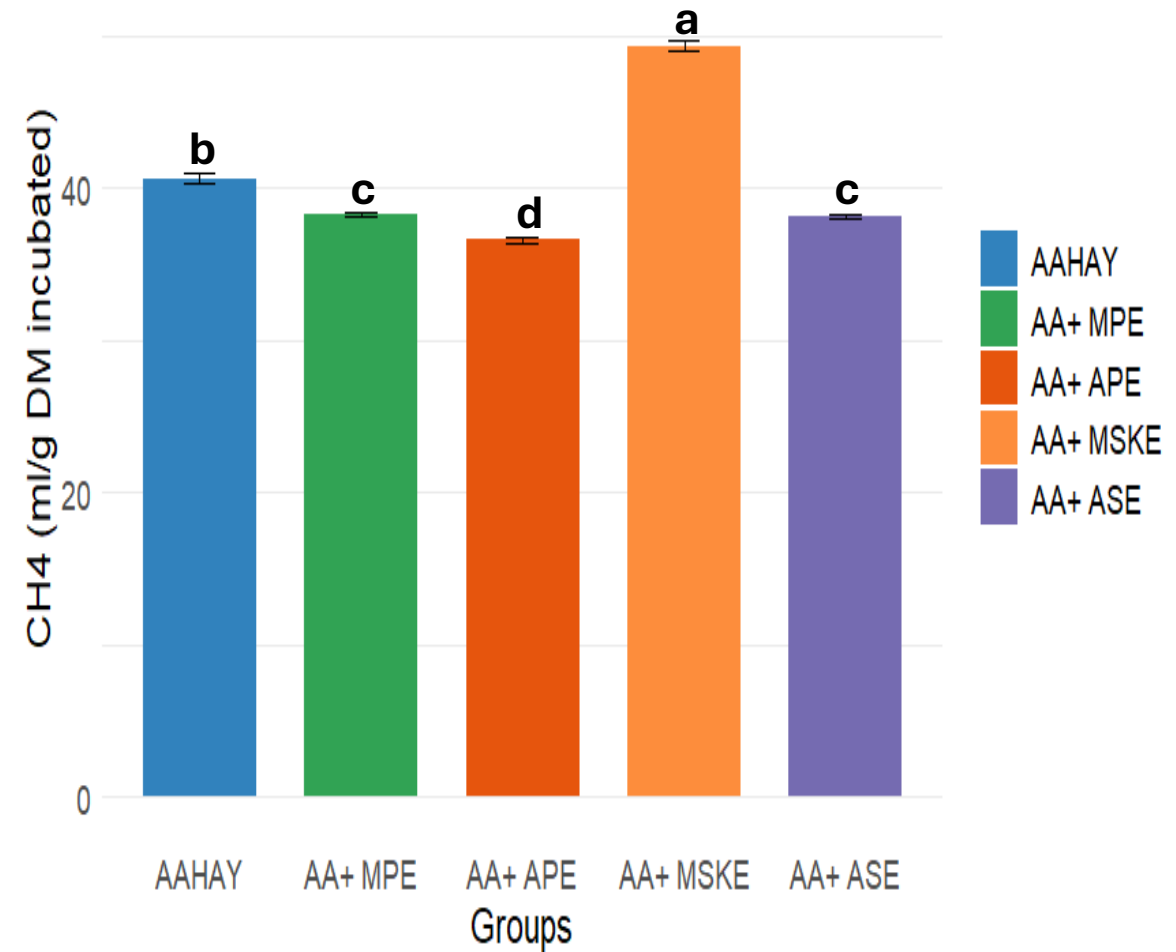
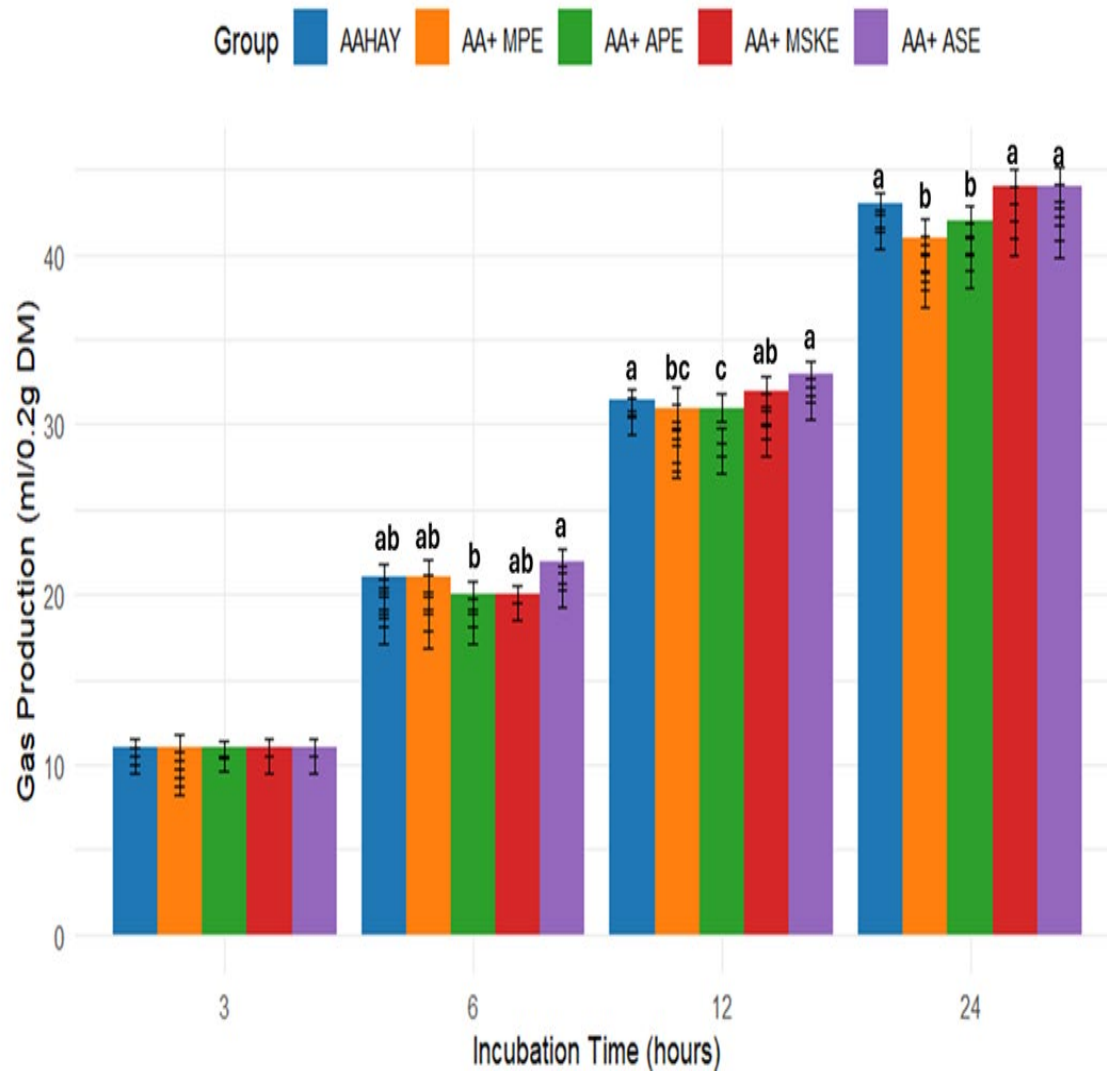


