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In vitro rumen fermentation characteristics of insect processed proteins compared to a conventional protein source

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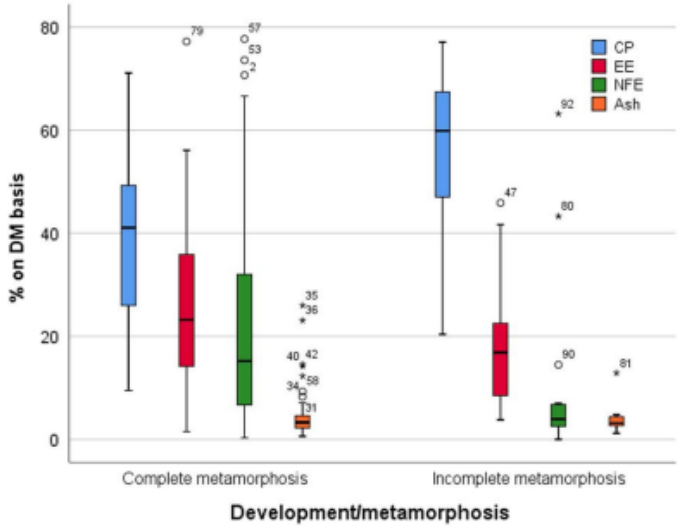
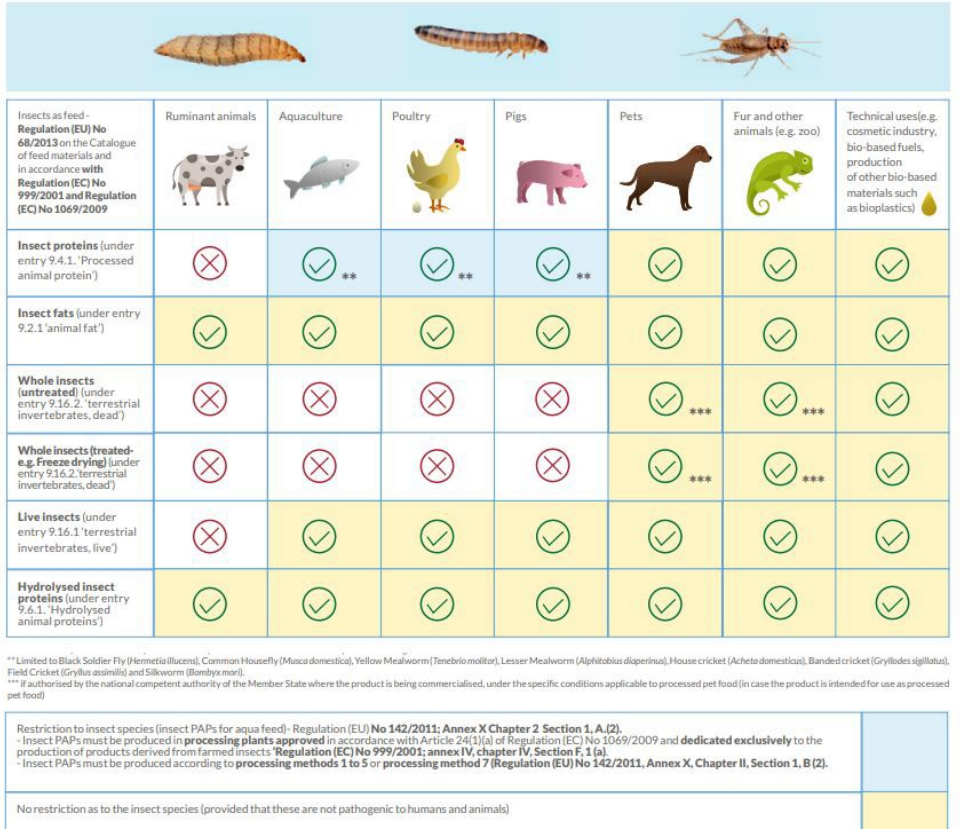
Insect in animal nutrition

- Nutritional facts
- Legislation
- Dietary inclusion recomandation
  - Monogastric poultry swine (5-15%)
  - Aquafeed (25-30% replacement of fishmeal, maybe higher according to fish species
  - Pet animal (complete feed already commercialized)
  - Ruminants?



