



Formulating balanced diets with local agricultural by-products from Greece as sustainable feed ingredients for *Tenebrio molitor* larvae

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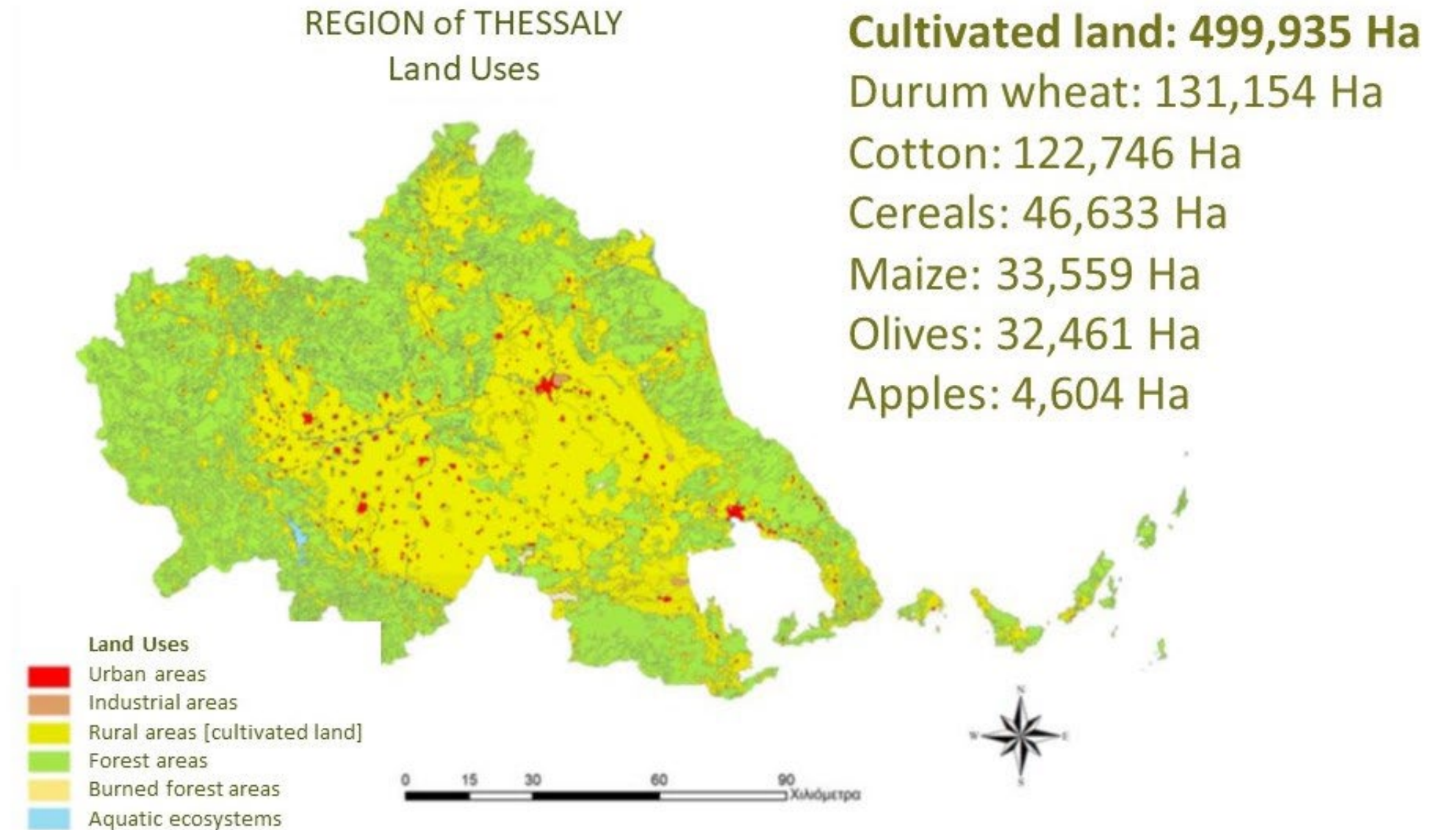
CROP WASTE FROM AGRICULTURAL PRODUCTION

A significant issue in Europe!

700++
million tonnes/year



Greece – Region of Thessaly



Laboratory of Entomology and Agricultural Zoology



University of
Thessaly, Greece



Local agricultural by-products from Greece as diet ingredients for *Tenebrio molitor* larvae



LOCAL AGRICULTURAL BY-PRODUCTS

1. Triticale
2. Oat
3. Barley
4. Cotton cake
5. Lupin
6. Hempseed
7. Rice



17% protein, 4.8% lipids

	Control	Diet 1	Diet 2	Diet 3
Wheat bran	100			
Rice bran		34	40	
Cotton cake		14	25	32.5
Oat by-product		52		33.5
Barley by-product			35	34

20% protein, 4.1% lipids

	Control	Diet 1	Diet 2	Diet 3	Diet 4
Yeast	13.5				
Wheat bran	86.5				
Triticale by-product		24.632	48.254		59.665
Barley by-product		43.682		50.061	
Cotton cake			51.746	32.544	
Lupin by-product		31.686		17.395	35.303
Hempseed by-product					5.031

23% protein, 4.1% lipids

	Control	Diet 1	Diet 2	Diet 3
Yeast	22			
Wheat bran	78			
Triticale by-product		47.558		40.885
Barley by-product			45.368	
Cotton cake				30.218
Lupin by-product		49.524	53.427	28.218
Hempseed by-product		2.917	1.205	

25% protein, 4.1% lipids

	Control	Diet 1	Diet 2	Diet 3
Yeast	28			
Wheat bran	72			
Triticale by-product		39.487		36.038
Cotton by-product class II			37.669	
Cotton cake				15.619
Lupin by-product		59.005	62.245	48.343
Hempseed by-product class II		1.508	0.086	



METHODOLOGY

Bioassay I (lab scale)



4g of substrate
(adding ad libitum)



50 newly-emerged
larvae

14 d after and
every 2 weeks



- **Survival**
- **Weight**



METHODOLOGY

Bioassay II (tray scale)



