newRIFF

New life for rice by-products through yellow mealworm bioconversion

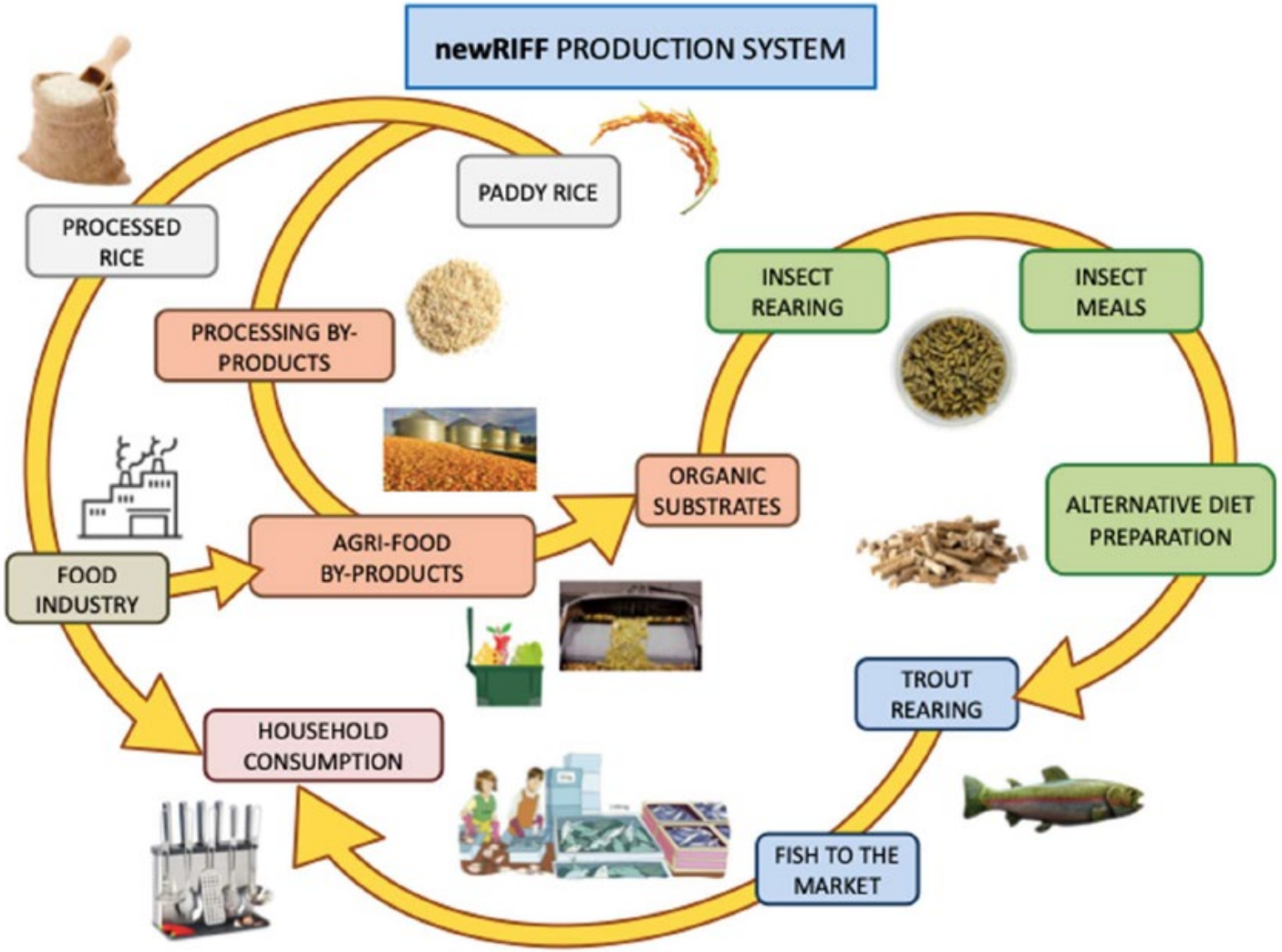
Resconi A[1], Bellezza Oddon S[1], Loiotine Z[1], Passaro RL[1], Mendez Rondo KY[1], Gasco L[1], Bacenetti[2] J, Biasato I[1]

[1]University of Turin, Largo Paolo Braccini 2, 10095 Grugliasco (TO), Italy
[2]University of Milan, Via Celoria 2. 20133 Milano, Italy

1/5 September 2024 - Florence, Italy

Andrea Resconi, PhD student

OBJECTIVES



Rice by products

↓ **bioconversion**

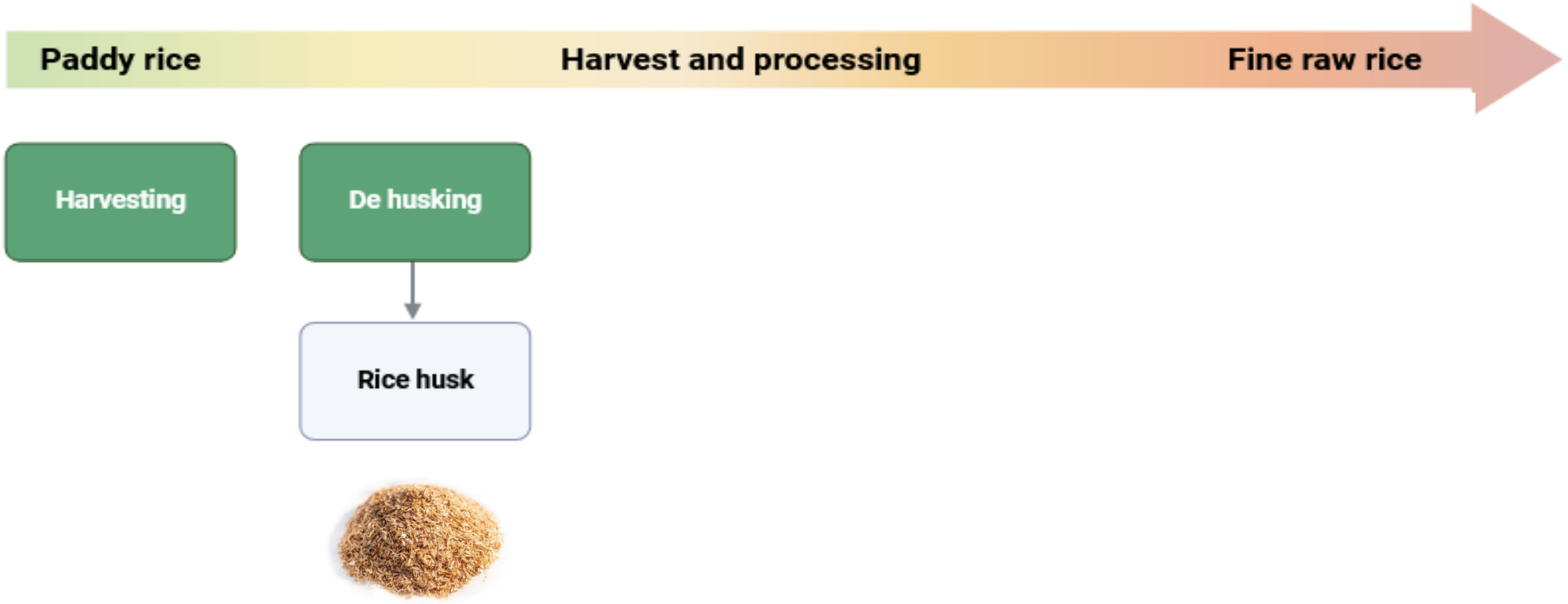
***T. molitor* rearing**

↓ **Processing of the larvae**

Insect meals for trout rearing

OBJECTIVES

Identify, collect and characterize local vegetable-based by-products to formulate by-product-based diets to rear *Tenebrio molitor* larvae