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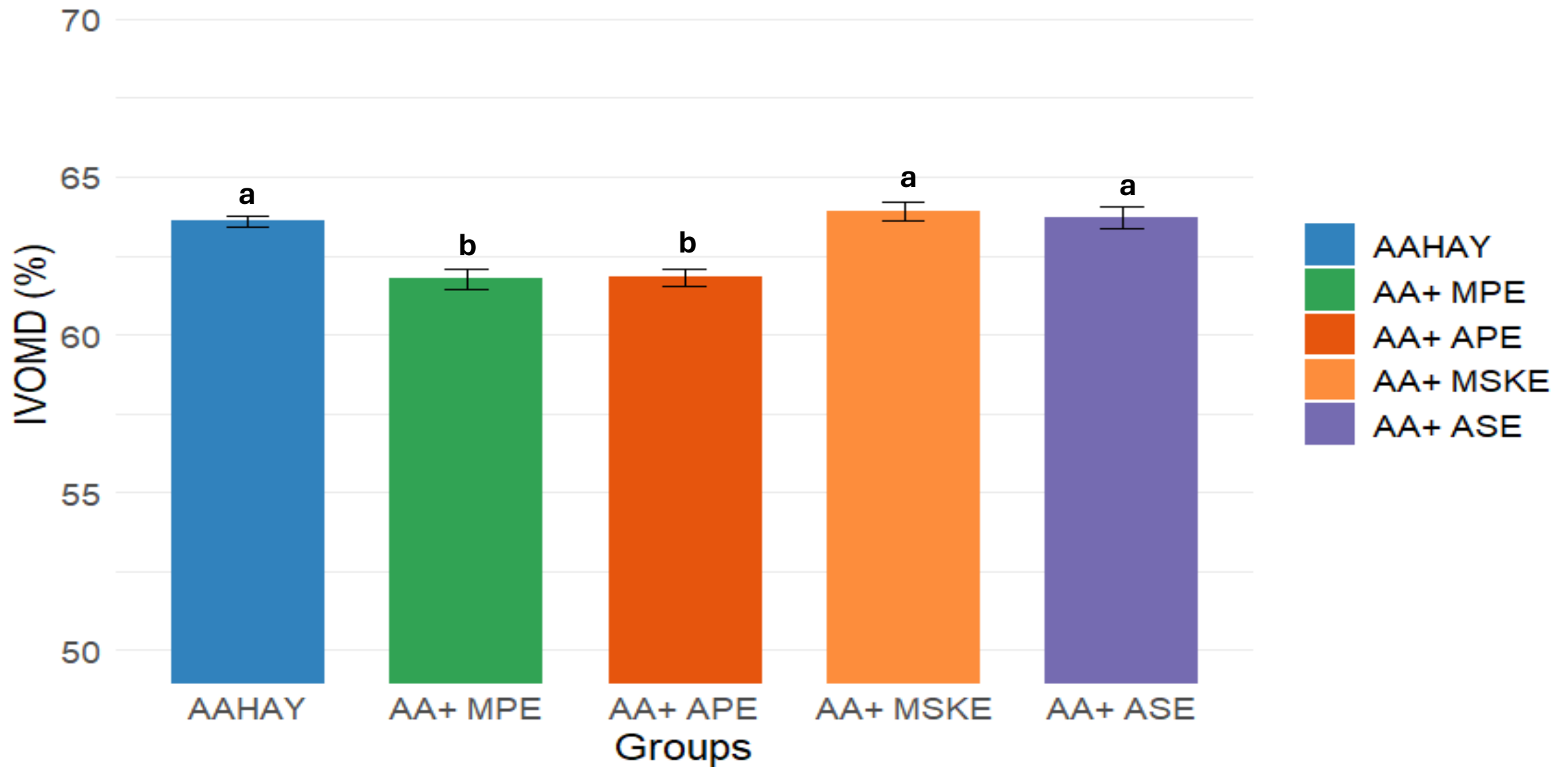
C2:C3

