

— Amino acid requirements of mealworm and black soldier fly larvae

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Amino acids

- Essential amino acids
 - Species dependent
 - Age dependent
- What about insects?
 - Which?
 - Lysine, methionine, tryptophan, isoleucine, threonine, valine,...?
 - How to determine?



Literature

- What about insects?

- Mealworms (Davis, 1975; Davis en Sosulski, 1978)
 - Serine, tyrosine, glutamic acid and glycine possibly not necessary
 - Alanine, cystine, proline en aspartic acid half essential
 - Maximal growth achieved by larvae receiving 50% of the phenylalanine levels present in their tissues
 - Threonine en tryptophan were limiting and were required in a concentration of more than 2x the concentration in the tissues



- BSF (Koethe et al. 2022)
 - 0.3% lysine sufficient
 - 3% lysine resulted in slower growth, smaller larvae and higher mortality



— Growth and harvest weight

Determination of Lysine, methionine, threonine, tryptophan and phenylalanine

Semi-artificial diets

- 25% basic diet added with sugar and synthetic amino acids
 - Mealworm: wheat bran with agar
 - BSF: chicken feed with water
- a mixture of 14: the 10 essential for mammals + glutamic acid, glycine, alanine en aspartic acid
- iso-energetic and isonitrogenous
- Of the 5 amino acids one was added in different doses. The non-essential glutamic acid was used to replace lower doses

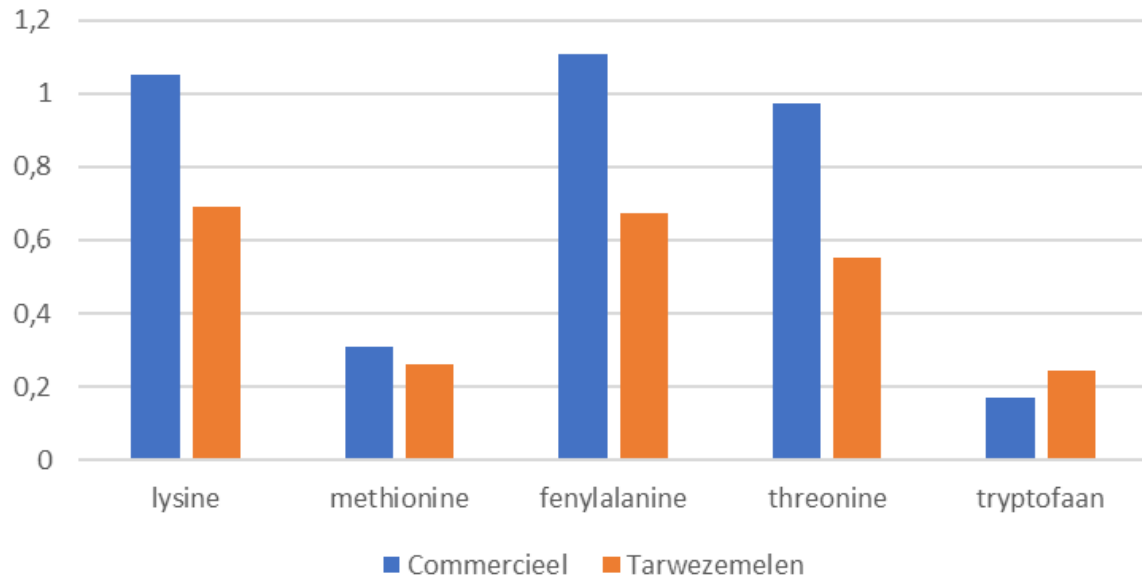
Growth, measured by weight gain, and survival were monitored at $27 \pm 1^\circ\text{C}$ en $60 \pm 5\%$ RH and compared with 100% basic diet