DESCRIPTION OF WORK

- **T1.1 Organic substrates availability analysis and supply**
- **T1.2 Identification of most suitable substrates**

Rice husk

Green grain

Rice bran

Broken rice

DESCRIPTION OF WORK

- **T1.1 Organic substrates availability analysis and supply**
- **T1.2 Identification of most suitable substrates**

Coffe silvery skin

Breading waste

Feed waste

Wheat bran

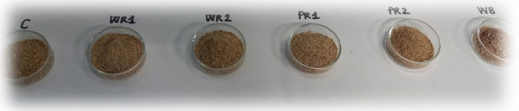
Hazelnut skin

Dry distillery waste

DIET FORMULATION

Quantities expressed as g/100 g (as is)

Feed ingredients (%)	C	WR1	WR2	PR1	PR2
Breading waste	46.9	9.3		1.9	
Feed waste	39.6	75.2	64	78.6	43.5
Dry distillary stillage	5.4	2.5	9.5	2.5	12.2
Coffee silvery film	6.6	1.9			2.1
Hazelnut film	1.5	0.6			
Risetto (white rice)		1.5	2.5		
Risetto (parboiled rice)				2.5	27.2
Broken rice (white rice)		1.5	3.5		
Broken rice (parboiled rice)				3.5	8
Green grain			3		2
Rice bran (white rice)		2.5	2		
Rice bran (parboiled rice)				2	
Rice husk (white rice)		5	15.5		
Rice husk (parboiled rice)				9	5
Total	100	100	100	100	100
Rice by-products inclusion	0	10.5	26.5	17	42.2



DIET FORMULATION

Diets	DM content	Ash	CP	EE	aNDFom	NSC	GE MJ/kg
C	89.22	4.99	18.24	3.00	14.36	59.40	18.80
WR1	88.57	9.19	18.75	2.98	21.59	47.49	18.29
WR2	88.77	9.69	18.26	2.96	29.58	39.51	18.37
PR1	89.36	9.41	18.30	3.08	24.68	44.53	18.32
PR2	89.23	6.12	18.16	3.04	25.31	47.36	18.89

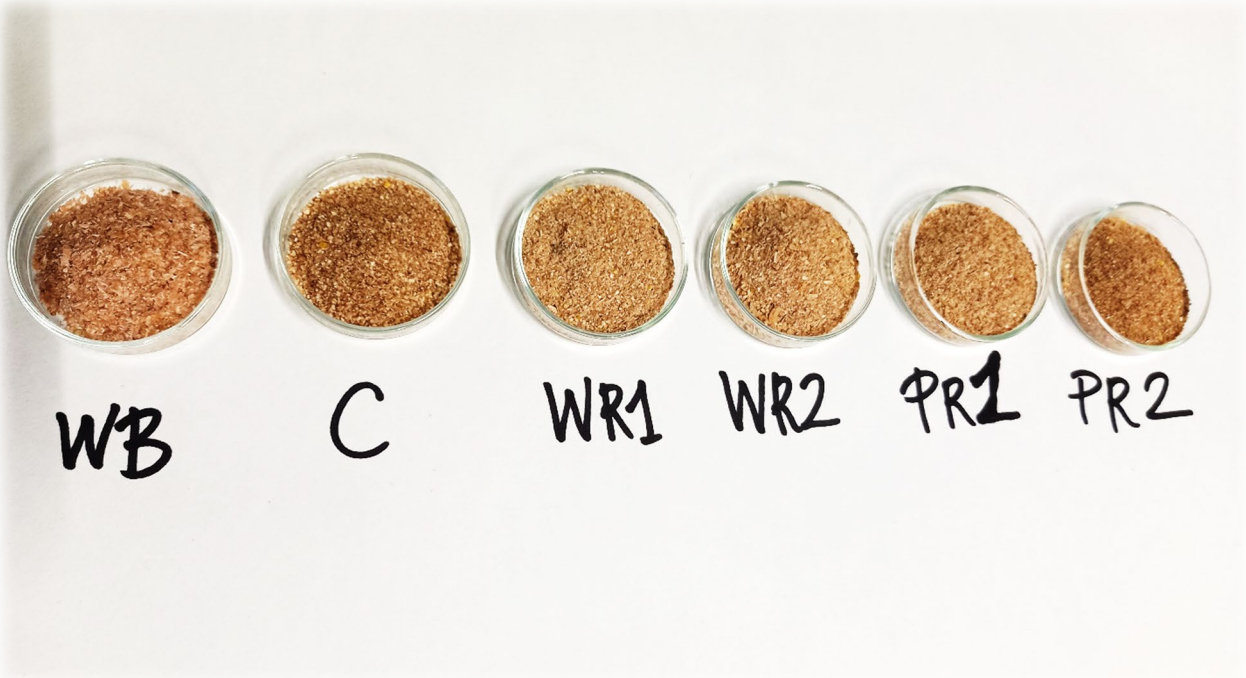
3.15%

3.92%

3.31%

DESCRIPTION OF WORK

- T1.1 Organic substrates availability analysis and supply
- **T1.2 Identification of most suitable substrates**



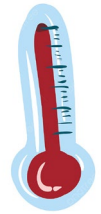
Tenebrio molitor feeding trial

5 replicates per diet

2.6 kg substrate/replicate

10000 larvae/replicate

0.26 g of feed/larva



29°C

0L : 24D

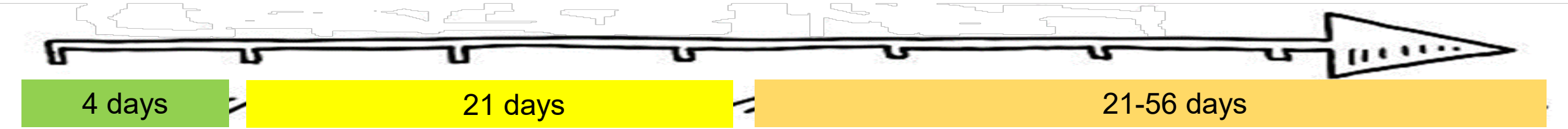
70% RH

Tenebrio molitor feeding trial

4 days reproduction → 21 days old larvae sieved from substrate → Counted and weighed → Divided in the replicates → Sampling every 7 days → End of larval stage