Phase 2 results

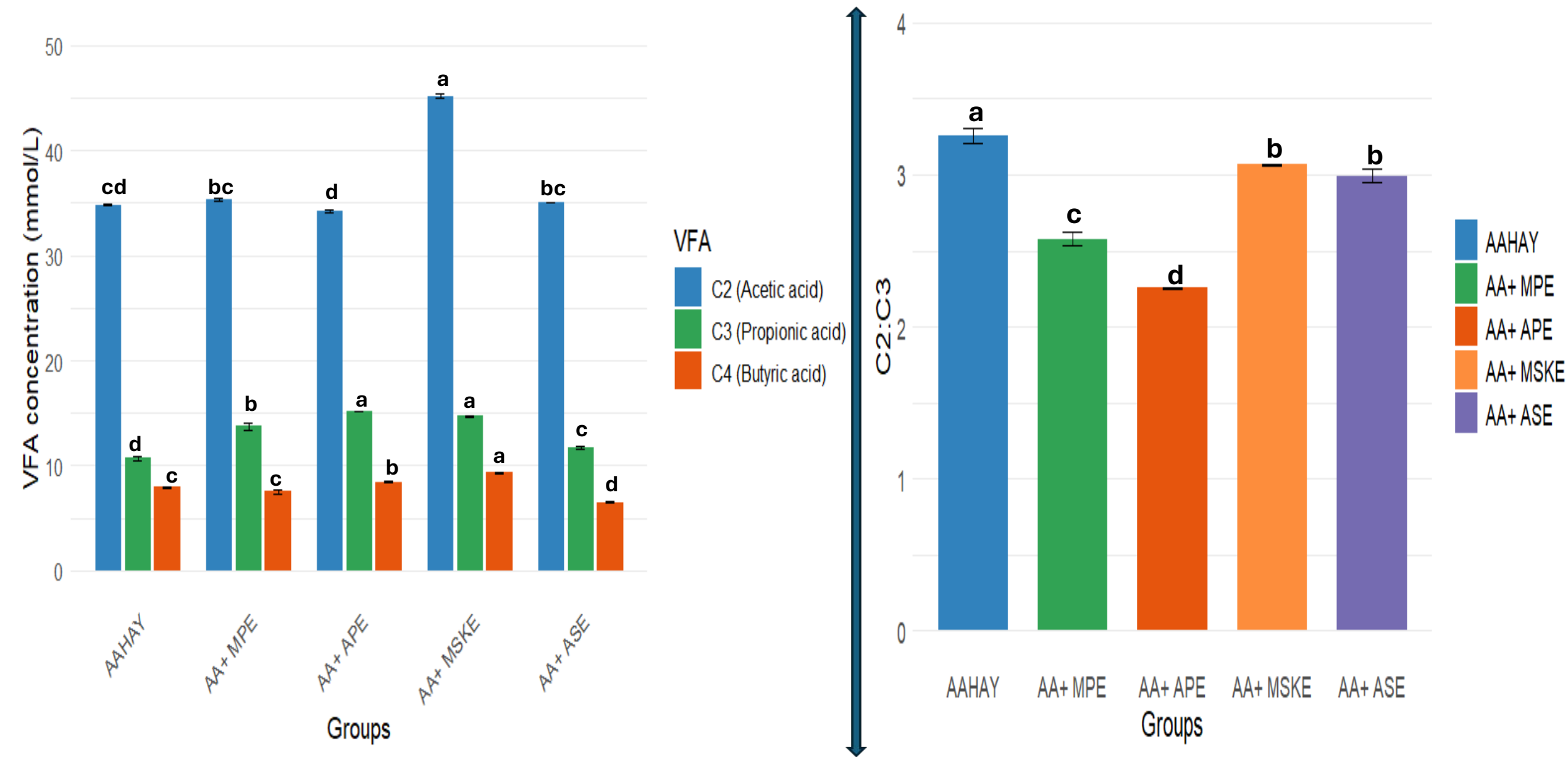
In vitro Gas volume and methane after 24-hour incubation of encapsulated extracts of byproducts.