2.1 kg/tray



10,000 larvae/tray

14 d after and
every 2 weeks



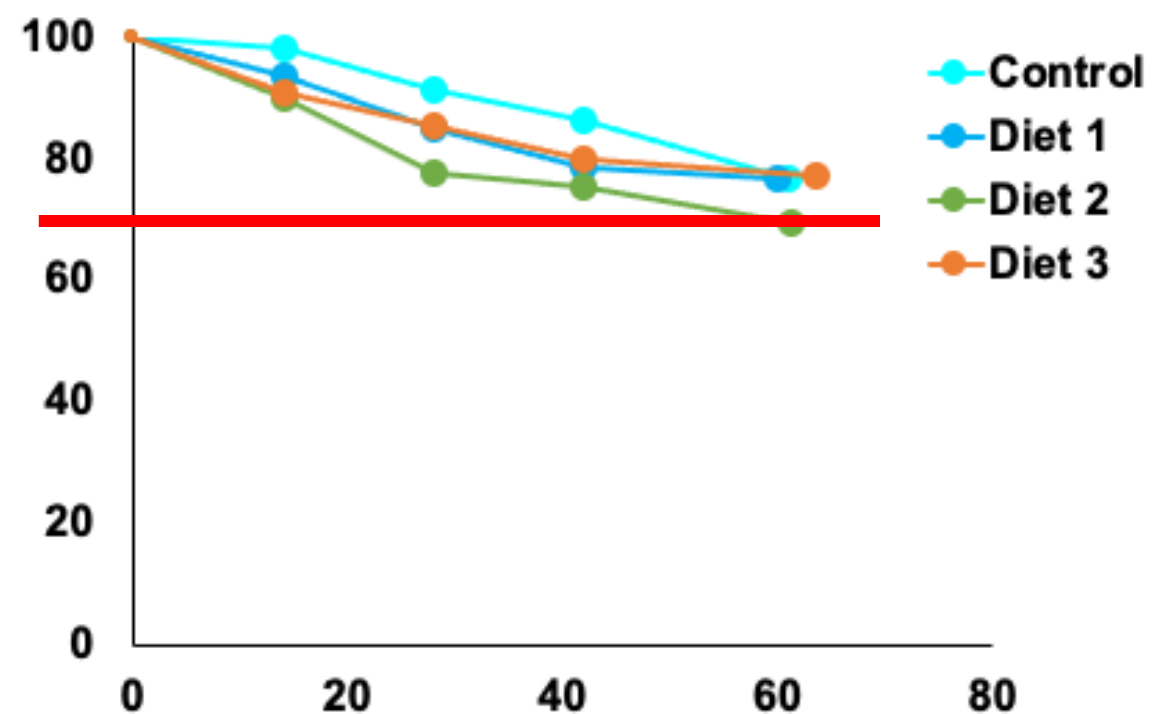
- **Survival**
- **Weight**



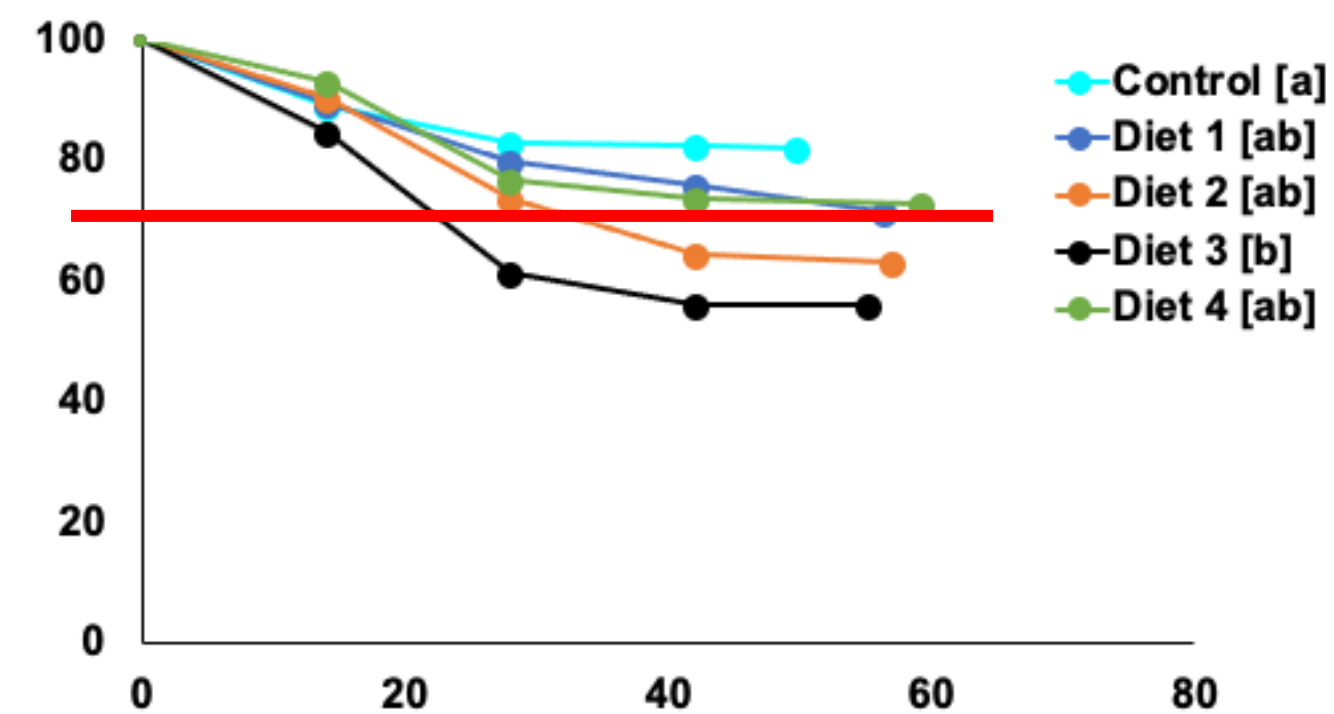
Larval survival (%)

Results - Bioassay I (lab scale)