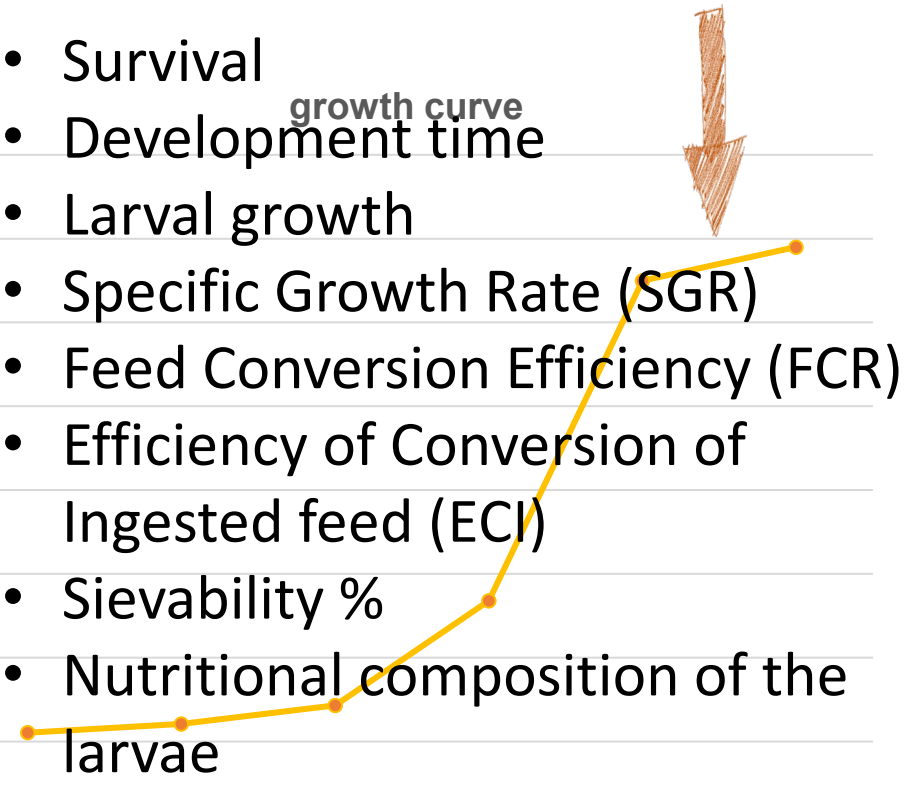



Tenebrio molitor feeding trial

Parameters analysed:

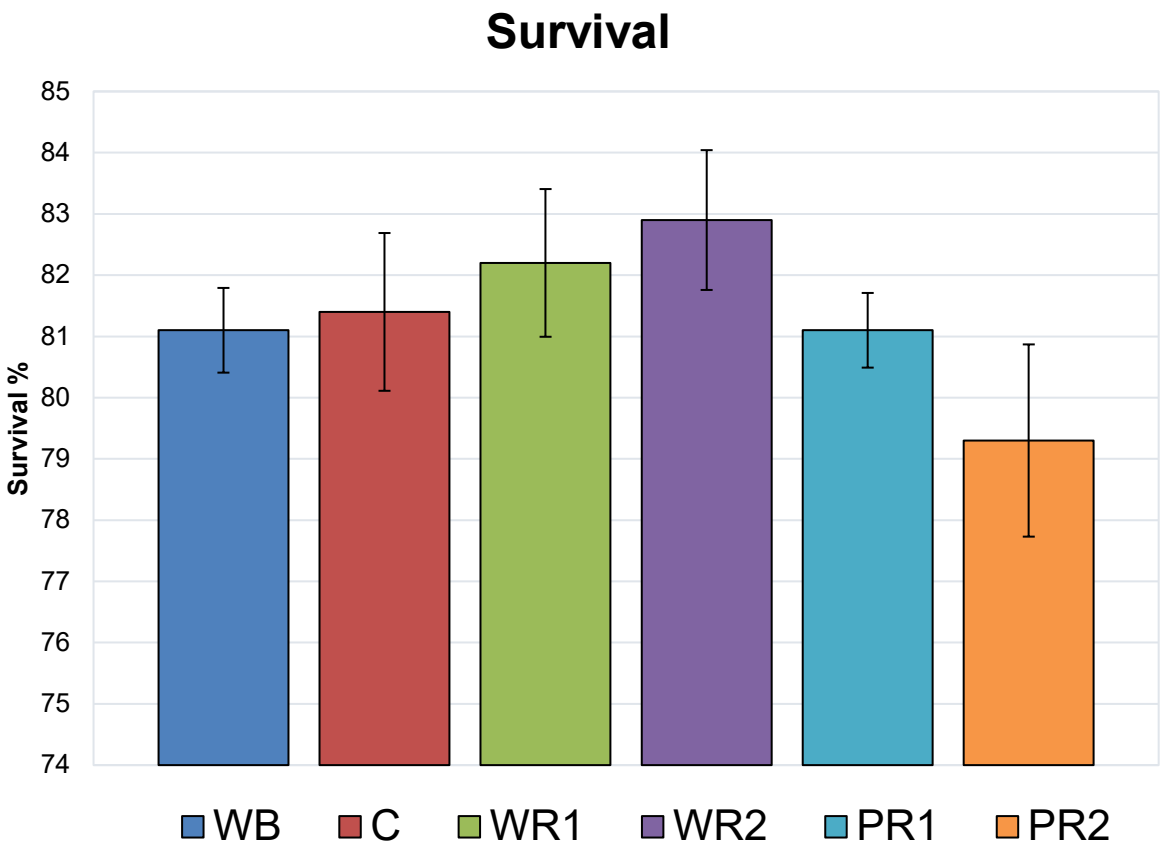
< 50% growth → plateau phase

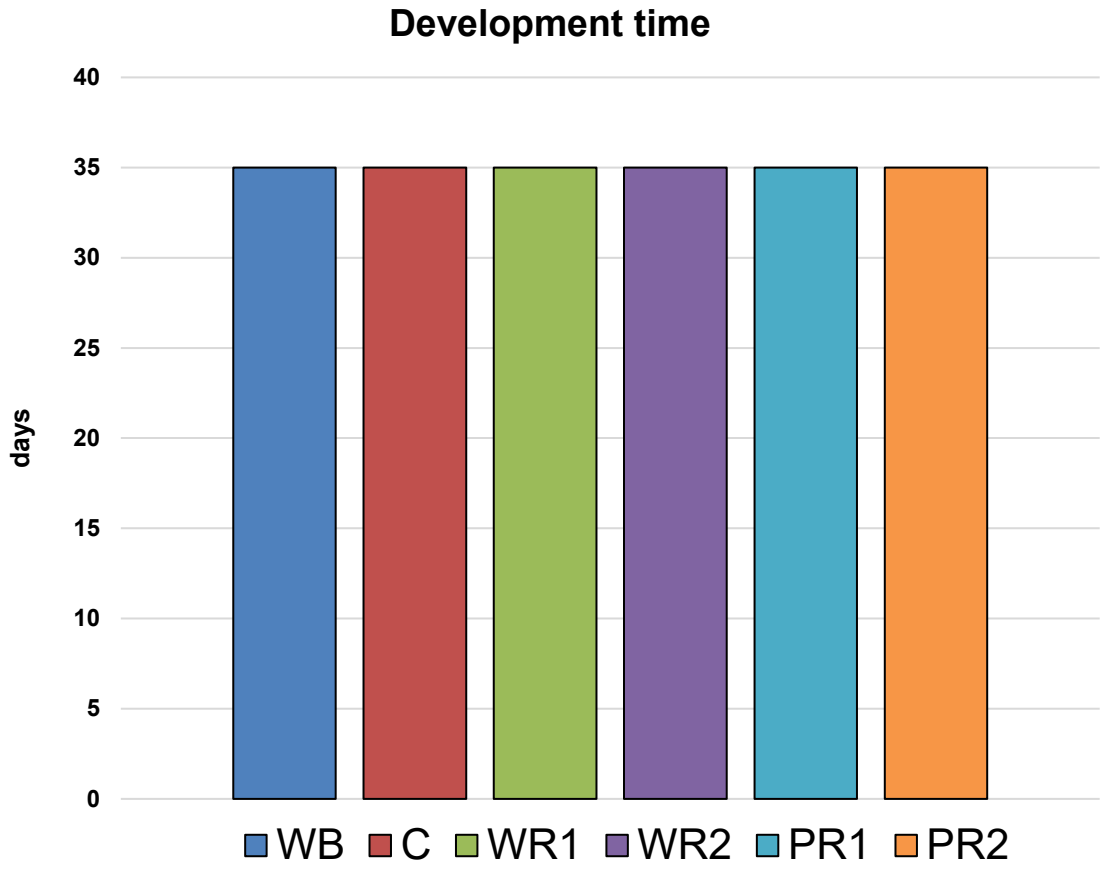
- Survival
- Development time
- Larval growth
- Specific Growth Rate (SGR)
- Feed Conversion Efficiency (FCR)
- Efficiency of Conversion of Ingested feed (ECI)
- Sievability %
- Nutritional composition of the larvae