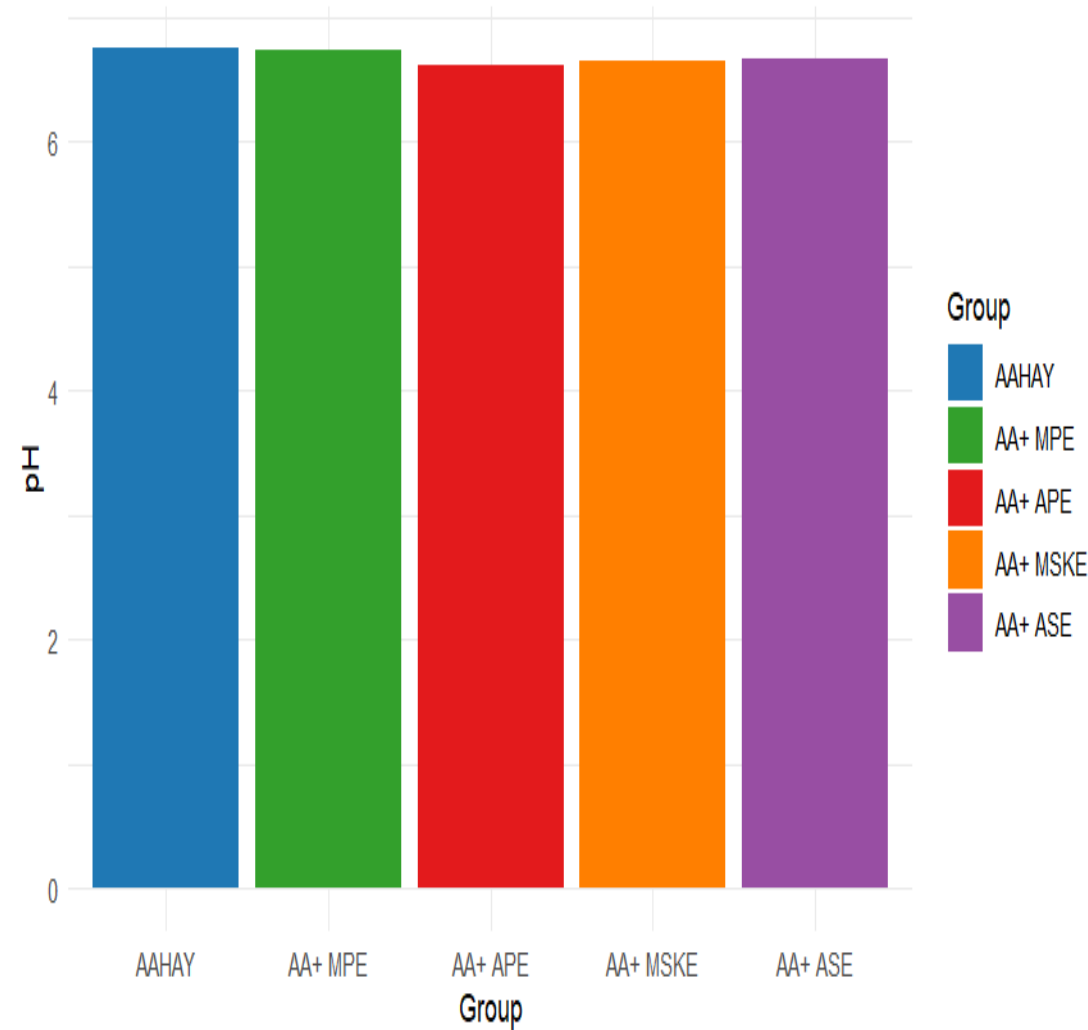
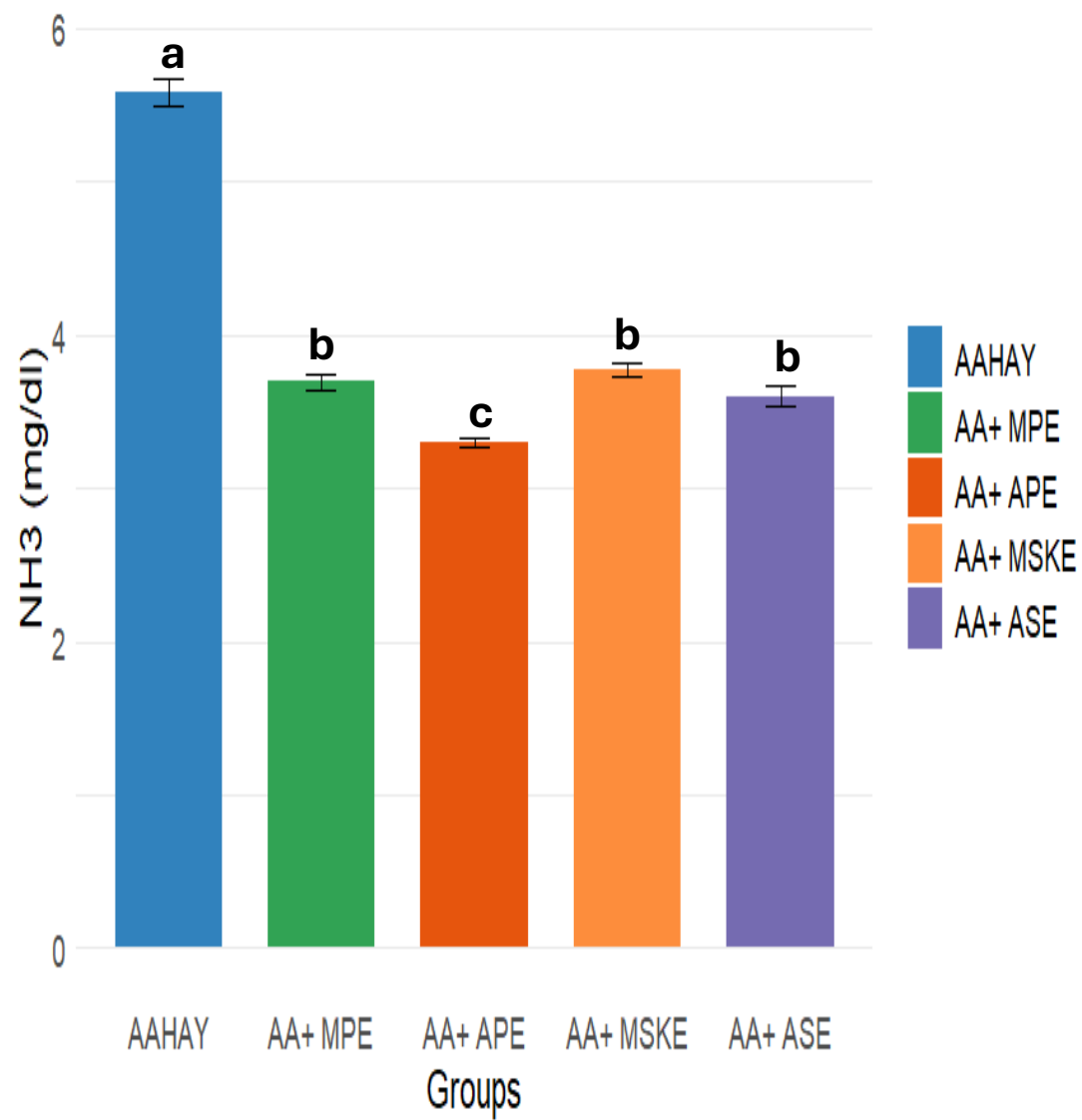
IVOMD after 24 hours in vitro fermentation of encapsulated extracts of by-products.