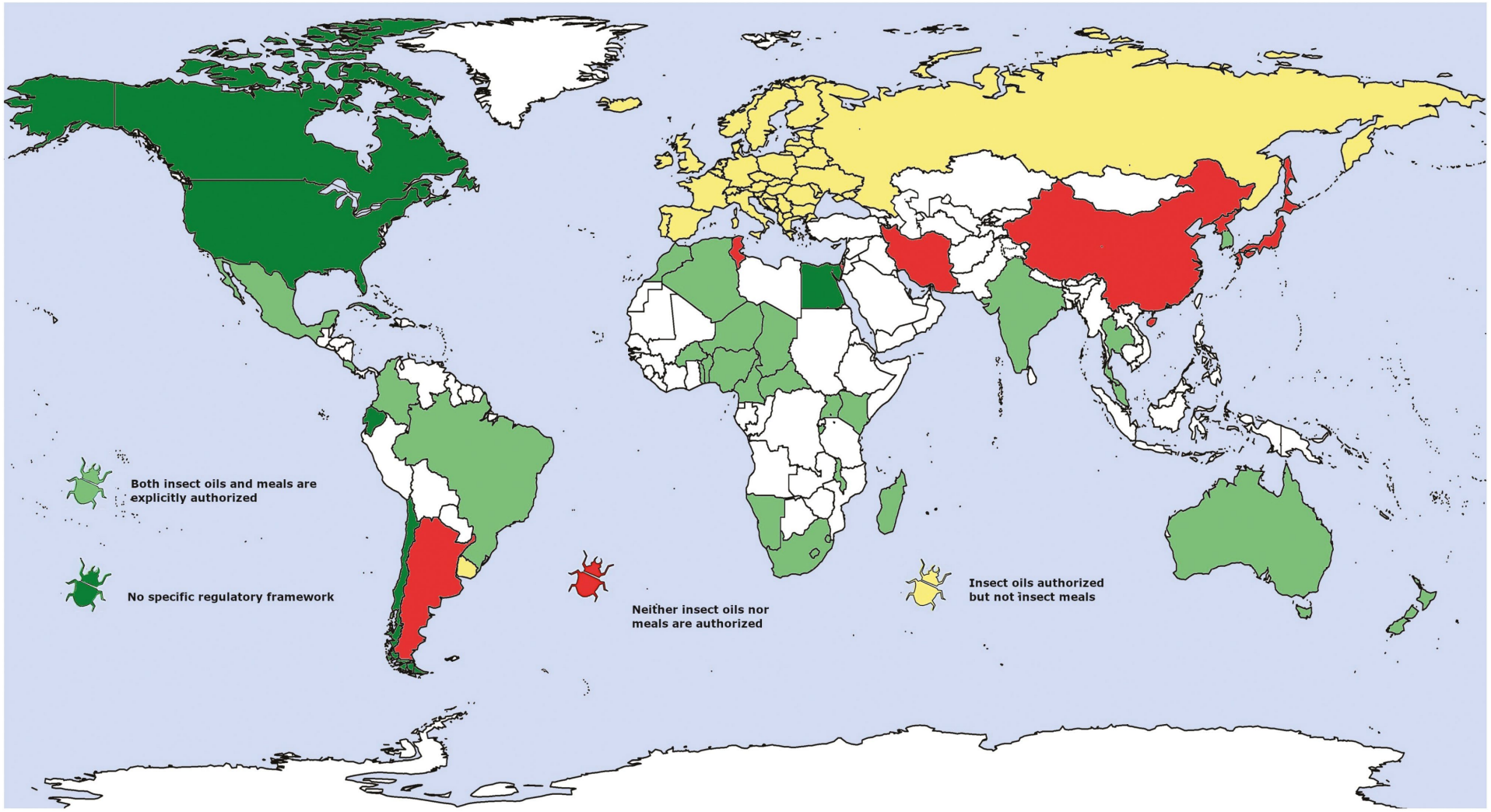


Insects as feed - **Regulation (EU) No 68/2013** on the Catalogue of feed materials and in accordance **with Regulation (EC) No 999/2001 and Regulation (EC) No 1069/2009**	Ruminant animals	Aquaculture	Poultry	Pigs	Pets	Fur and other animals (e.g. zoo)	Technical uses(e.g. cosmetic industry, bio-based fuels, production of other bio-based materials such as bioplastics)
Insect proteins (under entry 9.4.1.'Processed animal protein')	⊗	✓ **	✓ **	✓ **	✓	✓	✓
Insect fats (under entry 9.2.1'animal fat')	✓	✓	✓	✓	✓	✓	✓
Whole insects (untreated) (under entry 9.16.2. 'terrestrial invertebrates, dead')	⊗	⊗	⊗	⊗	✓ ***	✓ ***	✓
Whole insects (treated- e.g. Freeze drying) (under entry 9.16.2.'terrestrial invertebrates, dead')	⊗	⊗	⊗	⊗	✓ ***	✓ ***	✓
Live insects (under entry 9.16.1 'terrestrial invertebrates, live')	⊗	✓	✓	✓	✓	✓	✓
Hydrolysed insect proteins (under entry 9.6.1.'Hydrolysed animal proteins')	✓	✓	✓	✓	✓	✓	✓

** Limited to Black Soldier Fly (*Hermetia illucens*), Common Housefly (*Musca domestica*), Yellow Mealworm (*Tenebrio molitor*), Lesser Mealworm (*Alphitobius diaperinus*), House cricket (*Acheta domesticus*), Banded cricket (*Gryllodes sigillatus*), Field Cricket (*Gryllus assimilis*) and Silkworm (*Bombyx mori*).