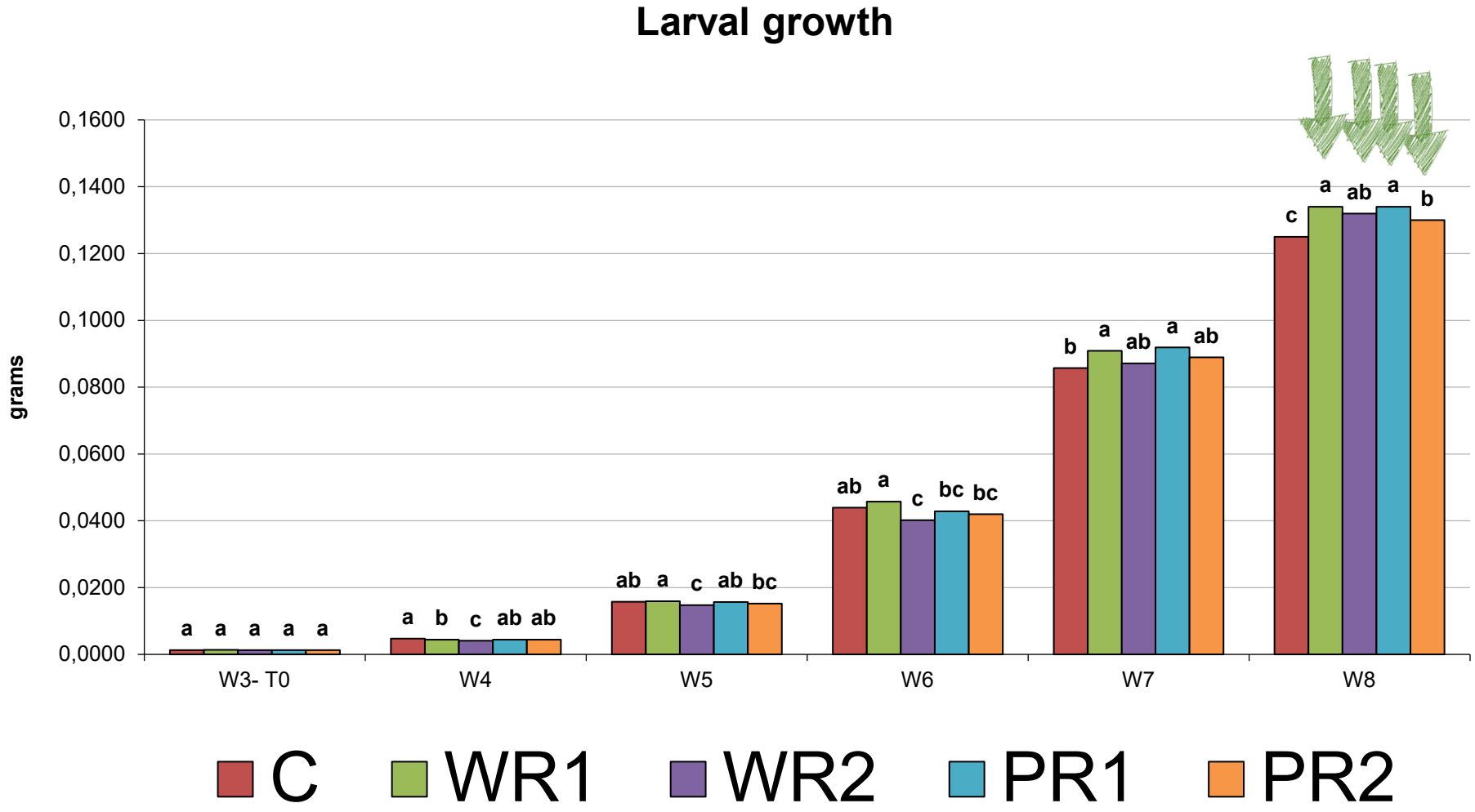
Statistical analysis was done using the SPSS v20.0 software.
ANOVA, P<0.05 and GLM, P<0.05