— Mealworm

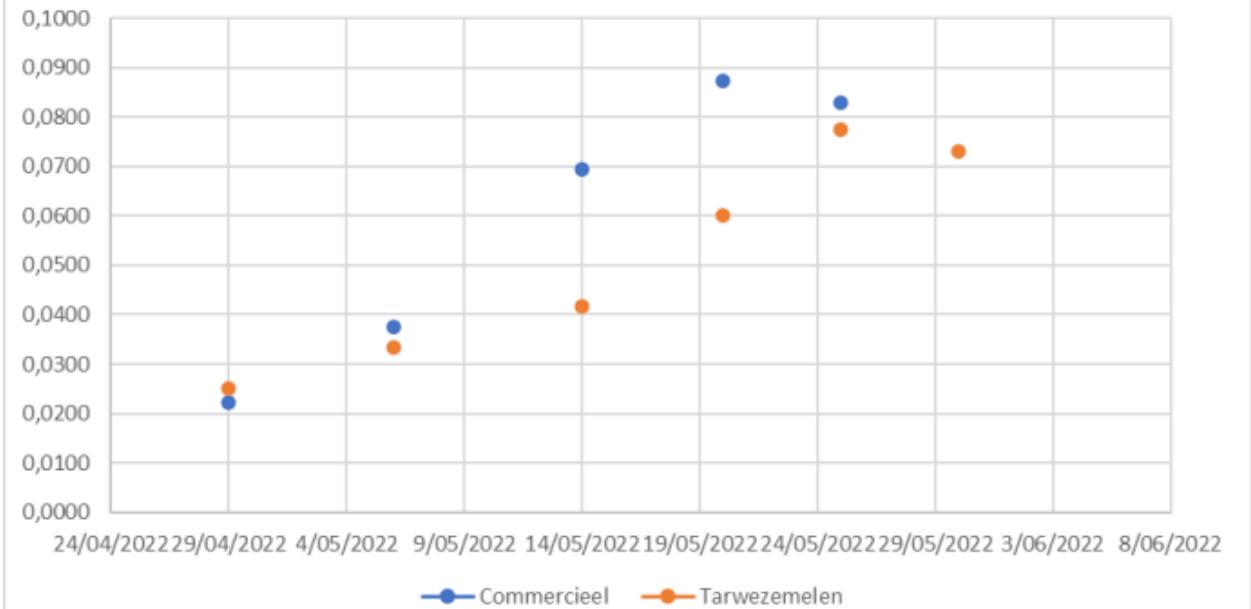
— Experimental diets

AA composition controls + growth

g/100 g DS



individueel gewicht (g)