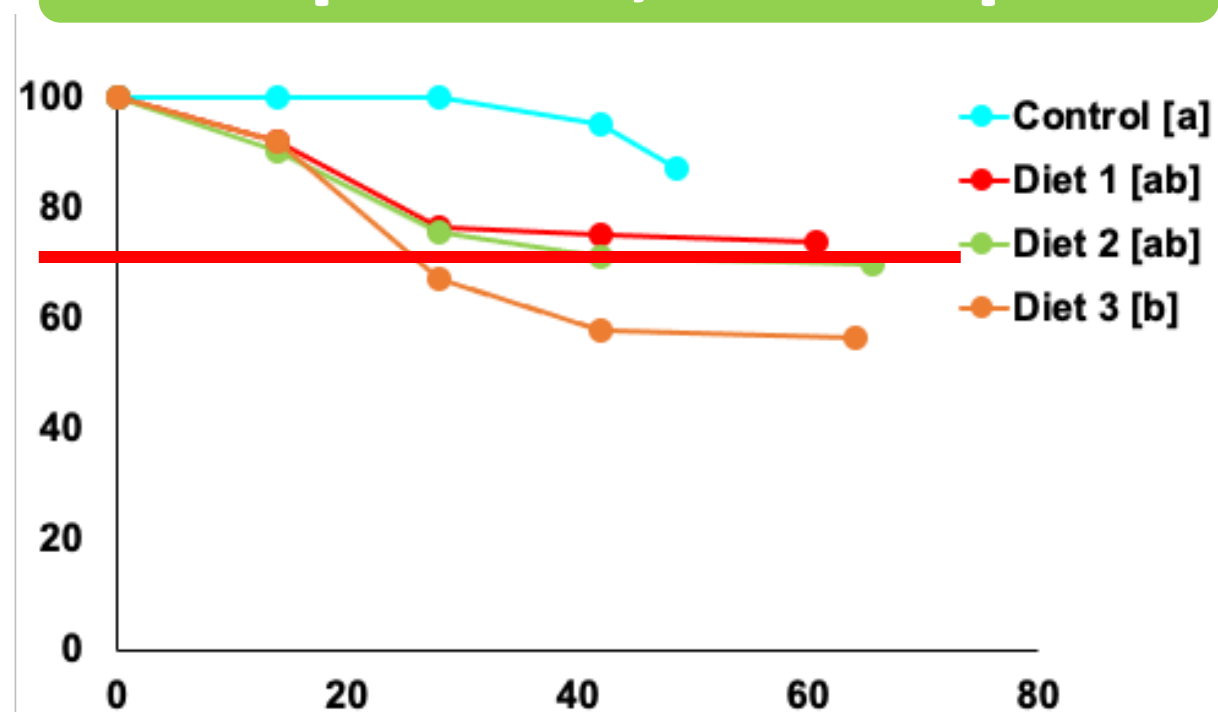
17% protein, 4.8% lipids



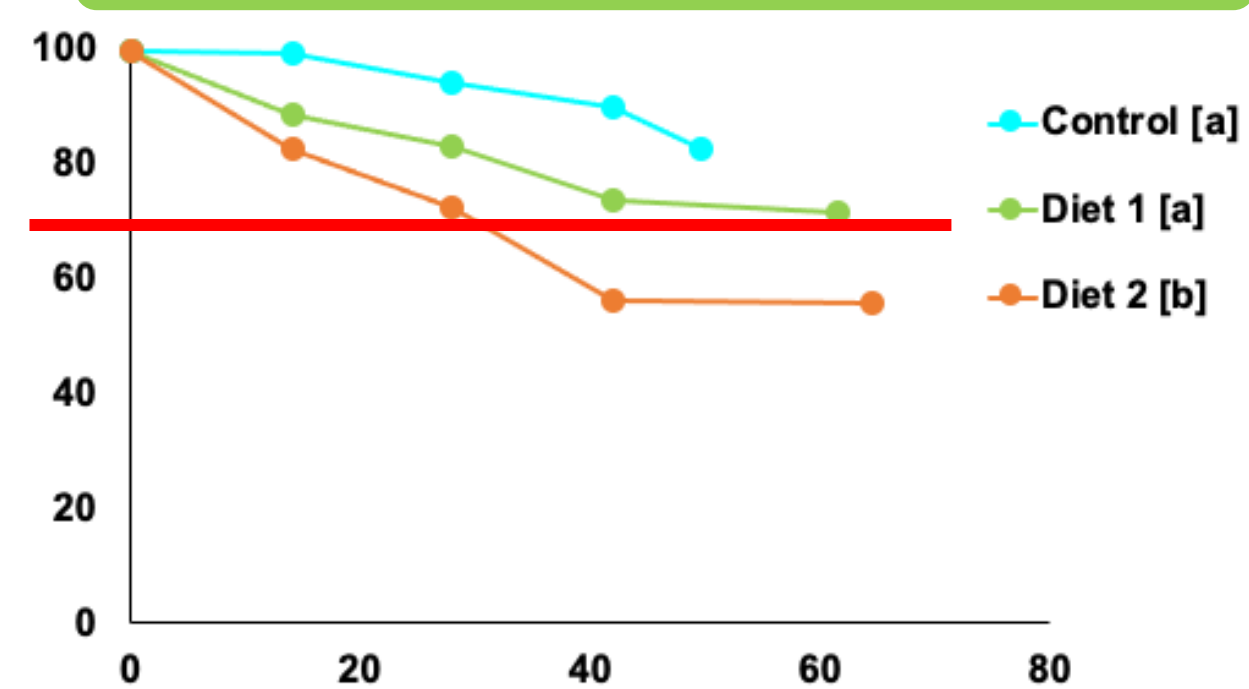
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23% protein, 4.1% lipids



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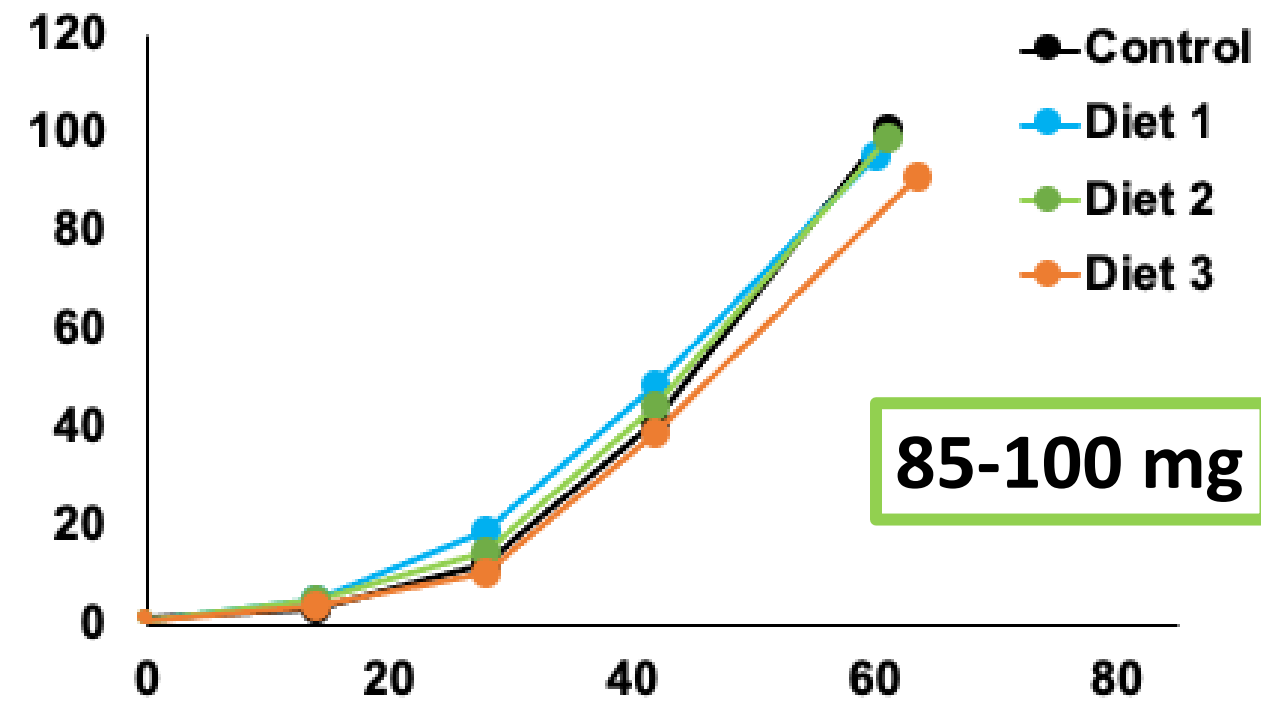


Time (days)

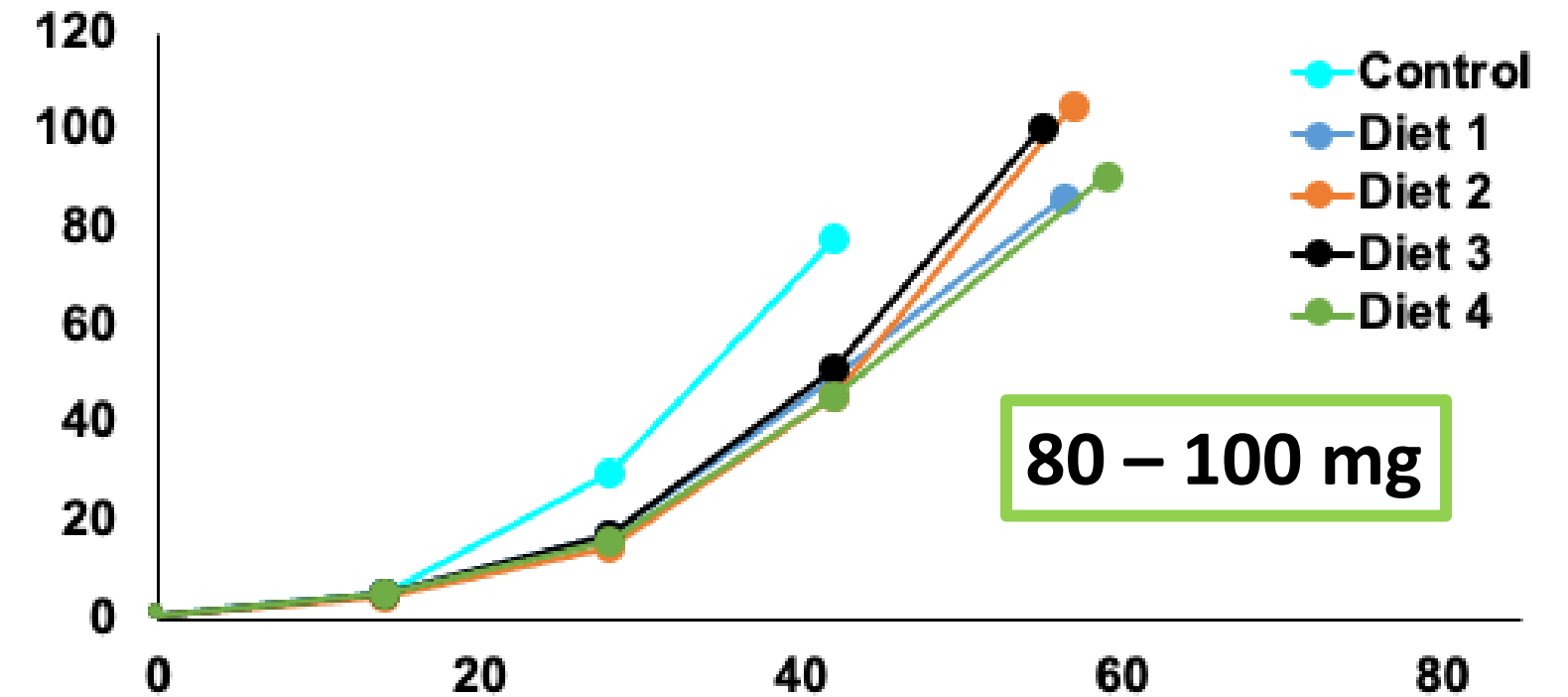
Individual larval weight (mg)