DIET SUITABILITY

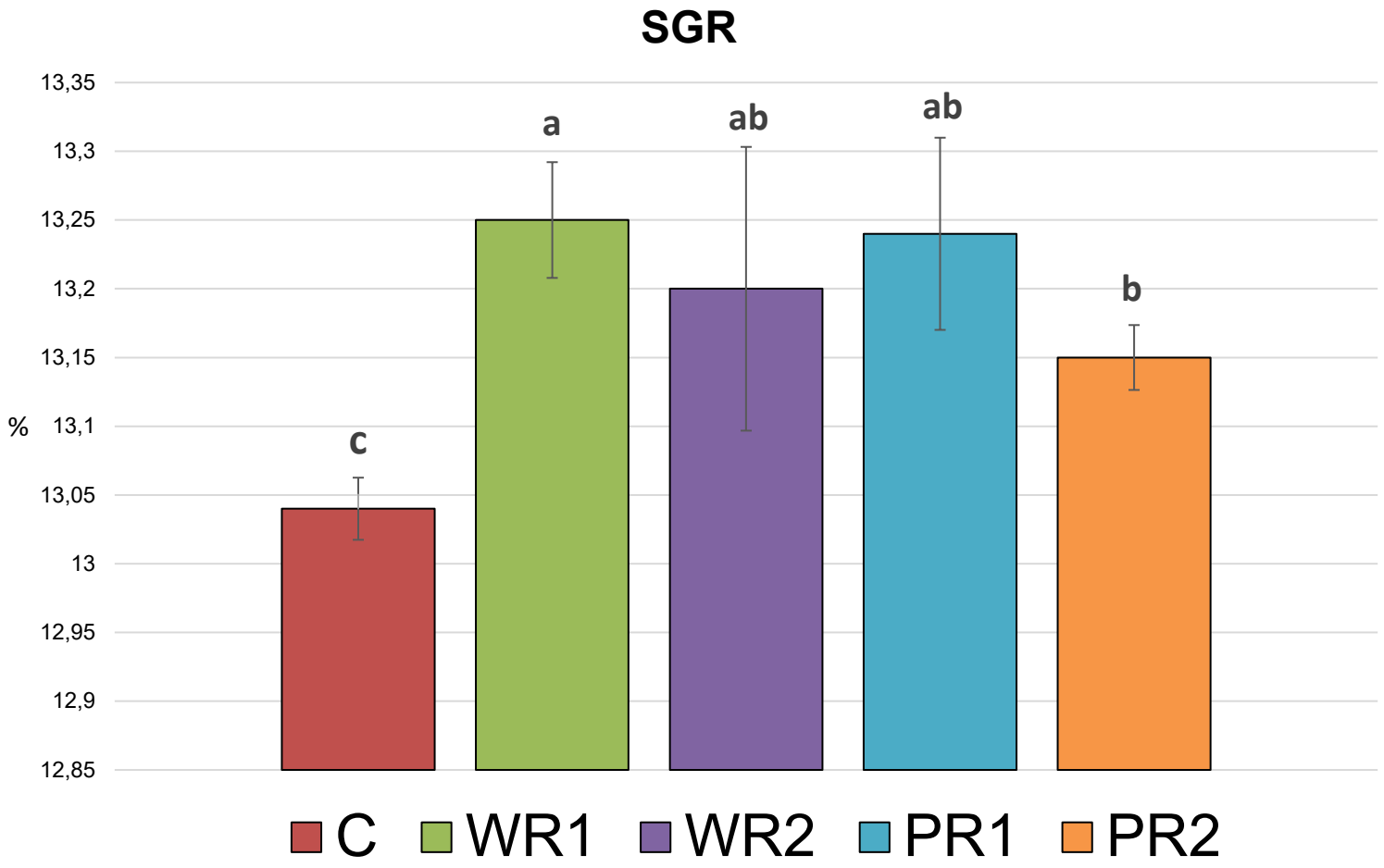




GROWTH PERFORMANCE



GROWTH RATE

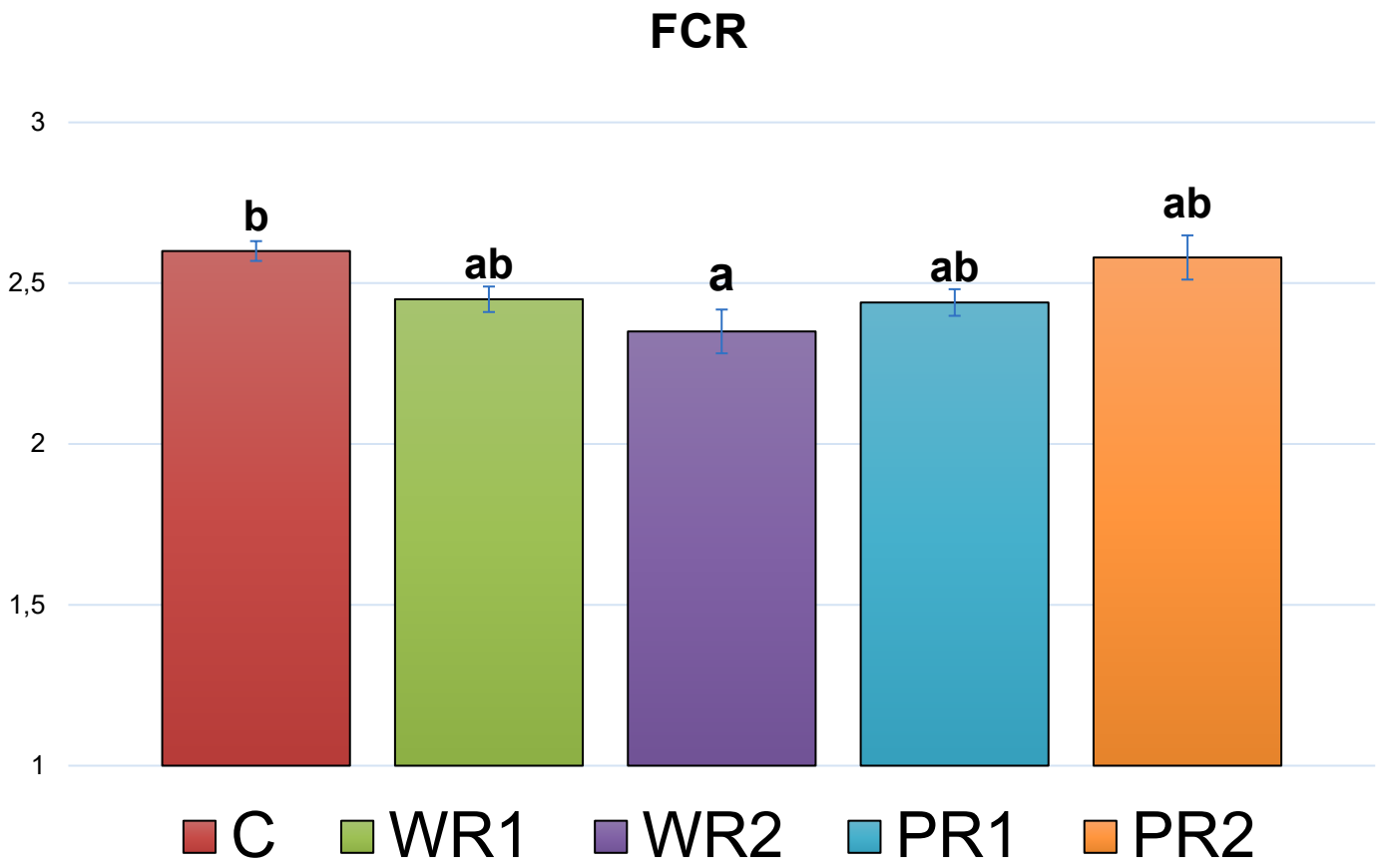


Specific growth rate (SGR) =

$$\frac{[\ln(larval\ biomass\ end) - \ln(larval\ biomass\ start)]}{Days} * 100$$

Calculated on fresh matter basis

BIOCONVERSION EFFICIENCY

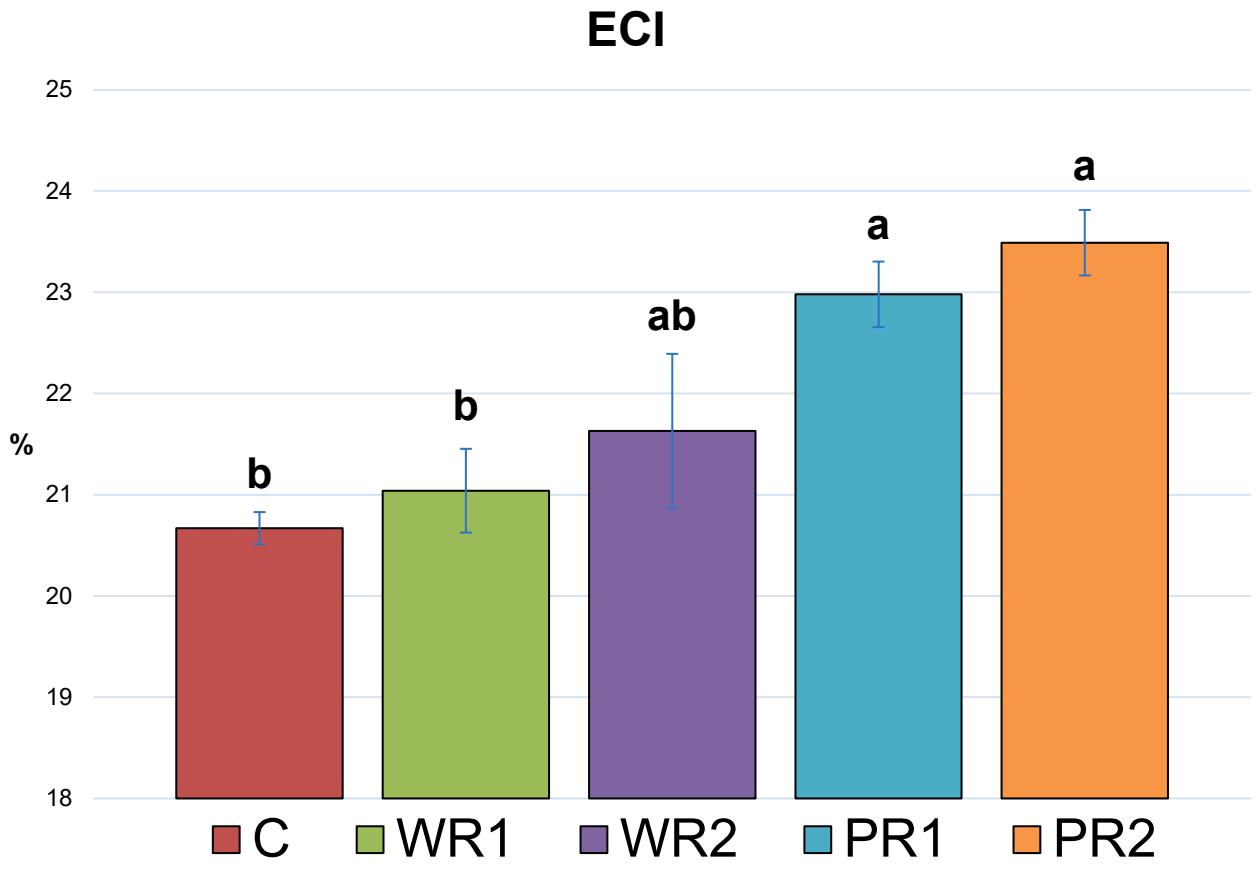