Survival 90-100%

FCR commercial = 1.6

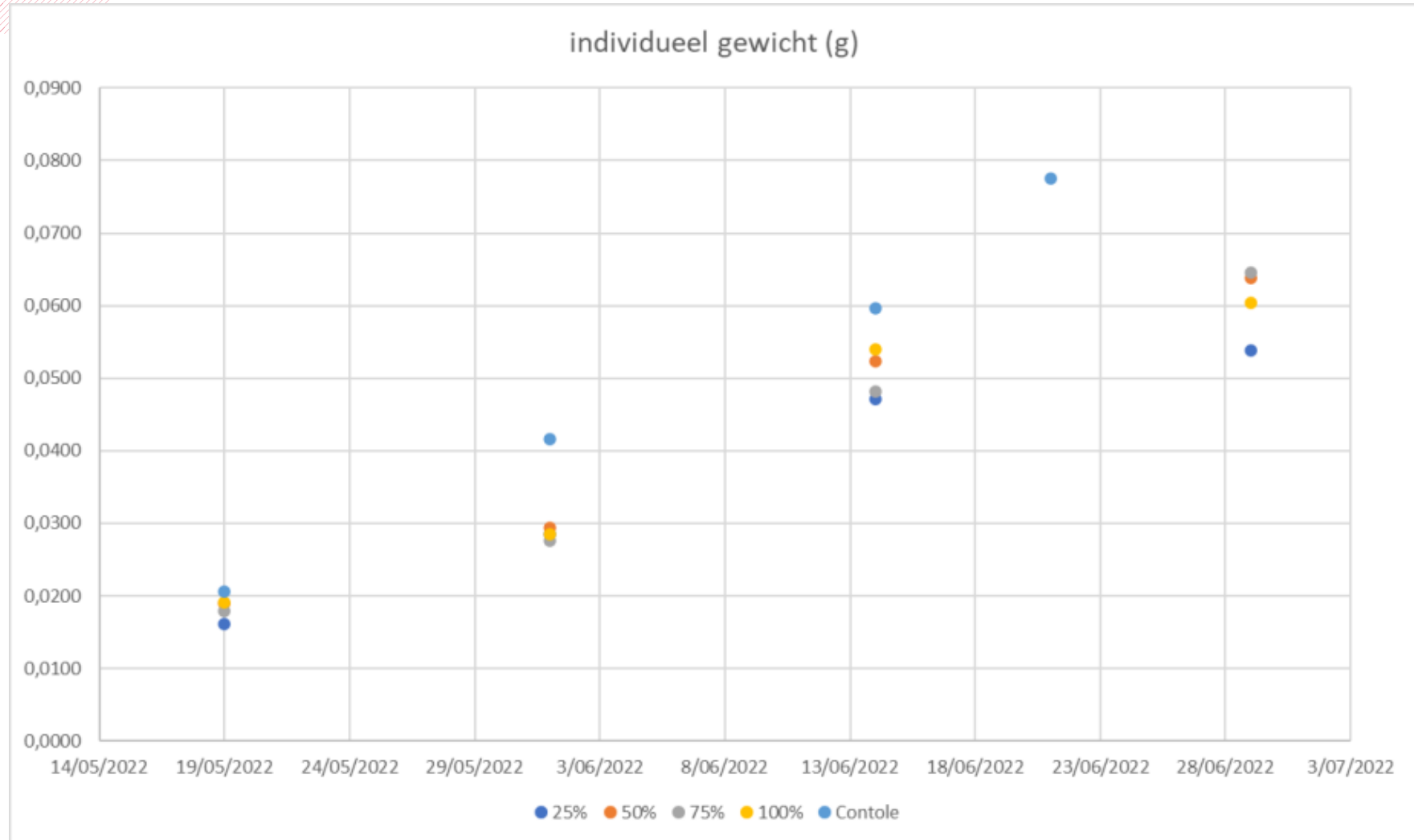
FCR Wheat bran = 1.9

— Experimental diets (100 larvae of 4-5 weeks, agar ad libitum)

	Lysine				Methionine			
	25%	50%	75%	100%	25%	50%	75%	100%
wheat bran	3,465	3,465	3,465	3,465	3,465	3,465	3,465	3,465
sugar	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
ASP	0,110	0,110	0,110	0,110	0,110	0,110	0,110	0,110
GLU	0,360	0,339	0,318	0,297	0,321	0,313	0,305	0,297
HIS	0,042	0,042	0,042	0,042	0,042	0,042	0,042	0,042
GLY	0,080	0,080	0,080	0,080	0,080	0,080	0,080	0,080
THR	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050
ALA	0,072	0,072	0,072	0,072	0,072	0,072	0,072	0,072
ARG	0,106	0,106	0,106	0,106	0,106	0,106	0,106	0,106
CYS	0,033	0,033	0,033	0,033	0,033	0,033	0,033	0,033
VAL	0,072	0,072	0,072	0,072	0,072	0,072	0,072	0,072
MET	0,023	0,023	0,023	0,023	0,000	0,008	0,016	0,023
PHE	0,061	0,061	0,061	0,061	0,061	0,061	0,061	0,061
ILE	0,050	0,050	0,050	0,050	0,050	0,050	0,050	0,050
LEU	0,094	0,094	0,094	0,094	0,094	0,094	0,094	0,094
LYS	0,000	0,021	0,042	0,063	0,063	0,063	0,063	0,063
TRY	0,022	0,022	0,022	0,022	0,022	0,022	0,022	0,022
cellulose	7,812 g	7,812 g	7,812 g	7,812 g	7,812	7,812	7,812	7,812

