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Determination of minimal nutrient requirements for *Tenebrio molitor* (TM) growth

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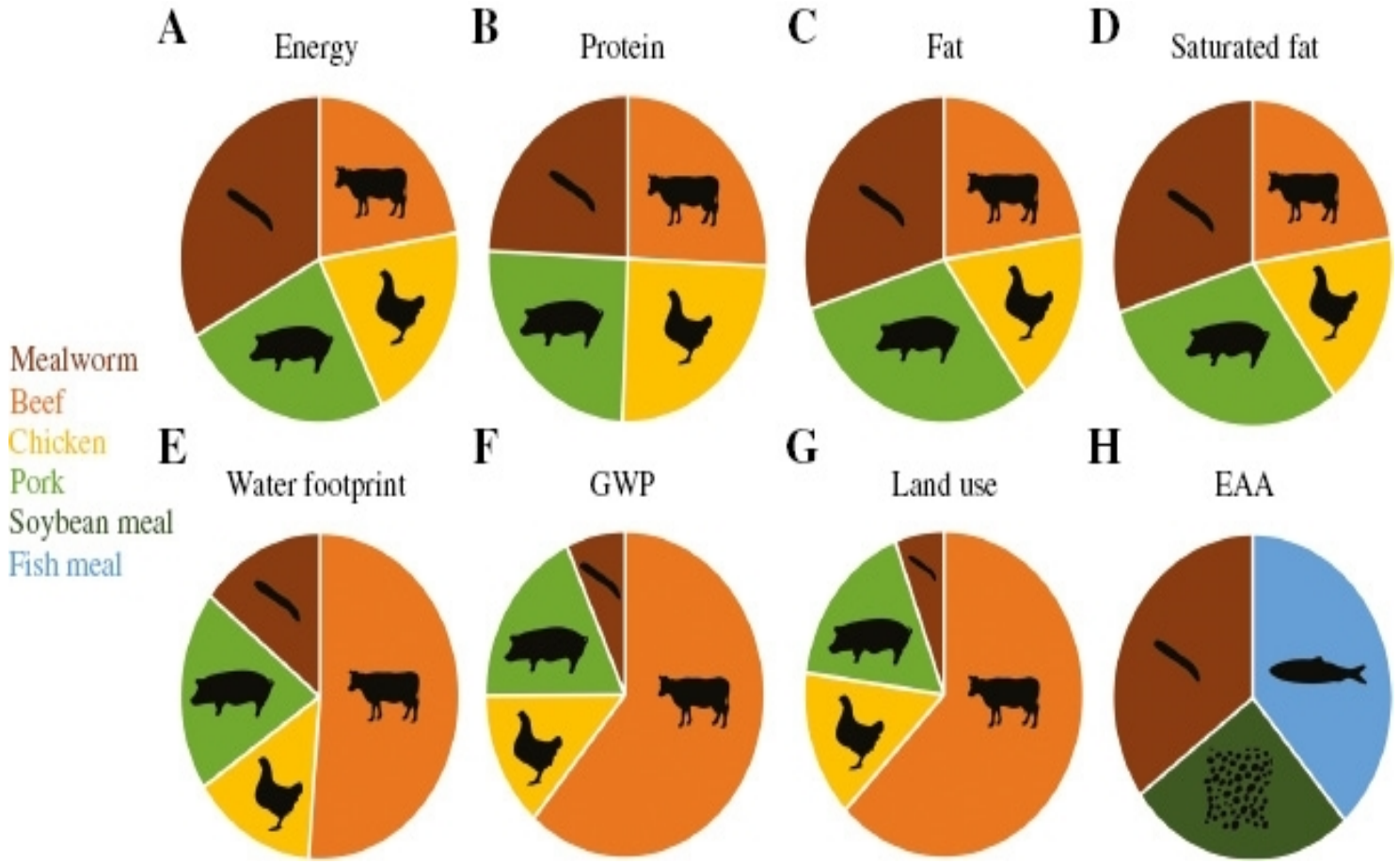
Introduction

Importance of Mealworms as feed:

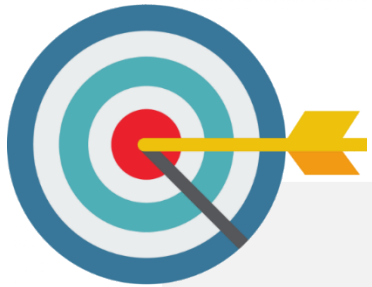
- An **alternative protein-rich and sustainable** animal feed and human food.