*** if authorised by the national competent authority of the Member State where the product is being commercialised, under the specific conditions applicable to processed pet food (in case the product is intended for use as processed pet food)

Restriction to insect species (insect PAPs for aqua feed)- Regulation (EU) **No 142/2011; Annex X Chapter 2 Section 1, A.(2).** - Insect PAPs must be produced in **processing plants approved** in accordance with Article 24(1)(a) of Regulation (EC) No 1069/2009 and **dedicated exclusively** to the production of products derived from farmed insects **'Regulation (EC) No 999/2001; annex IV, chapter IV, Section F, 1 (a).** - Insect PAPs must be produced according to **processing methods 1 to 5** or **processing method 7 (Regulation (EU) No 142/2011, Annex X, Chapter II, Section 1, B (2).**	
No restriction as to the insect species (provided that these are not pathogenic to humans and animals)	

Current worldwide legislation framework on the use of insects as feed for ruminants.



(Renna et al. 2023)

Insect in ruminant nutrition

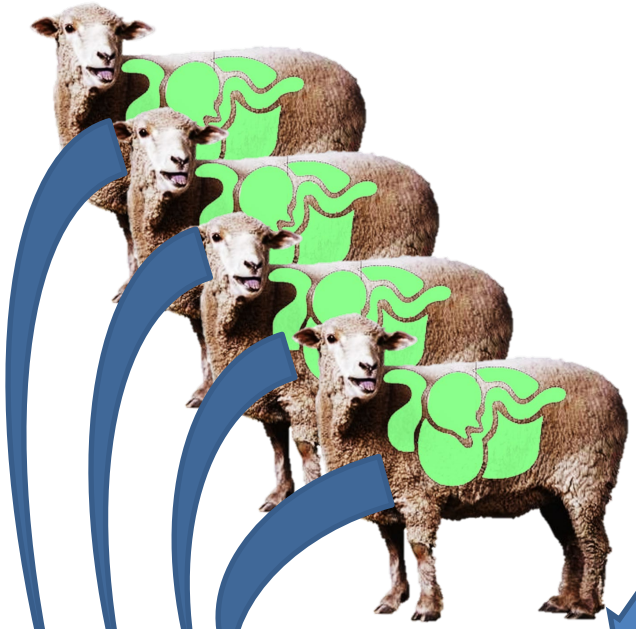
- Alternatives to conventional protein and fat sources
- At the moment more restrictive legislation than other farmed animals
- *in vitro* digestibility? Total Gas production
- Effect on CH_4 emissions and biohydrogenation?

Aim

This research aimed to evaluate the nutritional composition, **in vitro digestibility**, and **gas production** kinetics of **Black Soldier Fly** and ***Tenebrio molitor*** processed proteins compared with soybean meal f.e. as a reference raw material.