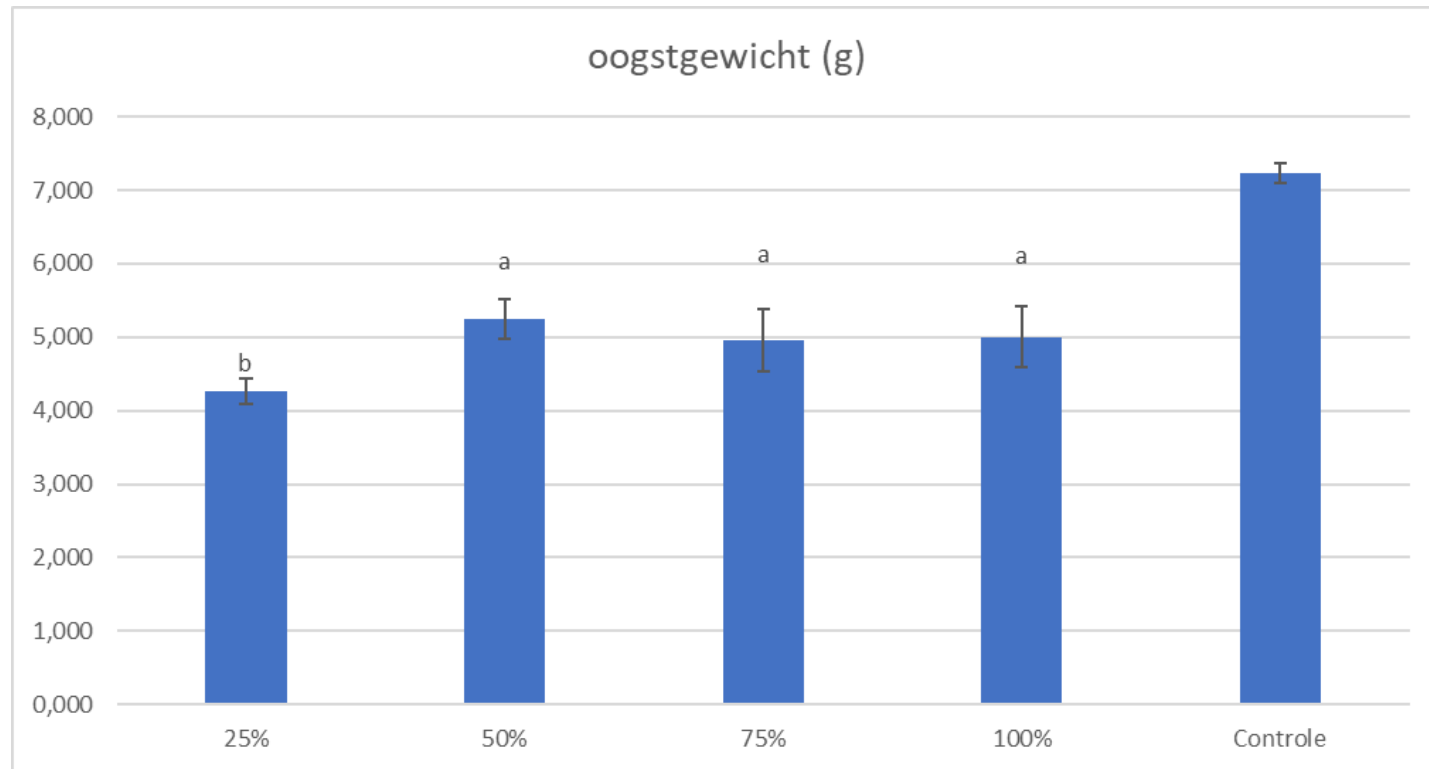
— Results

Growth curve (control = wheat bran)