- potential ability to utilise low-cost by-products as feed.



Grau, T., Vilcinskas, A., & Joop, G. (2017).

Aim



Determine the minimal nutrient requirements for mealworm growth.

Materials and Methods

Evaluate the effect of minimal feed on insect growth for 24 days.

Environmental Condition:

- Temperature of 27° C
- Humidity of 60%
- Food replenished every 10 days.

Assessments:

- Growth.
- Pupation.
- Death and live larvae.

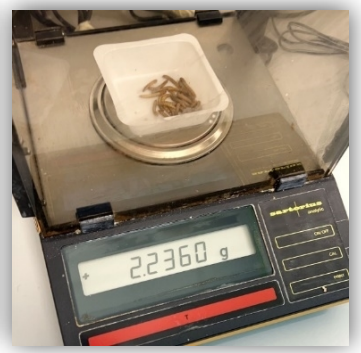
Treatment groups:

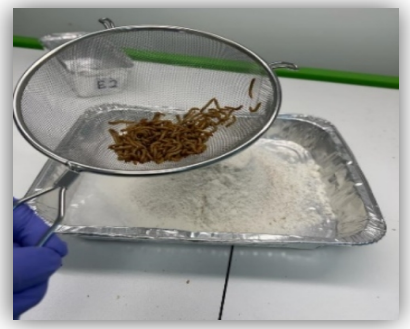
- 250 insects per replicate.
- 6 treatment groups.

Materials and Methods – feed composition

Group	Diet Composition
WB	Wheat Bran (Control)
C+P	Cellulose + 15% Protein (Casein)
C+P+MV	Cellulose + 15% Protein + MV
C+P+FA	Cellulose + 15% Protein + 5% Fat (Wheat-germ oil)
C+P+MV+FA	Cellulose + 15% Protein + MV + 5% Fat
C+P+G+MV+FA	Cellulose + 15% Protein + 15% Glucose + MV + 5% Fat

MV: minerals and vitamins.





Materials and Methods

MV: minerals and vitamins to match WB

Mineral content	mg/100g Feed
Choline chloride	100
Calcium carbonate	183
Cupric sulphate	3
Ferric citrate	50
Magnesium chloride	2396
Manganese II chloride tetrahydrate	42
Sodium phosphate monobasic	3943
Potassium chloride	2251
Sodium chloride	5
Zinc carbonate Basic	13
Vitamin content	**mg/100g Feed**
Thiamin (Vit B1)	0.5
Riboflavin (Vit B2)	0.5
Nicin (Vit B3)	13.5
Panthothenic acid (Vit B5)	2.1
Folate (Vit B9)	0.1
Alpha-tocopherol (Vit E)	1.4