Material and methods

- Samples: soybean meal, Black soldier fly, *Tenebrio molitor*
- Nutritional characterization
- *in vitro* ruminal fermentation
  - Total gas production
  - *in vitro* short chain fatty acids production
  - gas production profile
  - and methane production
- Data were analysed using IBM SPSS **Statistics** software using one-way analysis of variance (**ANOVA**) to compare means.



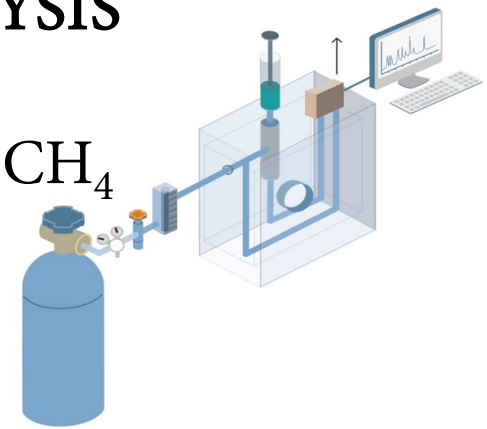
NUTRITIONAL CHARACTERIZATION

TOTAL GAS PRODUCTION

- calibrated syringe
- and pressure transducer

GC ANALYSIS

- VFA and CH_4



Nutritional characterization

Sample	DM	Ash	OM	CP	NDF	ADF	ADL	EE
BSF	90.0	11.3	88.7	31.4	15.8	7.75	1.15	32.0
TM	88.0	3.93	96.1	46.4	14.9	8.39	1.49	30.8
Soy	95.6	5.07	94.9	45.8	12.2	7.56	0.16	1.15

Chitin content

BSF 5-6% (Spranghers et al. 2017)

TM 8-10% (VIVES internal report)

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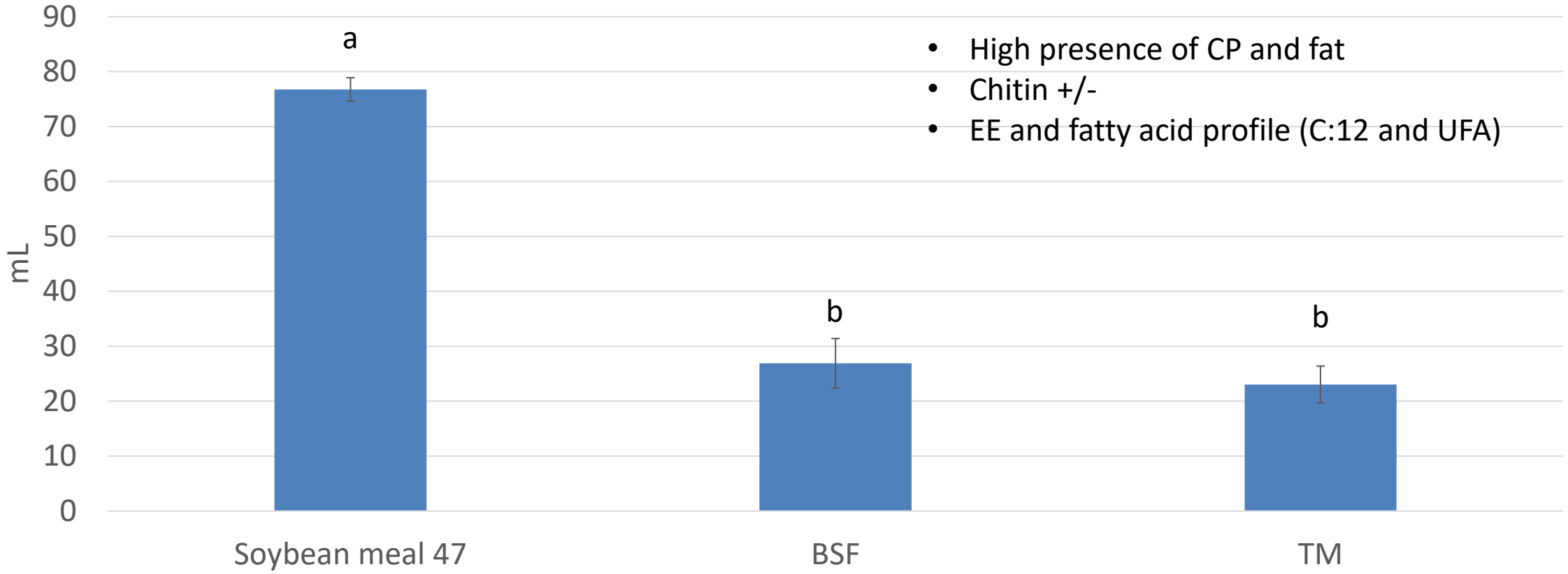
In vitro test _ Gas production