— Results

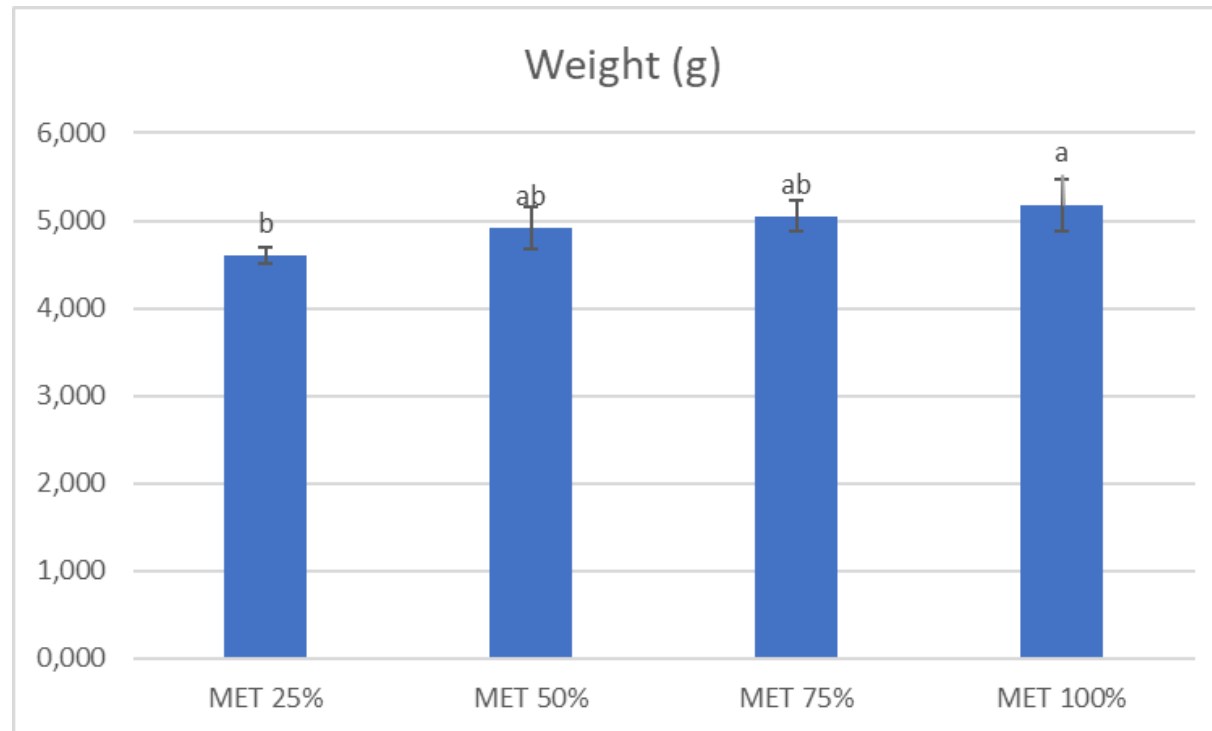
Lysine



100% = 0.69 g/100 g DM

— Results

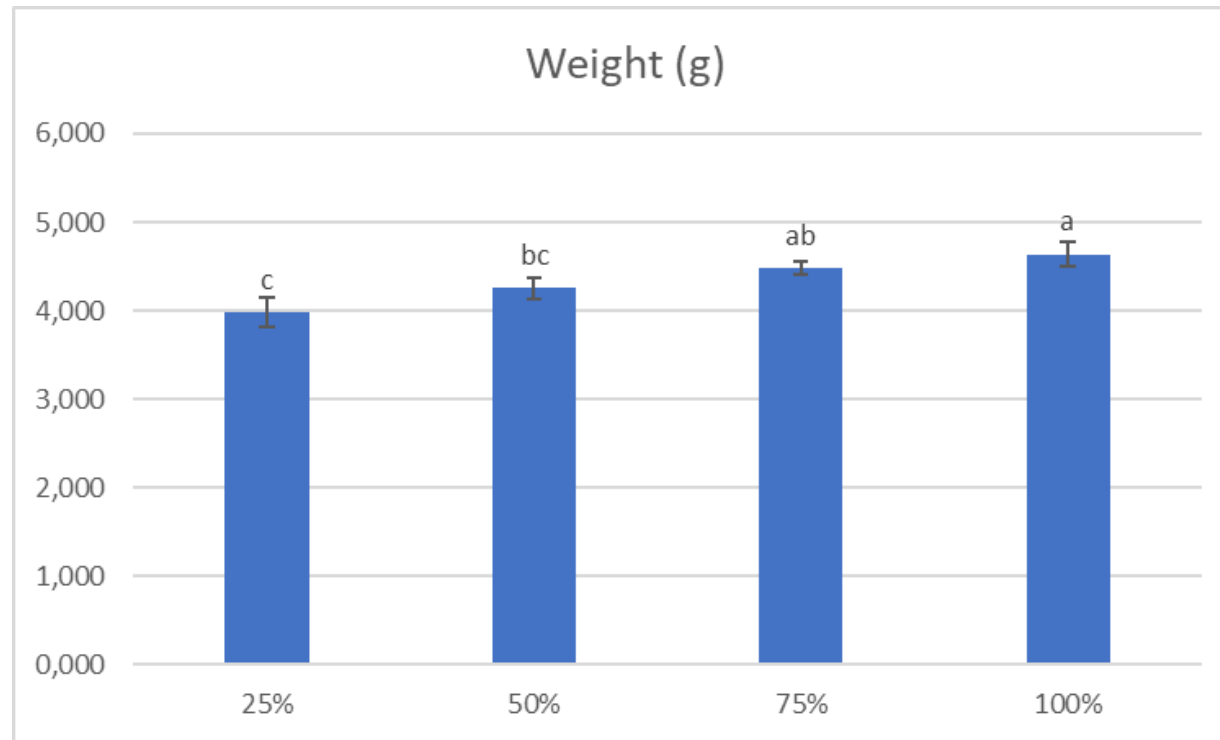
Methionine



100% = 0.26 g/100 g DM

— Results

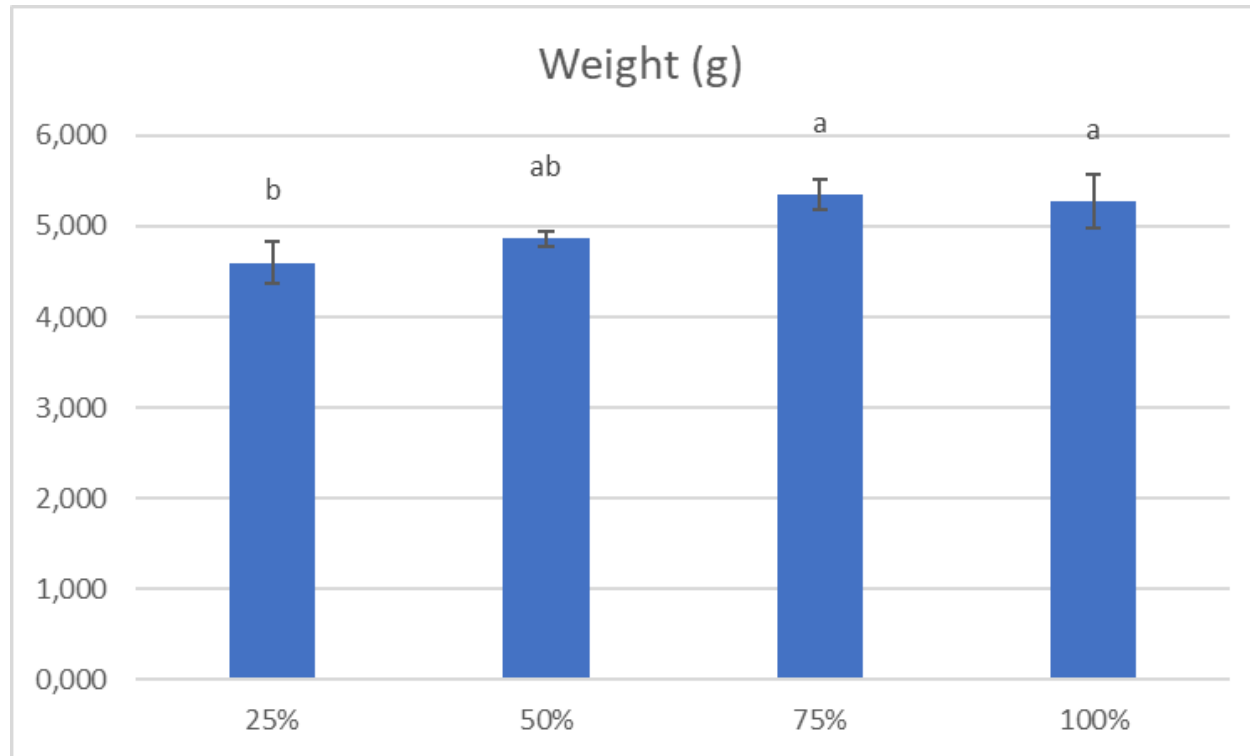