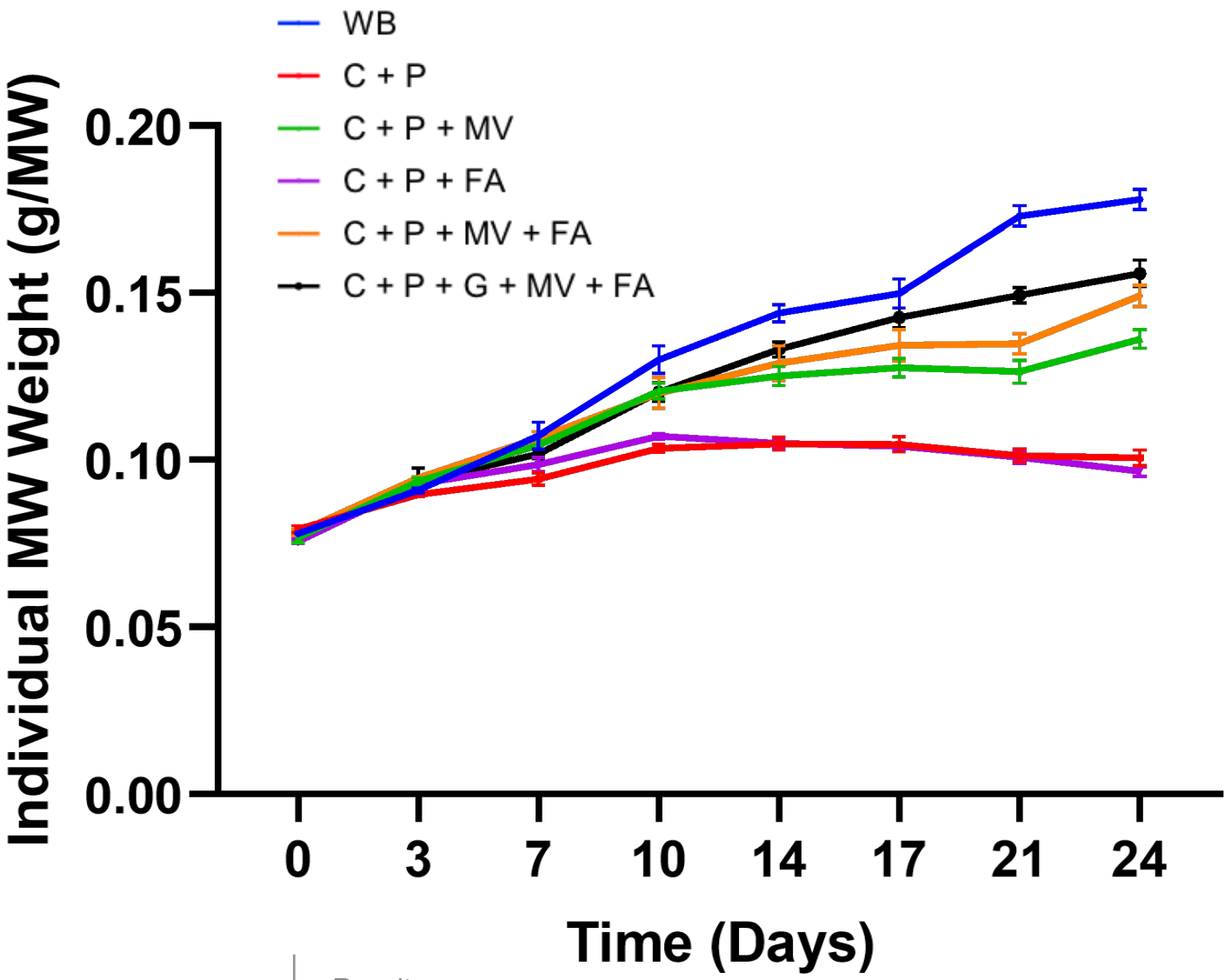
Fat (Wheat-germ oil)

Table 2. The average fatty acid composition of wheat germ oil (oil content of wheat germ is %8–11 by weight) [8, 21, 38, 39, 40]

Fatty acid	Percent of total fatty acid
Palmitic acid (16:0)	11–17
Stearic acid (18:0)	0.6–3.6
Oleic acid (18:1)	14–25
Linoleic acid (18:2)	49–60
Linolenic acid (18:3)	4–10

Ghafoor, K. et al., (2017).