- High presence of CP and fat
- Chitin +/-
- EE and fatty acid profile (C:12 and UFA)

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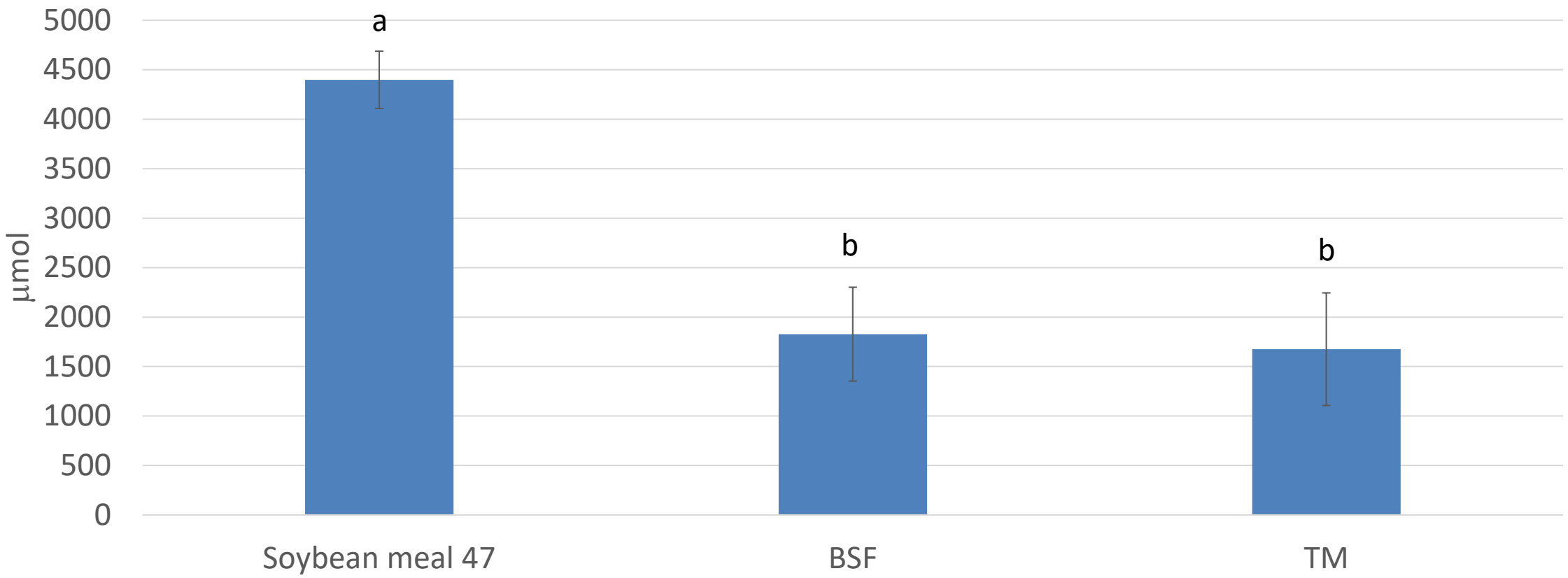
In vitro test _ Total VFAs production