Results - Bioassay I (lab scale)

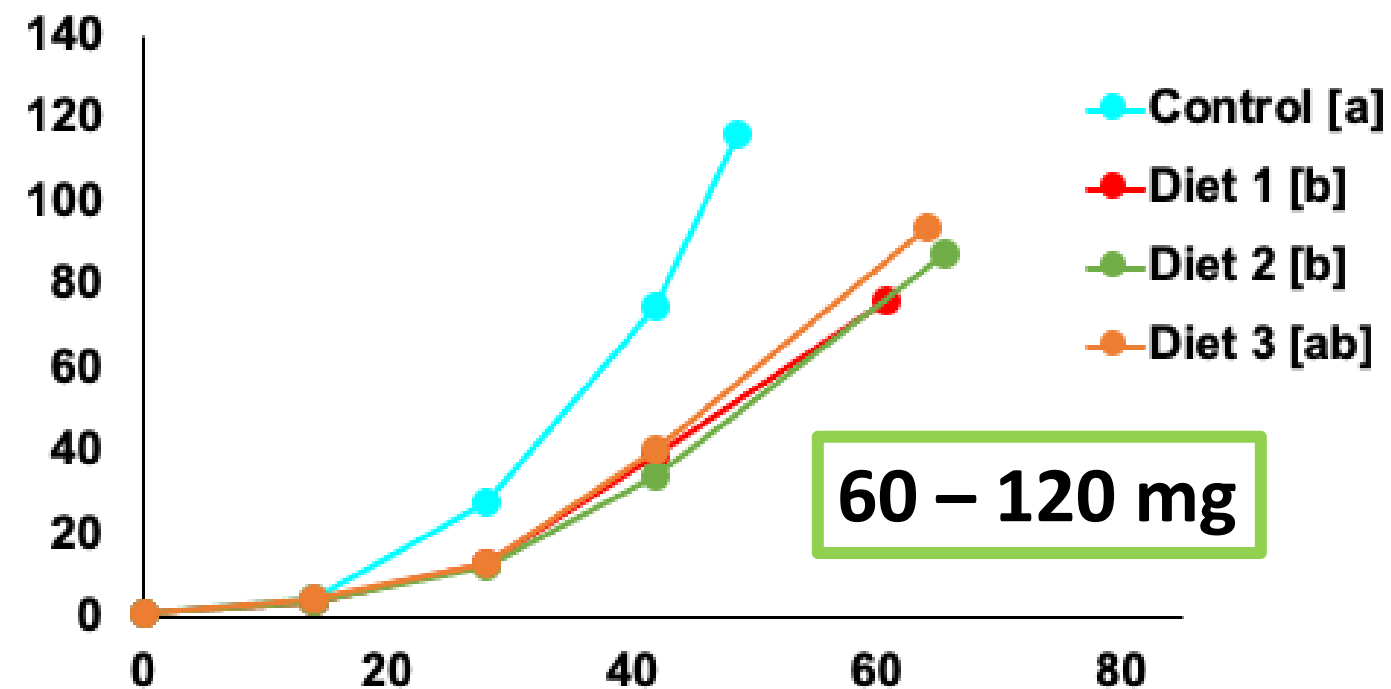
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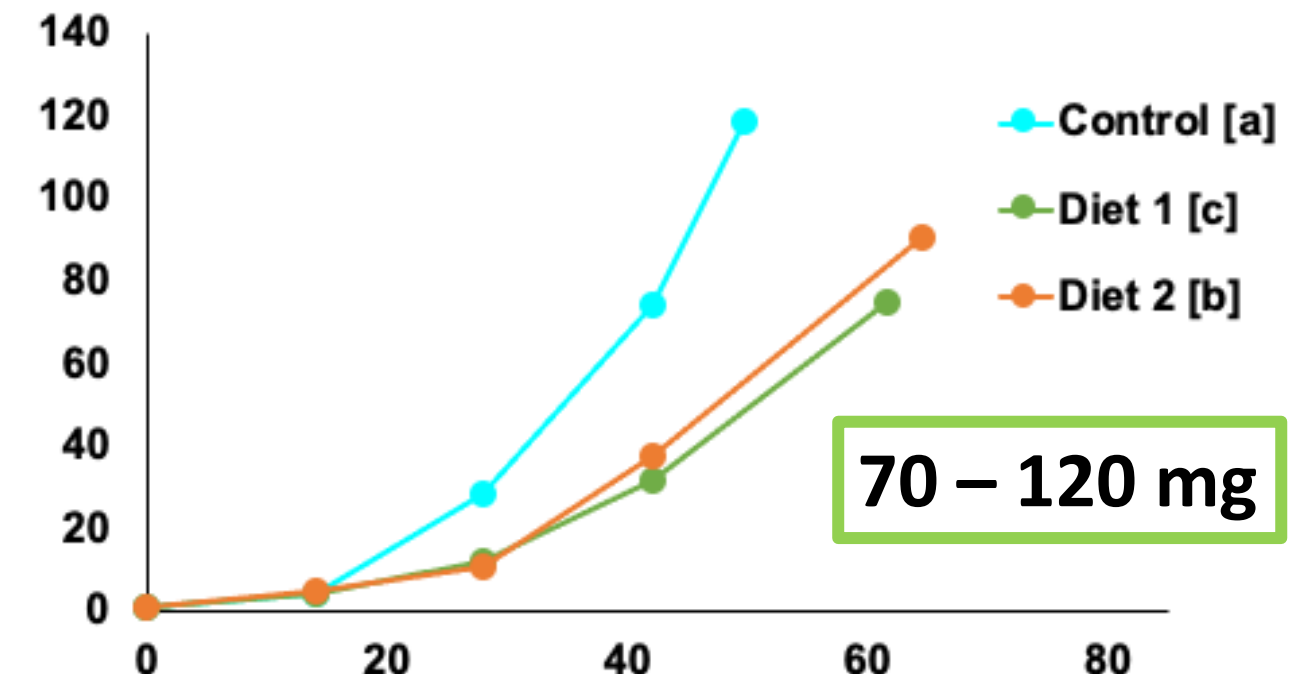
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25% protein, 4.1% lipids



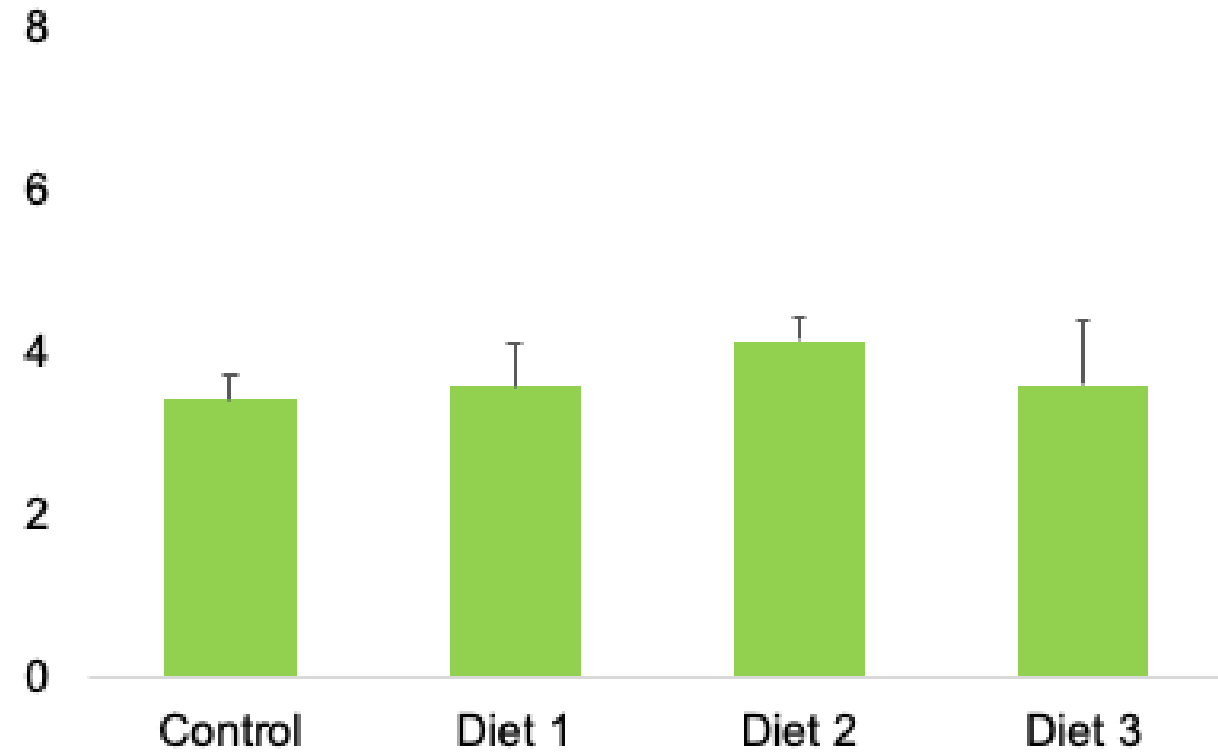
Time (days)