Feed Conversion Ratio (FCR) =

$$\frac{\boldsymbol{Diet\ consumed}}{(\boldsymbol{larval\ biomass\ end - larval\ biomass\ start})}$$

(Calculated on as is basis)

BIOCONVERSION EFFICIENCY

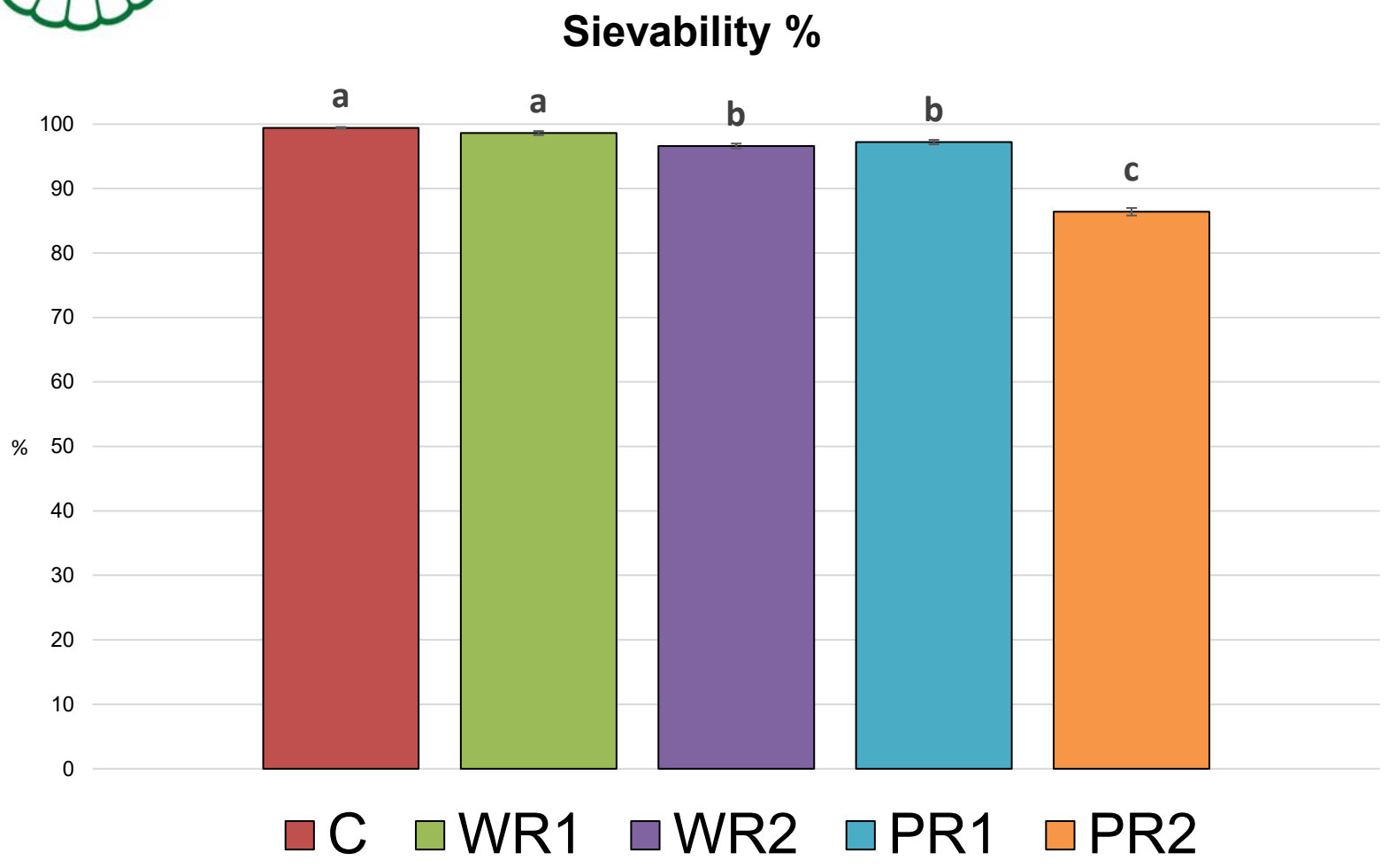


Efficiency of Conversion of Ingested feed (ECI) =

$$\left[\frac{larval\ biomass\ end - larval\ biomass\ start}{Diet - Diet\ residues}\right] * 100$$