Results - Growth



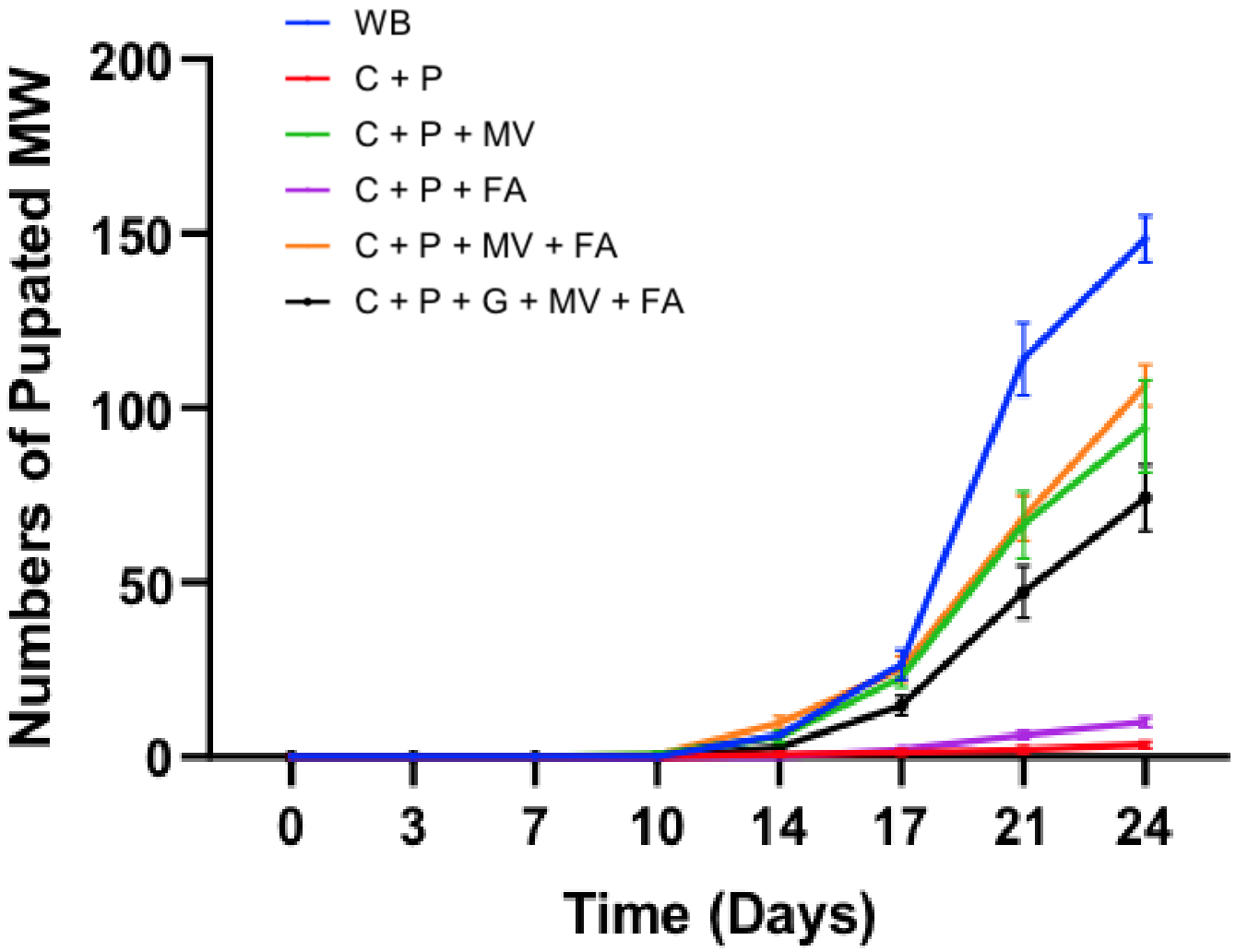
- Time x diet interaction ($P<0.001$)

- WB had the highest final body weight.

- C+P+G+MV+FA grew but 17% less than WB ($P<0.05$).