Results - Bioassay I (lab scale)

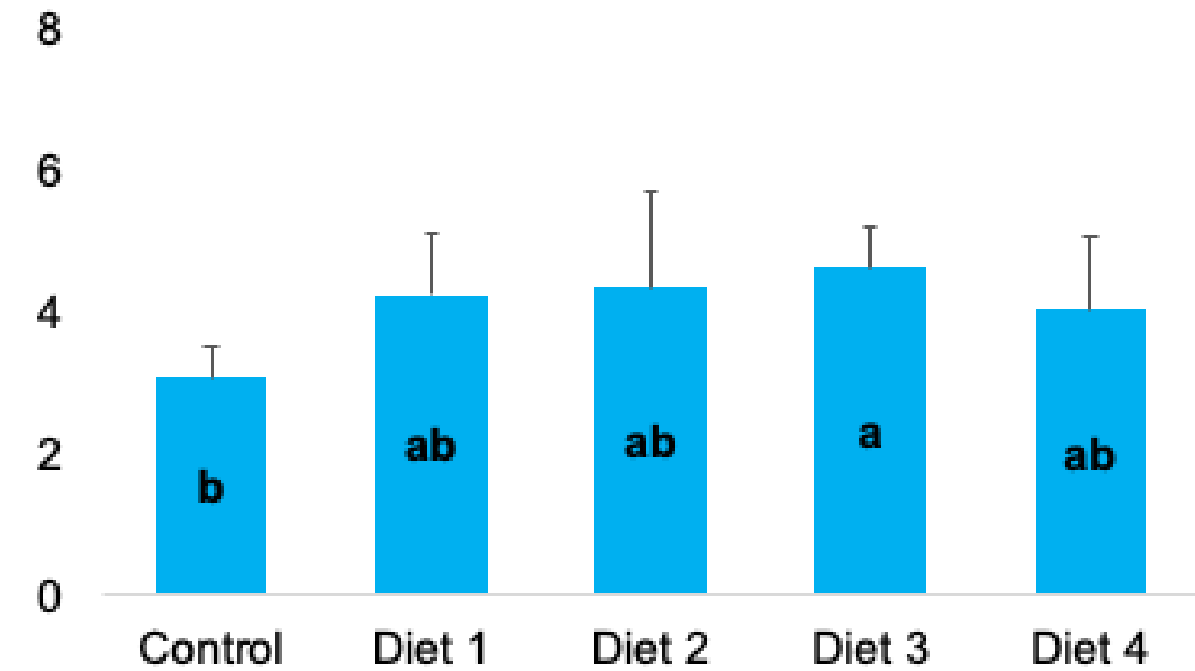
FCR

Feed conversion ratio

17% protein, 4.8% lipids

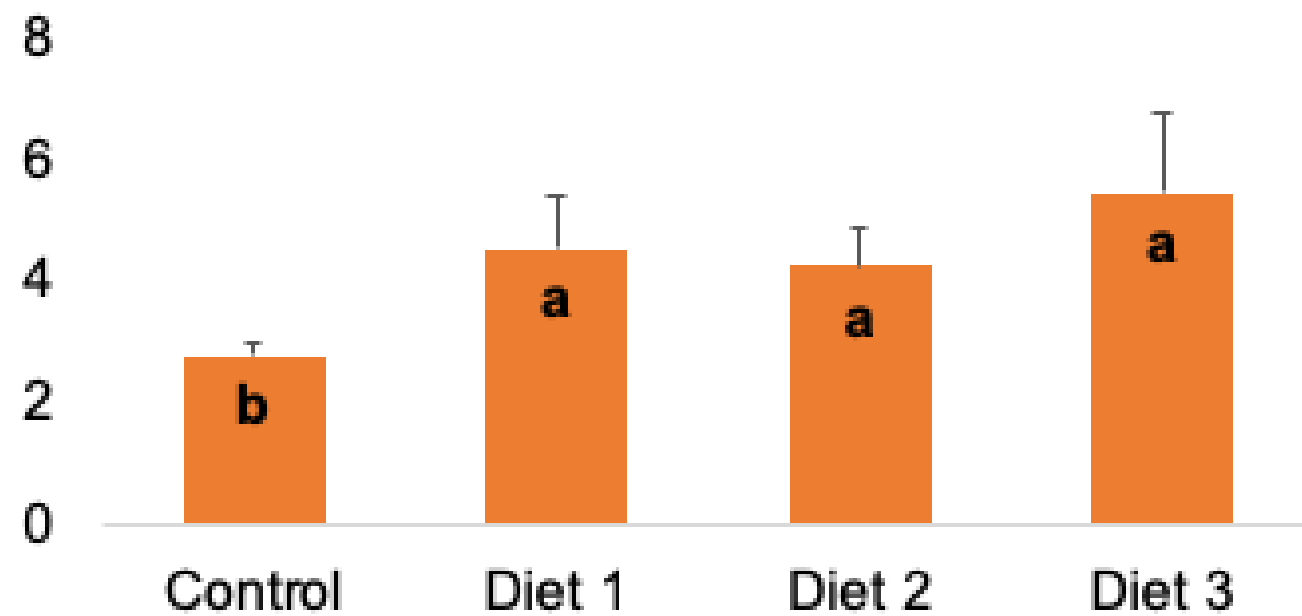


20% protein, 4.1% lipids

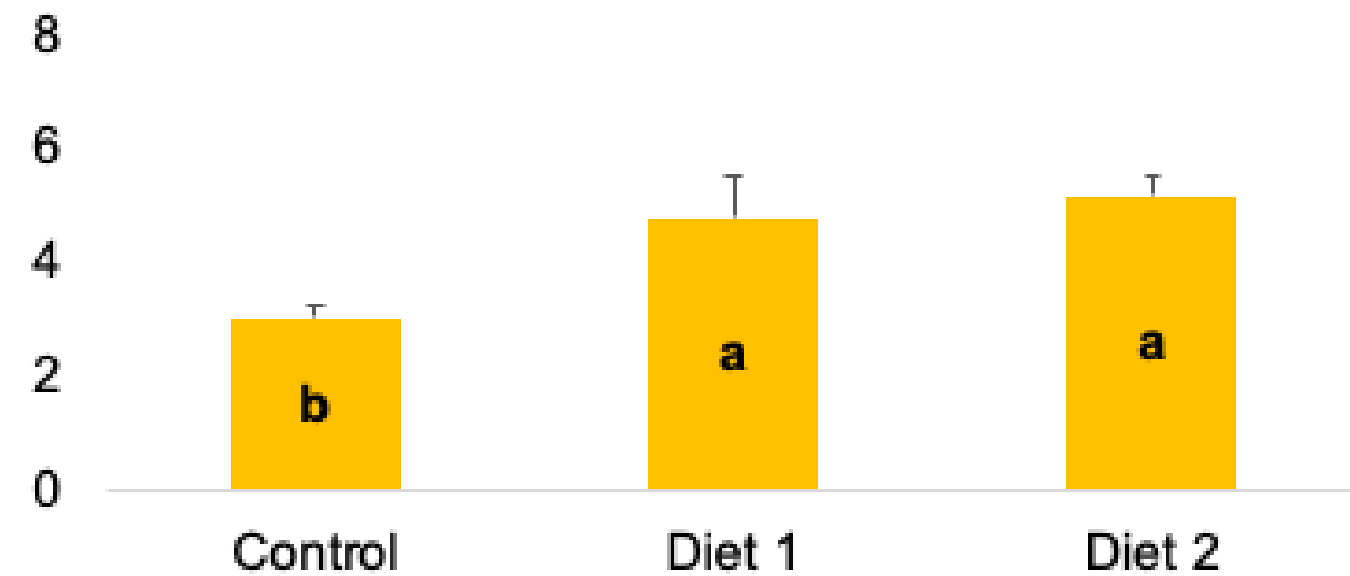