(Calculated on DM basis)

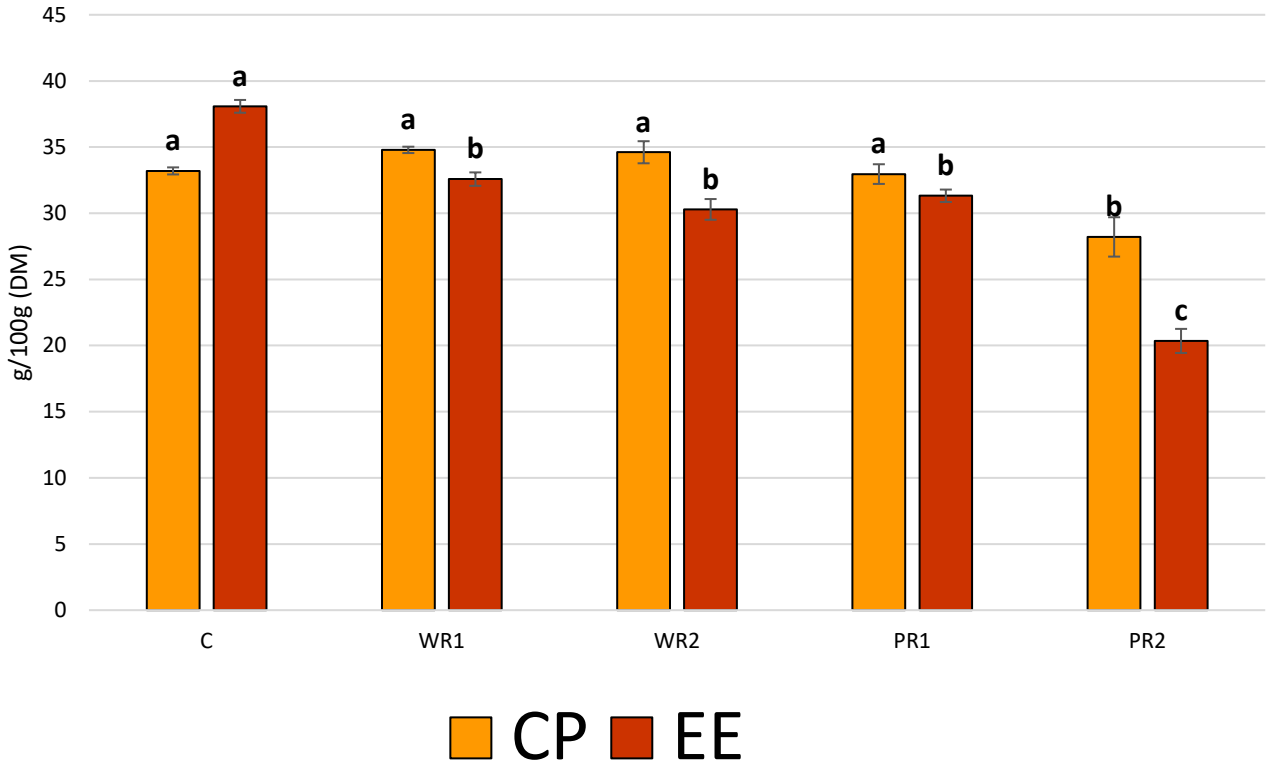
SIEVABILITY

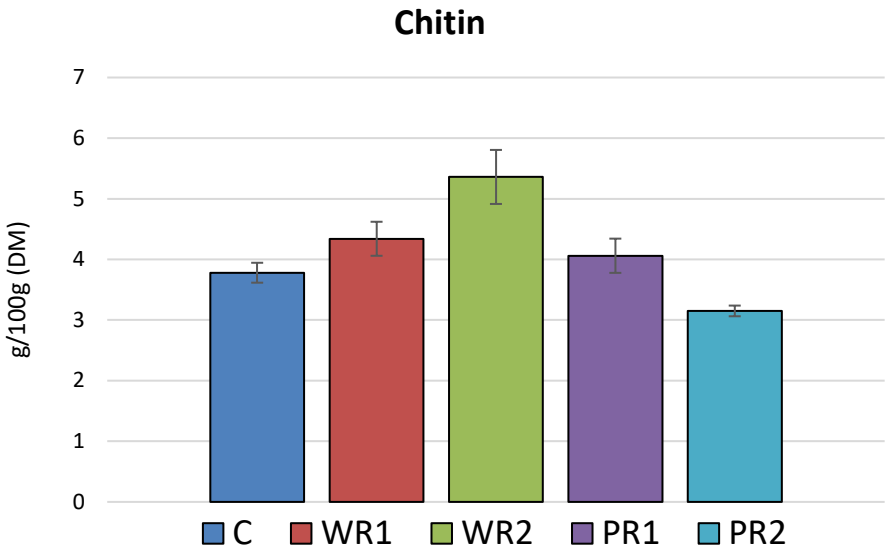


Sievability Percentage (SP) =

$$\frac{frass\ after\ sieving\ (g)}{total\ frass} * 100$$

NUTRITIONAL COMPOSITION



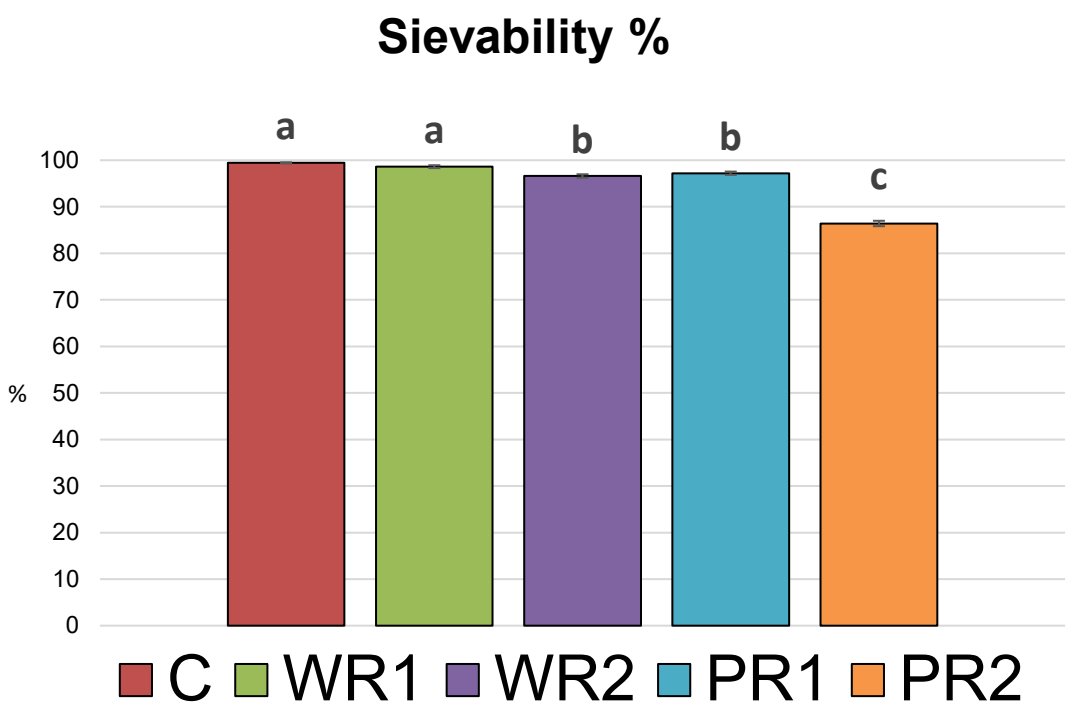


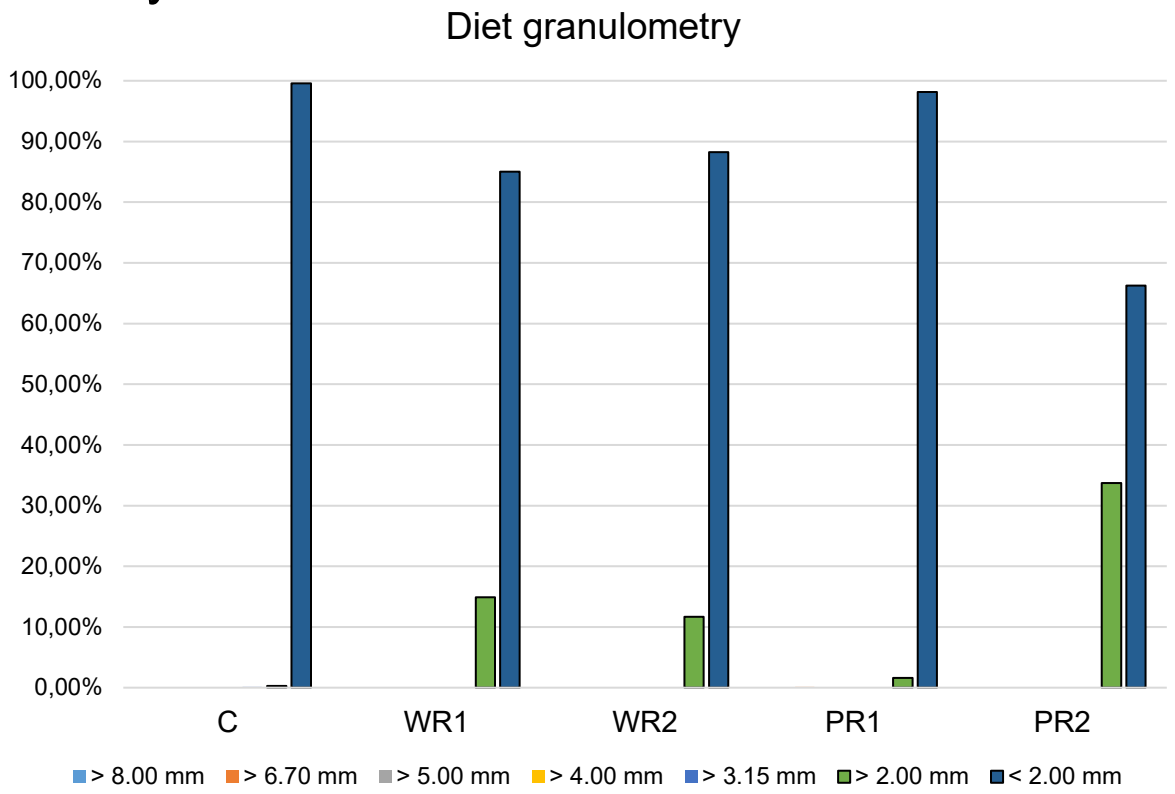
Final remarks

- All diets tested proven suitable for *Tenebrio molitor* rearing, proving the suitability of the rice by-products
- Diets WR1, WR2 and PR1 are the most promising – high larval weight, good FCR and ECI, highest SGR, good SP (above 96%), high protein content
- High granulometry of the diet will result in poor sievability

Final remarks

- High granulometry of the diet will result in poor sievability





Final remarks