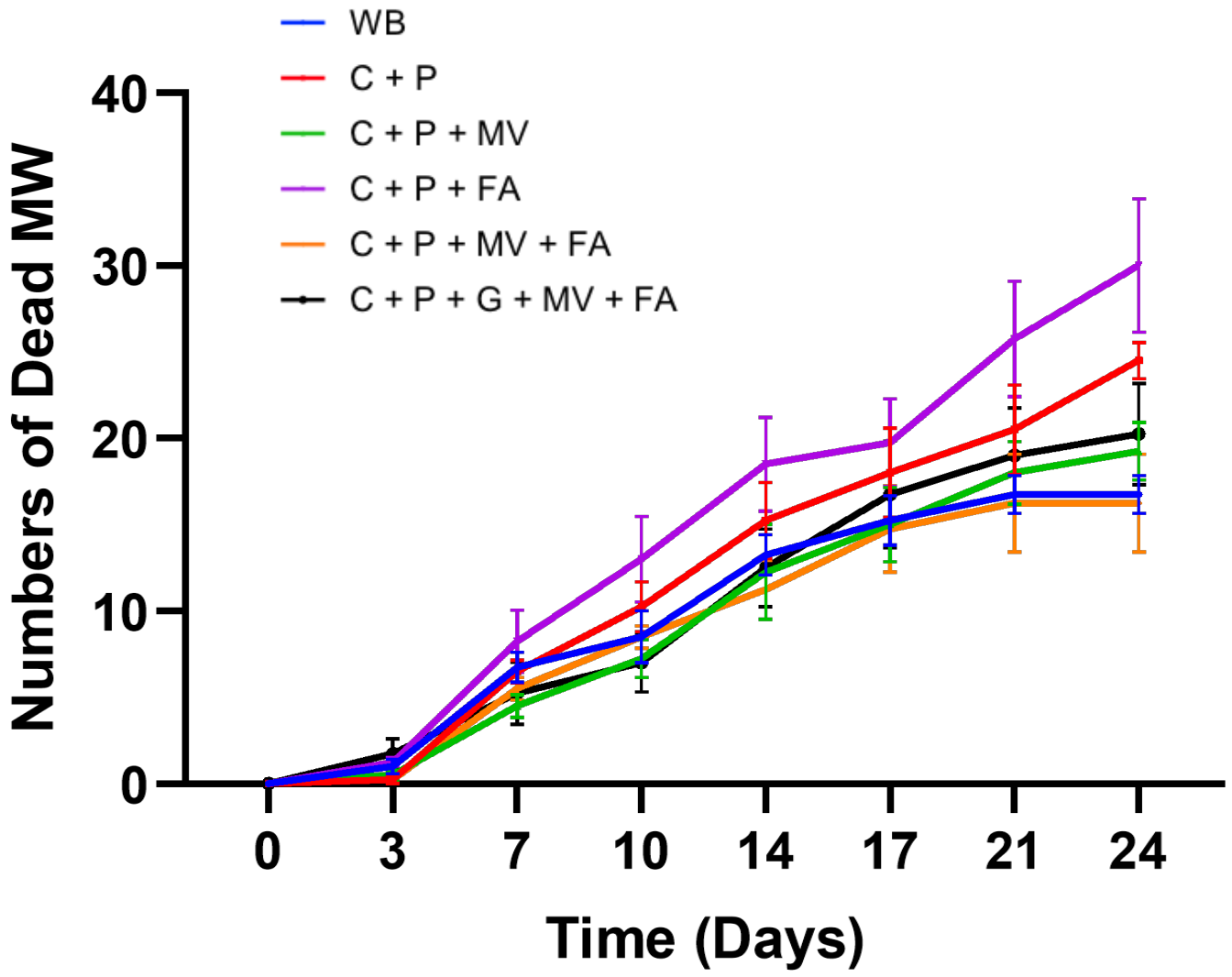
- MW did not grow without MV.

Results - Total Pupated Mealworm



- Time x diet interaction (P<0.001)
- WB showed the highest level of pupation (p<0.001), 59% pupation.
- C+P+G+MV+FA 30% pupated
- Very low pupation without MV.