<4 = Good FCR

23% protein, 4.1% lipids



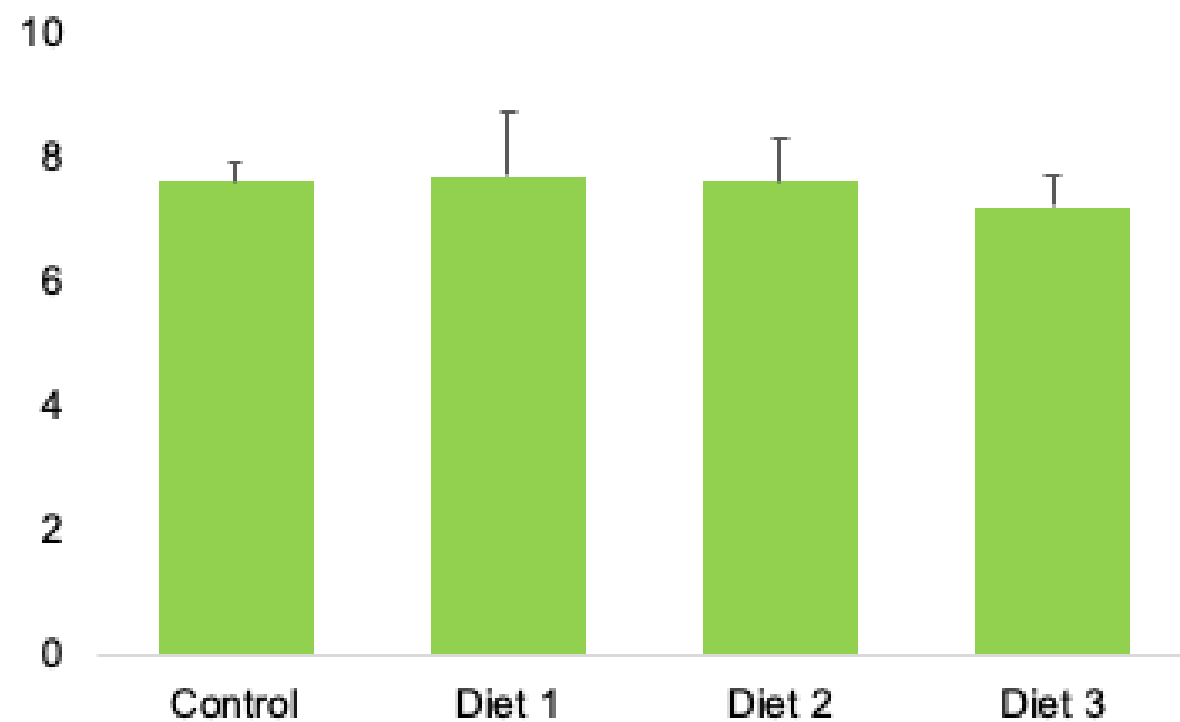
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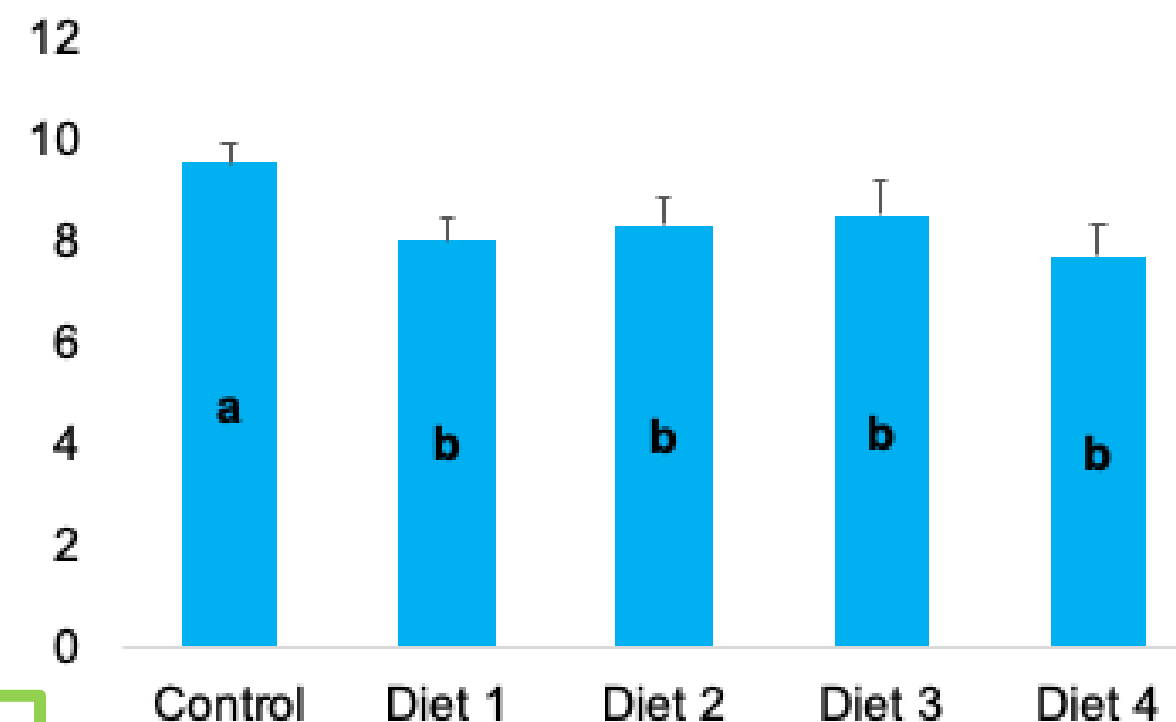
Results - Bioassay I (lab scale)