Threonine



100% = 0.55 g/100 g DM

— Results

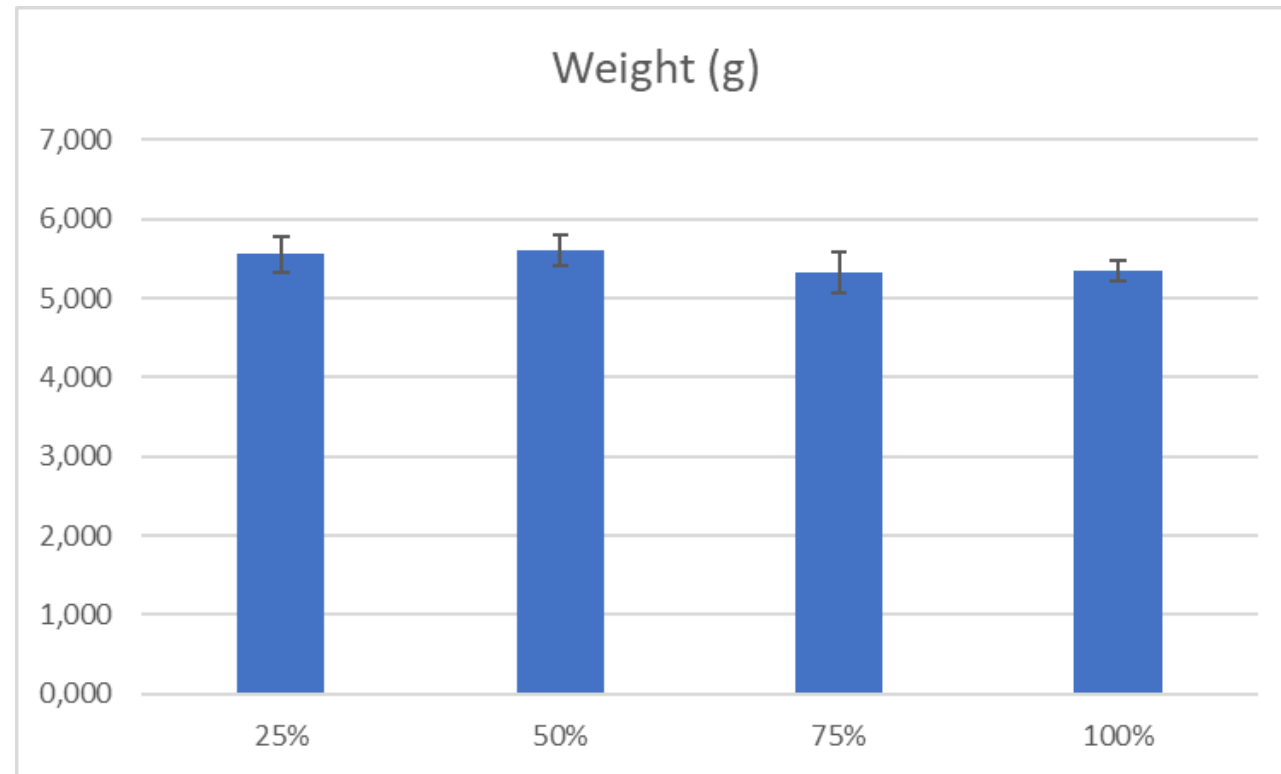
Phenylalanine



100% = 0.67 g/100 g DM

— Results

Thryptophan



100% = 0.24 g/100 g DM

— Overview results

Minimum (FCR= 1.9):