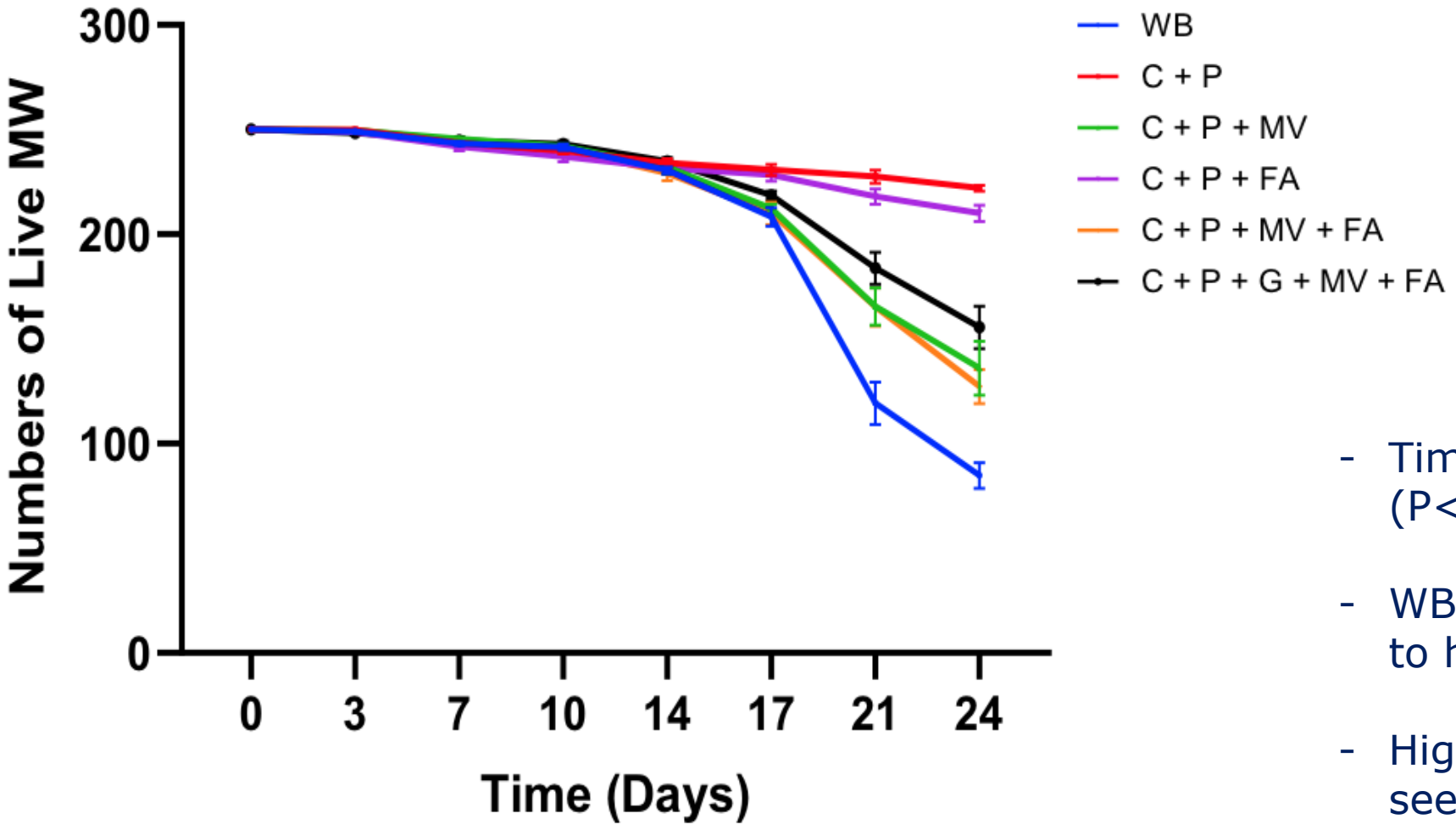
Results - Total Dead Mealworm



- Time x diet interaction (NS)
- Time (P<0.001)
- Treatment (P<0.001)