SGR
Specific Growth Rate

17% protein, 4.8% lipids

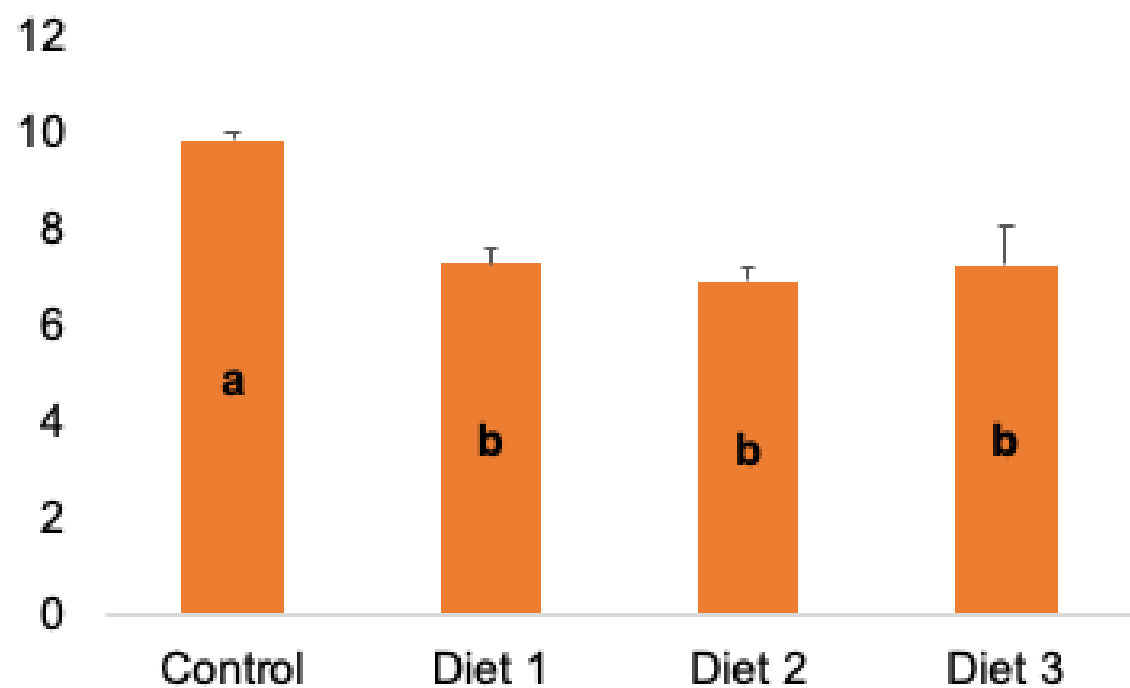


20% protein, 4.1% lipids

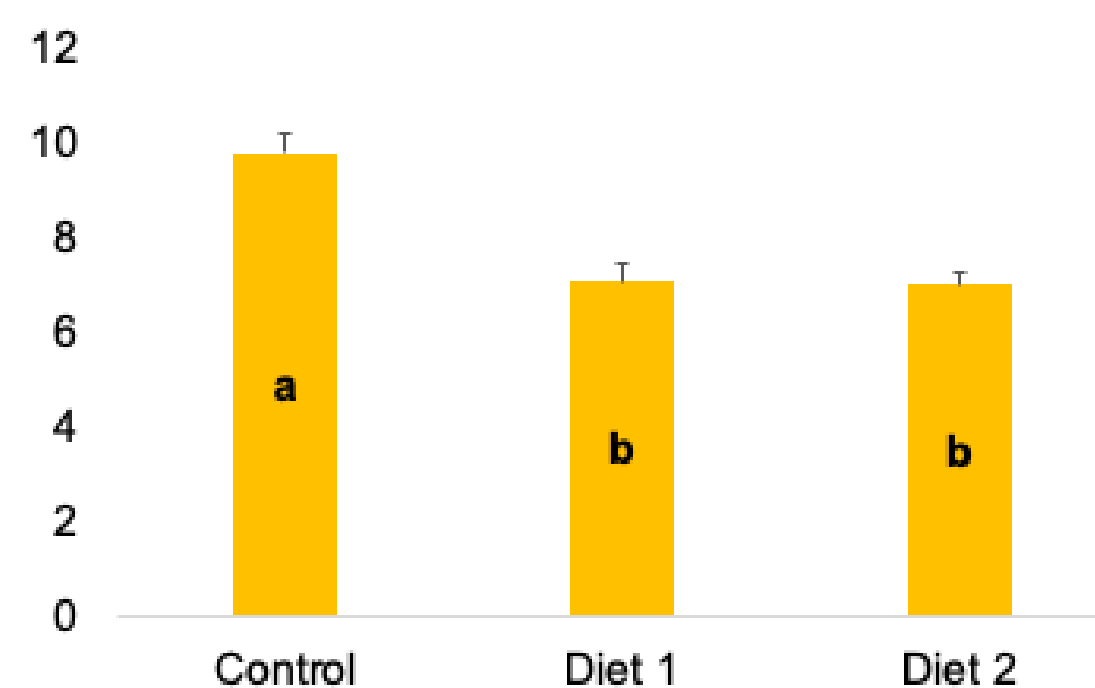


>7% = Good SGR

23% protein, 4.1% lipids

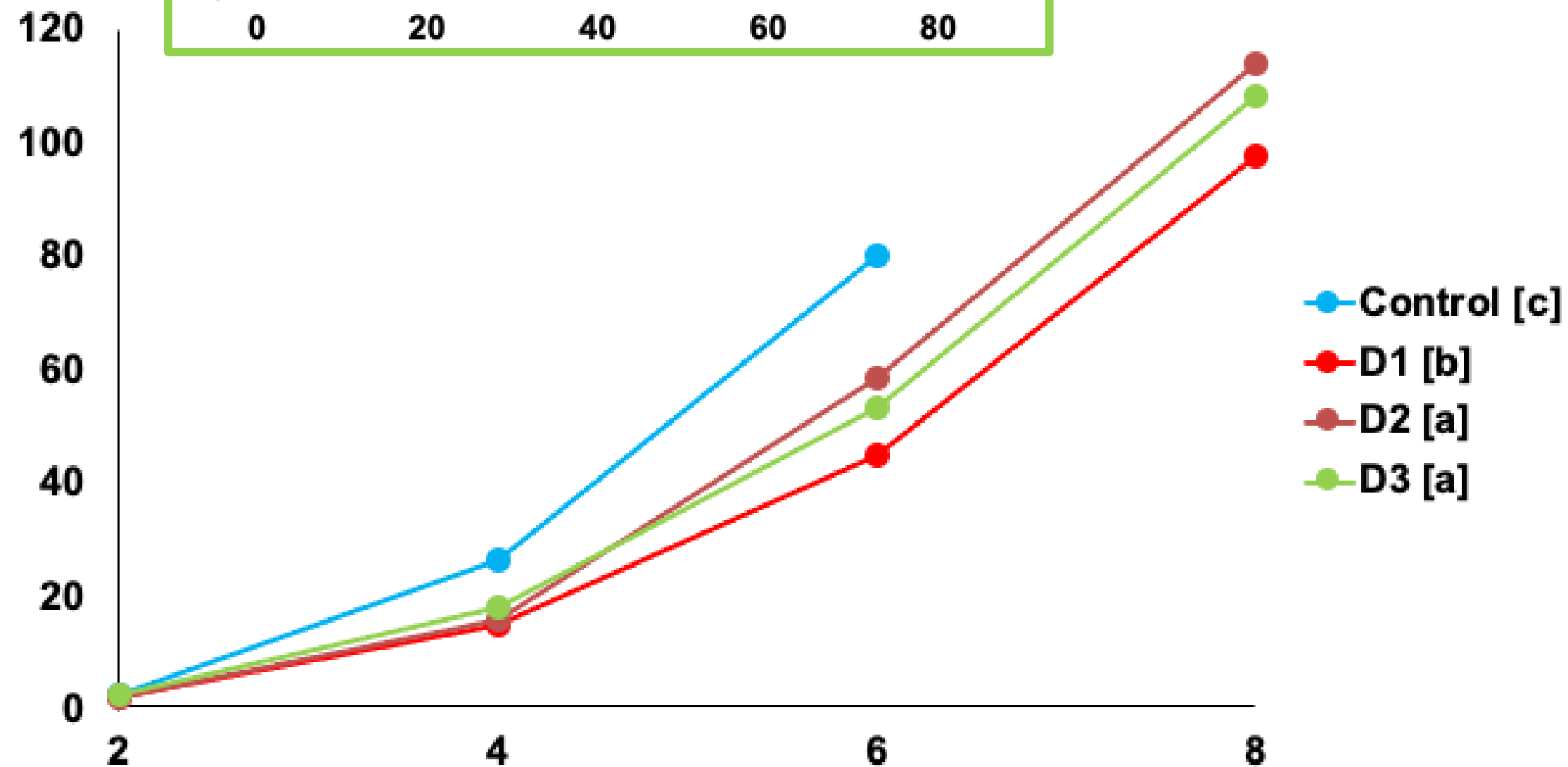
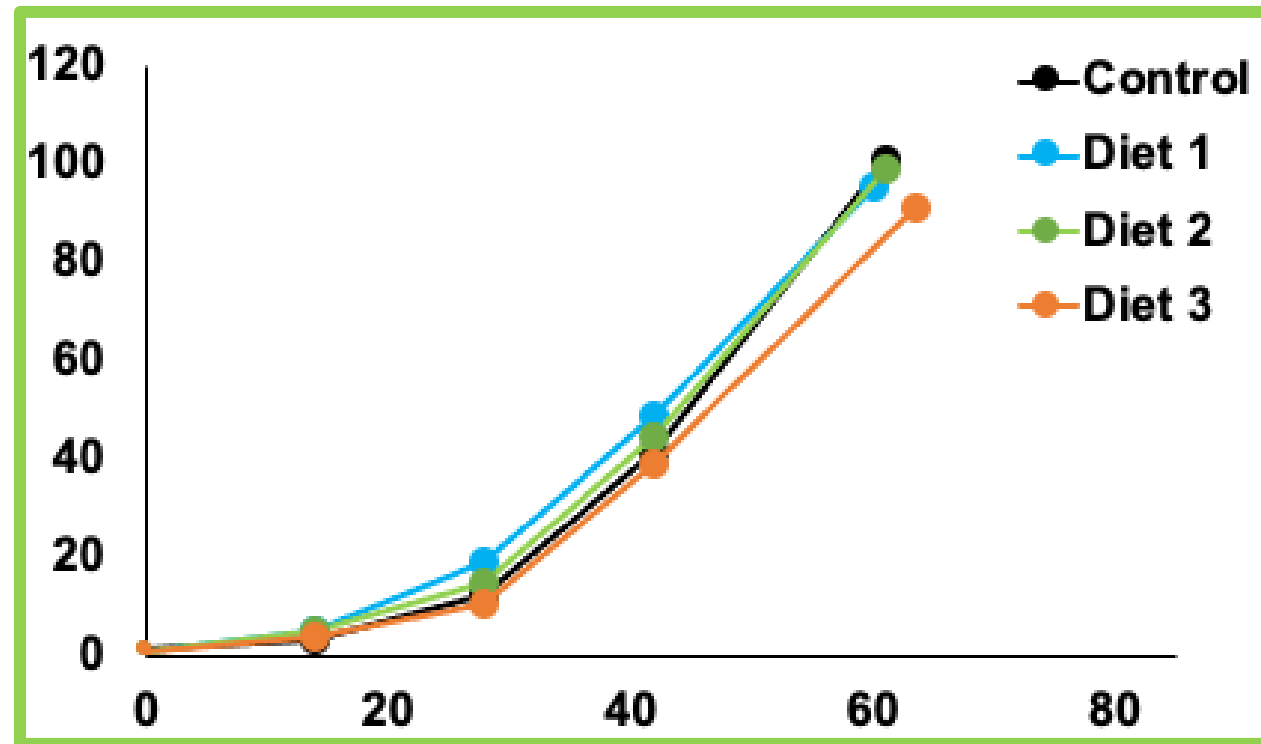