Lysine: 0.35 g/100 g DM → 0.67 g/ 100 g growth

Methionine: 0.13 g/100 g DM → 0.25 g/ 100 g growth

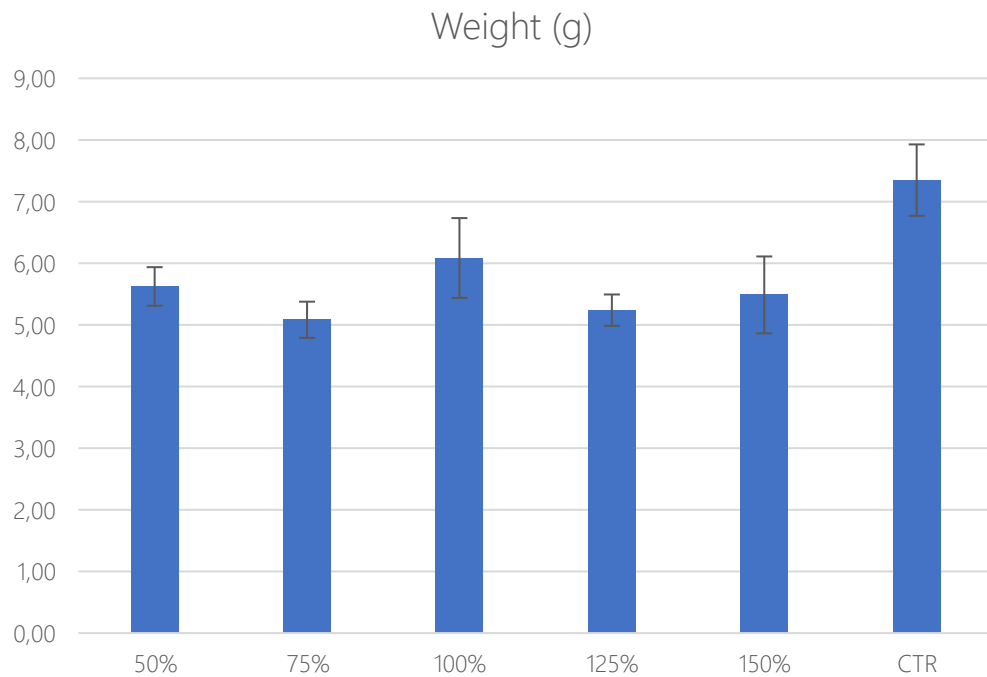
Tryptophan: 0.06 g/100 g DM → 0.11 g/ 100 g growth

Phenylalanine: 0.34 g/100 g DM → 0.65 g/ 100 g growth

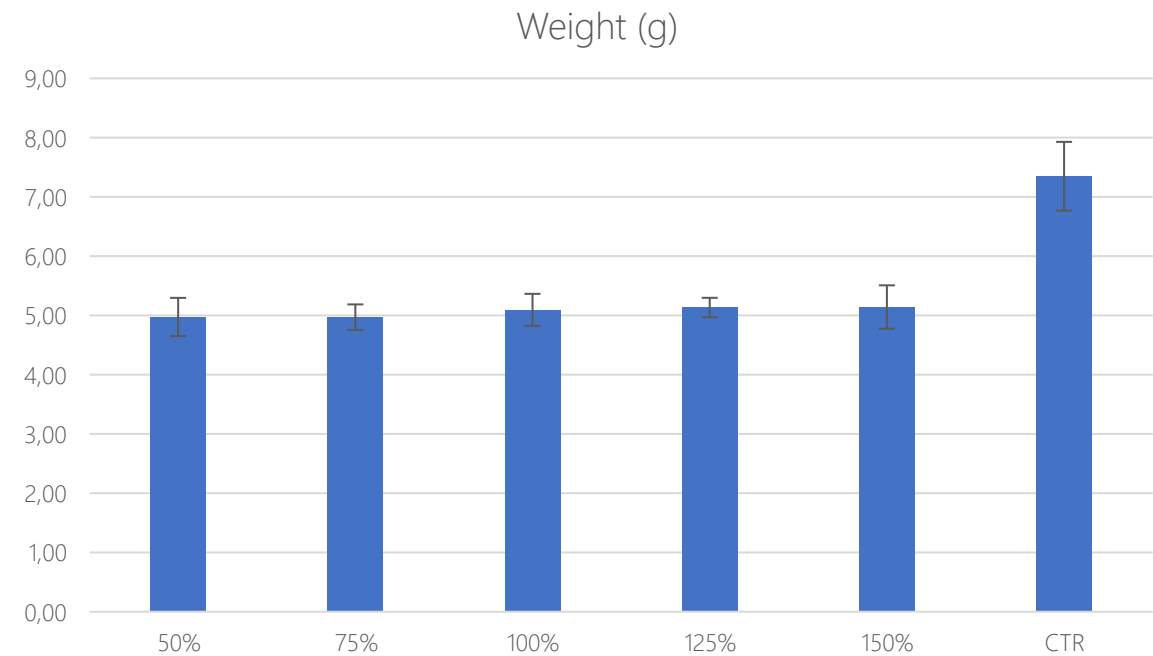
Threonine: 0.42 g/100 g DM → 0.80 g/ 100 g growth