- Differences in the diets can be attributed to their composition

Feed ingredients (%)	C	WR1	WR2	PR1	PR2
Breading waste	46.9	9.3		1.9	
Feed waste	39.6	75.2	64	78.6	43.5
Dry distillary stillage	5.4	2.5	9.5	2.5	12.2
Coffee silvery film	6.6	1.9			2.1
Hazelnut film	1.5	0.6			
Risetto (white rice)		1.5	2.5		
Risetto (parboiled rice)				2.5	27.2
Broken rice (white rice)		1.5	3.5		
Broken rice (parboiled rice)				3.5	8
Green grain			3		2
Rice bran (white rice)		2.5	2		
Rice bran (parboiled rice)				2	
Rice husk (white rice)		5	15.5		
Rice husk (parboiled rice)				9	5
Total	100	100	100	100	100
Rice by-products inclusion	0	10.5	26.5	17	42.2

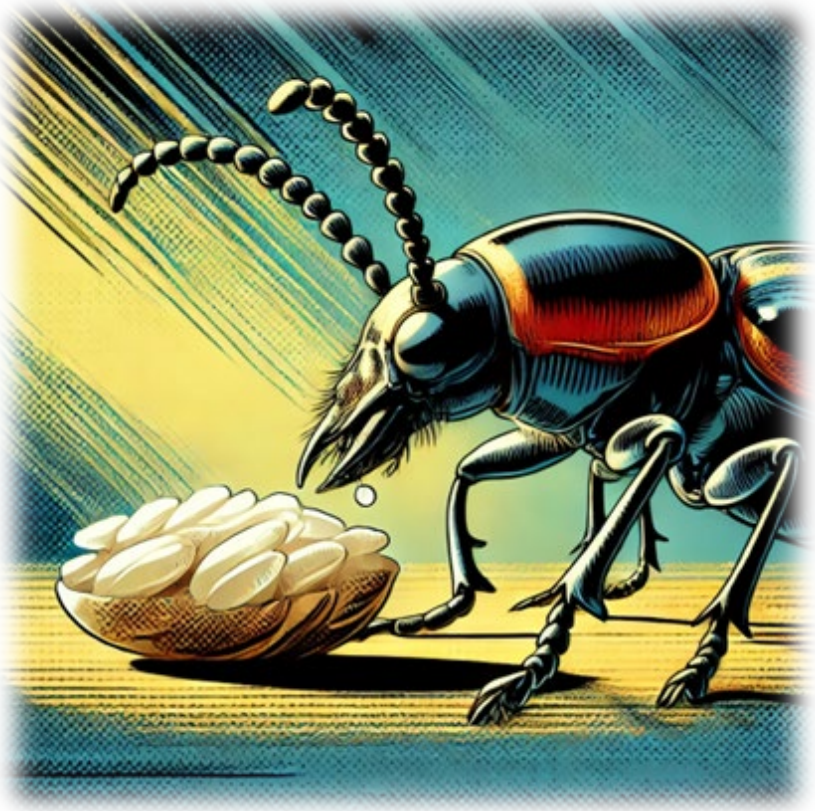
Ongoing:

Life Cicle Assessment

Microbiological analysis

Heavy metals analysis

Thank you!



andrea.resconi@unito.it