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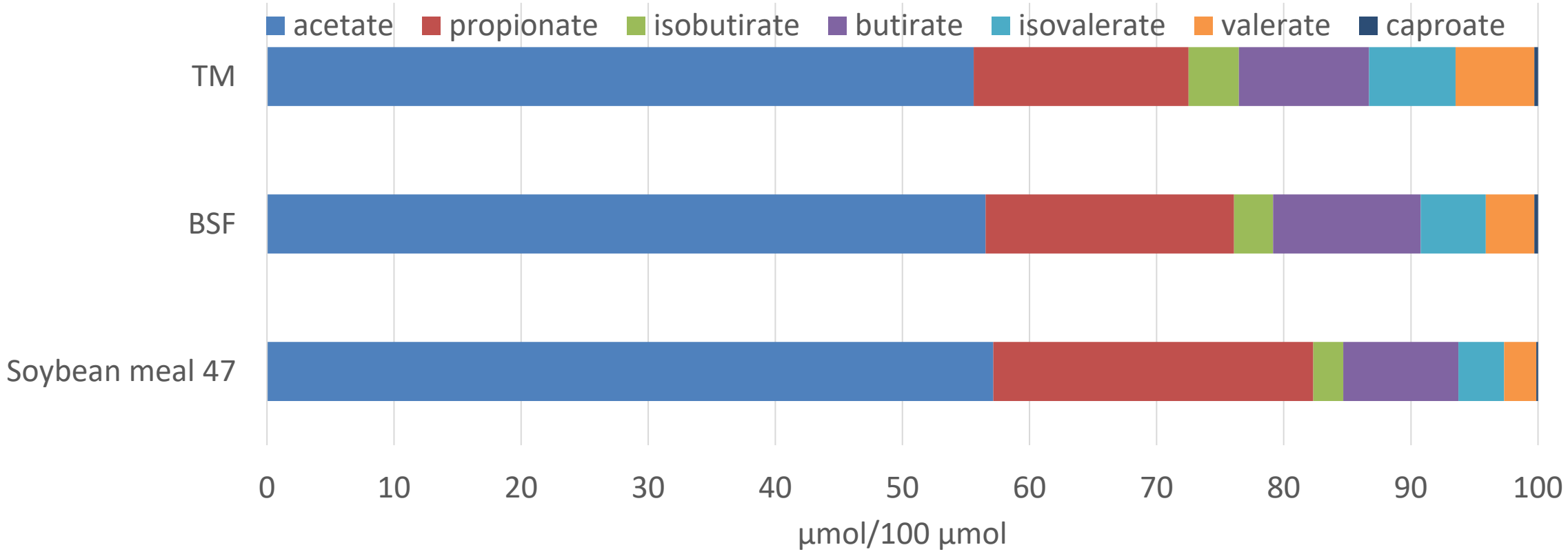
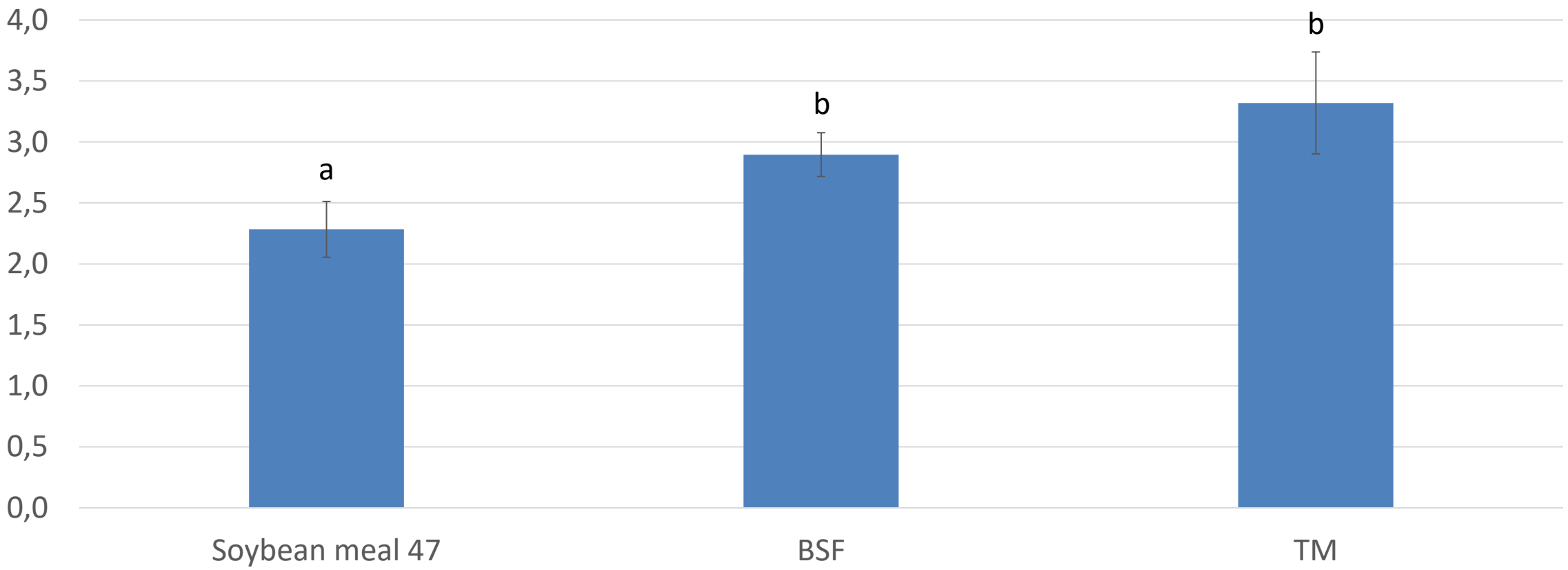
In vitro test _ VFAs molar proportion