Volatile fatty acids; acetate (C2), propionate (C3), butyrate (C4), C2:C3, after 24 hours in vitro fermentation of encapsulated extracts of by-products.



Ammonia nitrogen (NH₃-N), and pH after 24 hours in vitro fermentation of encapsulated extracts of by-products.



Conclusion

Promising Feed Ingredients: Mango peel, Mango Seed Kernel and Avocado Seed are viable feed ingredients with good digestibility.

Environmental Impact: Encapsulated peel extracts of both fruits mango and avocado are effective in reducing methane emissions, beneficial for sustainable ruminant feeding strategies.

Sustainable Feeding Strategies: Utilizing fruit byproducts can help address food-feed competition, reduce waste, and promote environmentally-friendly livestock production.

Take-Home Message:

Turning Waste into Wealth: Our study reveals that agricultural byproducts are not just waste, they are valuable resources that can enhance animal nutrition while mitigating environmental impacts.
Incorporating these byproducts into ruminant diets is a win-win for both productivity and sustainability.

Future Perspectives

In Vivo Trials: Conduct comprehensive in vivo studies to validate in vitro findings on rumen fermentation and methane reduction.

Microbial Analysis: Explore the impact of mango and avocado byproducts on ruminal microbiota composition and activity

Economic Feasibility: Assess the cost-effectiveness and scalability of using these byproducts in commercial ruminant feeding programs.

THANK YOU

Do you have any questions?

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