25% protein, 4.1% lipids



Individual larval weight (mg)

Results - Bioassay II (tray scale)

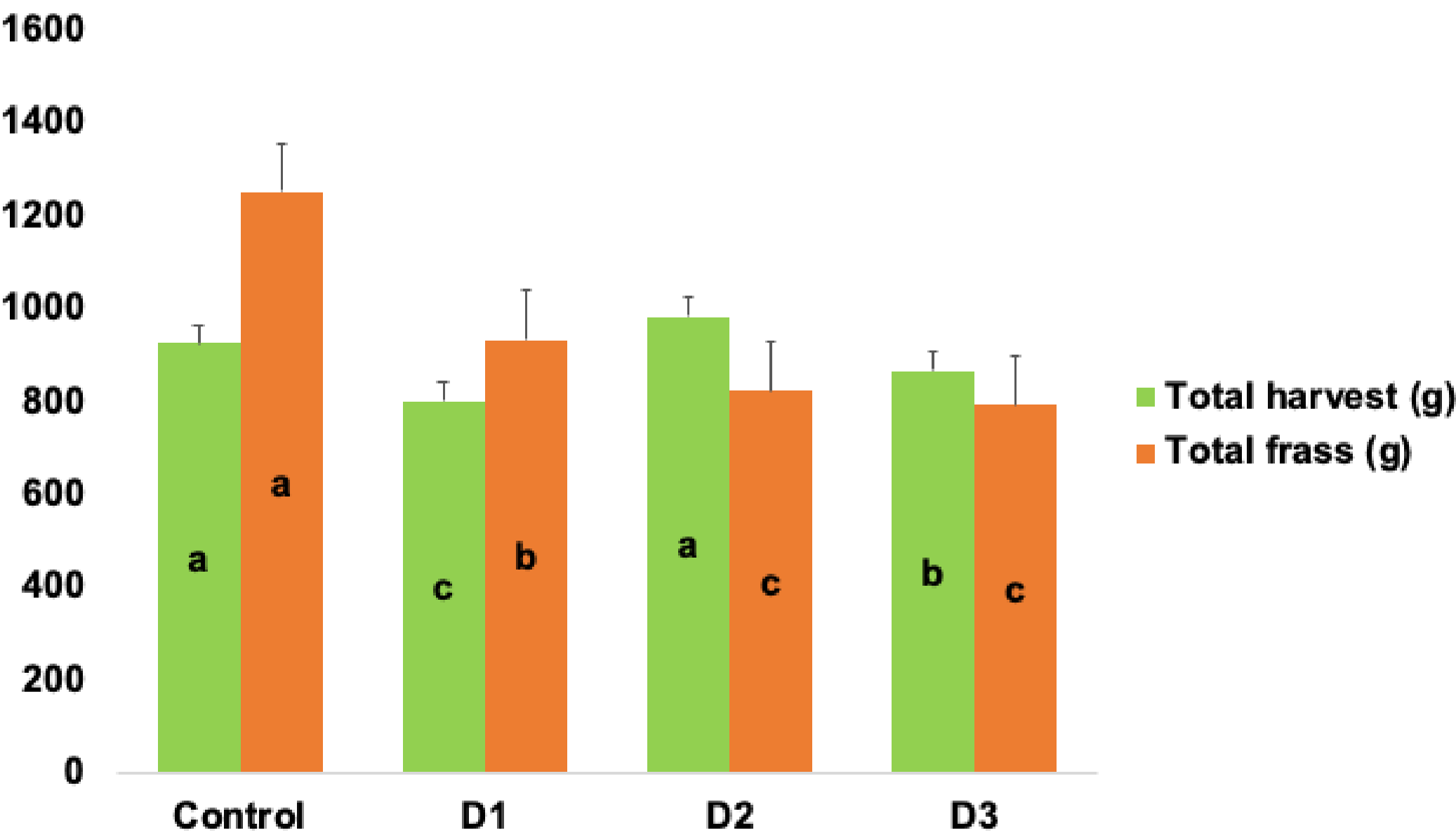


17% protein, 4.8% lipids

	Control	Diet 1	Diet 2	Diet 3
Wheat bran	100			
Rice bran		34	40	
Cotton cake		14	25	32.5
Oat by-product		52		33.5
Barley by-product			35	34

Time (weeks)

Results - Bioassay II (tray scale)



17% protein, 4.8% lipids

	Control	Diet 1	Diet 2	Diet 3
Wheat bran	100			
Rice bran		34	40	
Cotton cake		14	25	32.5
Oat by-product		52		33.5
Barley by-product			35	34



CONCLUSIONS



The incorporation of local byproducts from cereal, cotton, and hempseed production into compound diets efficiently supports the growth and performance of *T. molitor* larvae.

Diet 2 selected for mass-production of *T. molitor* larvae

- 17% protein & 4.8% lipids
- Rice bran, Cotton cake, Barley by-product



THANKS FOR Your Attention

CONTACT DETAILS

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