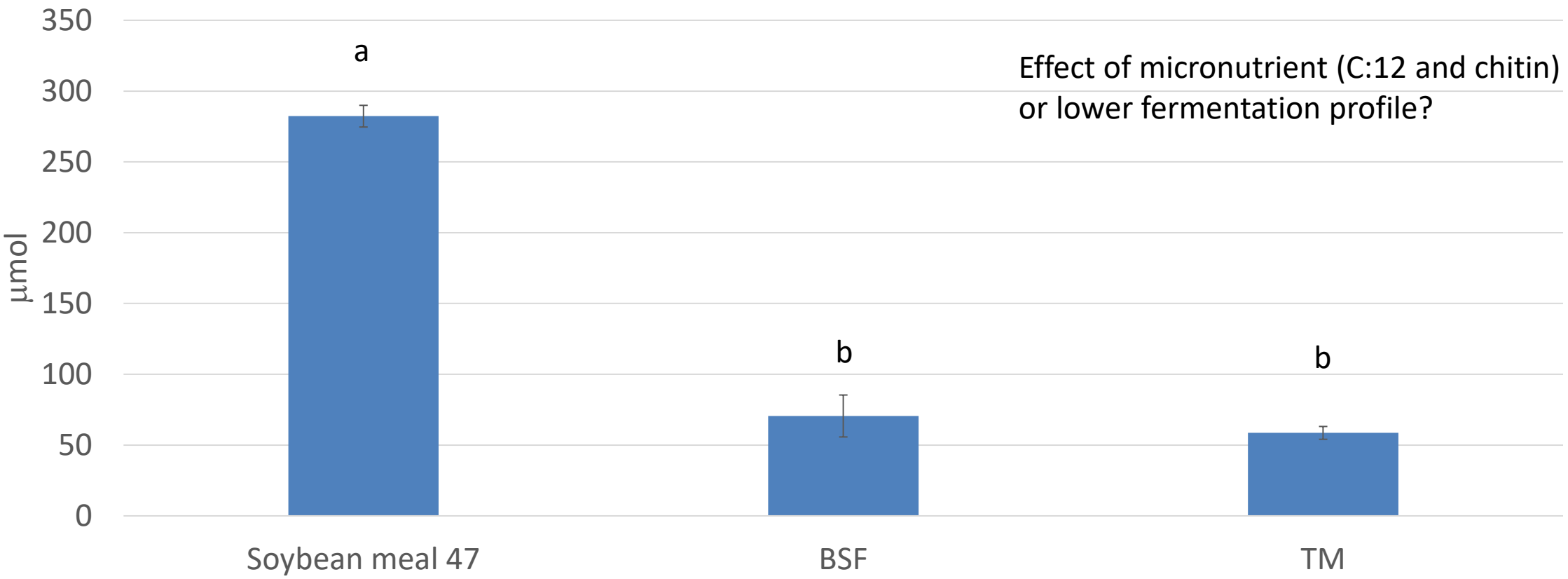
Propionate soybean meal > insect meal
Iso but TM>BSF>SM
Iso val and Val TM>BSF>SM

Results in line with previous study
(Renna et al. 2022)

In vitro test _ acetate/propionate ratio



In vitro test _ Methane



Conclusion

- The insect meals contained high CP and EE content
  - the use of full fat insect meal might be challenging toxic effect/methane reduction
- insect processed proteins hereby tested were characterized by low fermentation profile
- lower methane production compared to soybean meal
- it might speculate that insect PAPs could represent a valid by pass protein source

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Thank you for the attention

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