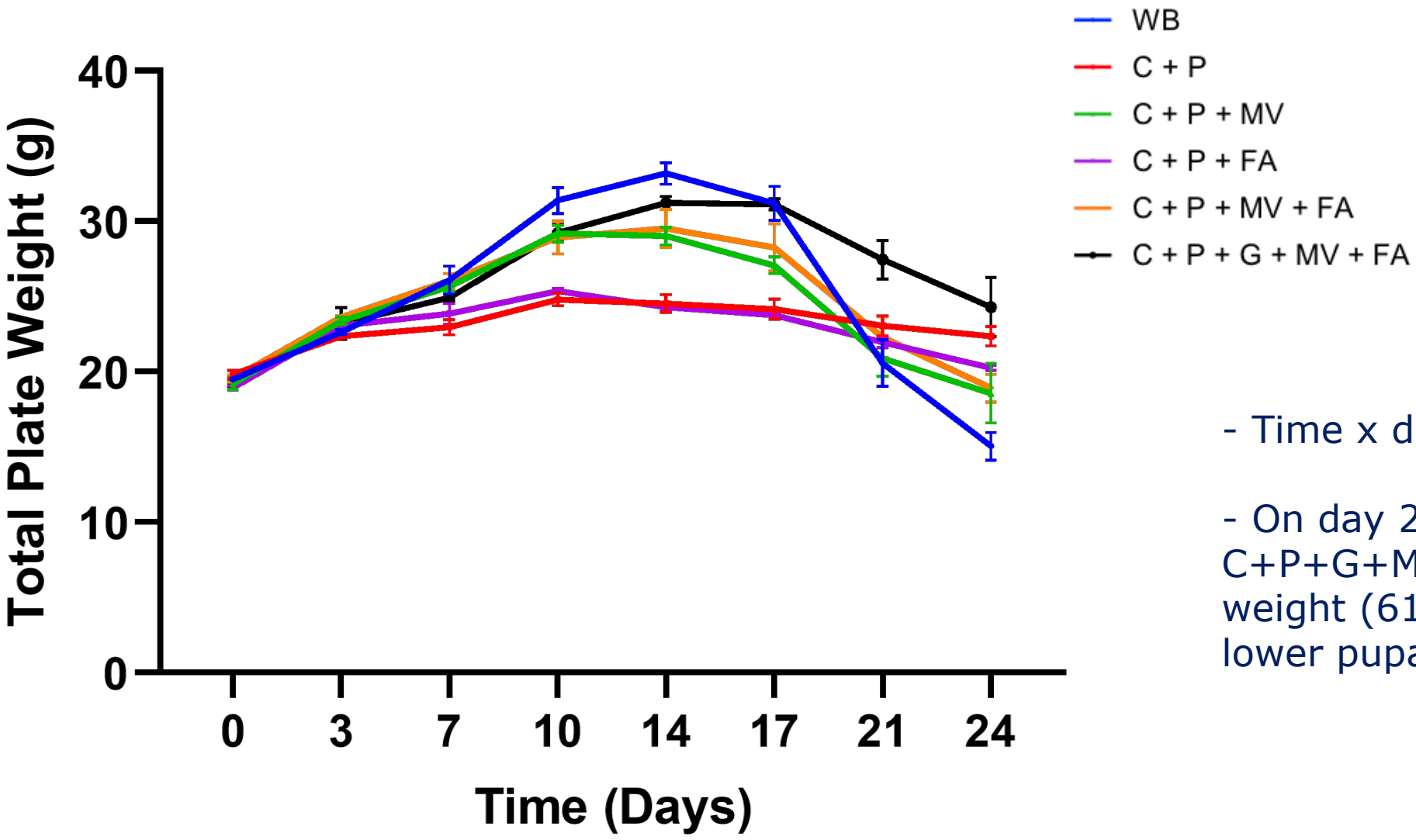
- Highest deaths seen without MV.

Results - live larvae



- Time x diet interaction ($P<0.001$).
- WB has the lowest values due to higher pupation.
- Highest numbers of live MW seen without MV due to low pupation.

Results (Total Plate Growth Rate)



- Time x diet interaction ($P<0.001$).

- On day 24:
C+P+G+MV+FA had the highest total weight (61% higher than WB) due to lower pupation.

Conclusion

- For growth, MW have a requirement for vitamins and minerals.
- MW growth can be enhanced by the addition of fat and carbohydrate (as well as protein).
- Larvae fed on the ‘complete’ synthetic diet do not pupate at the same rate as those fed on WB.
- These results cast doubt on whether MW can be reared on minimal substrates, such as polystyrene.

Acknowledgements

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