— Further improvement?

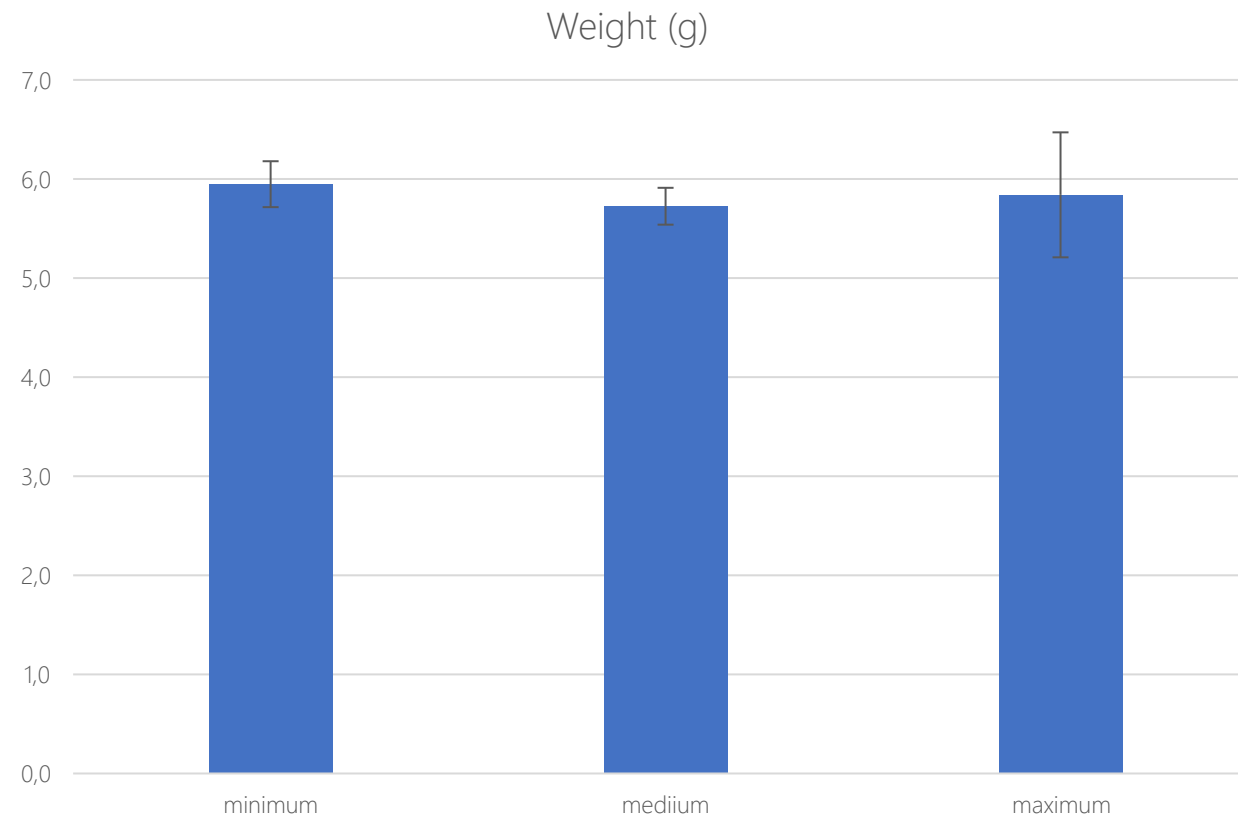
Methionine



Threonine



— Verification



Medium= in between minimum and control
Maximum = control

— **Black soldier fly**

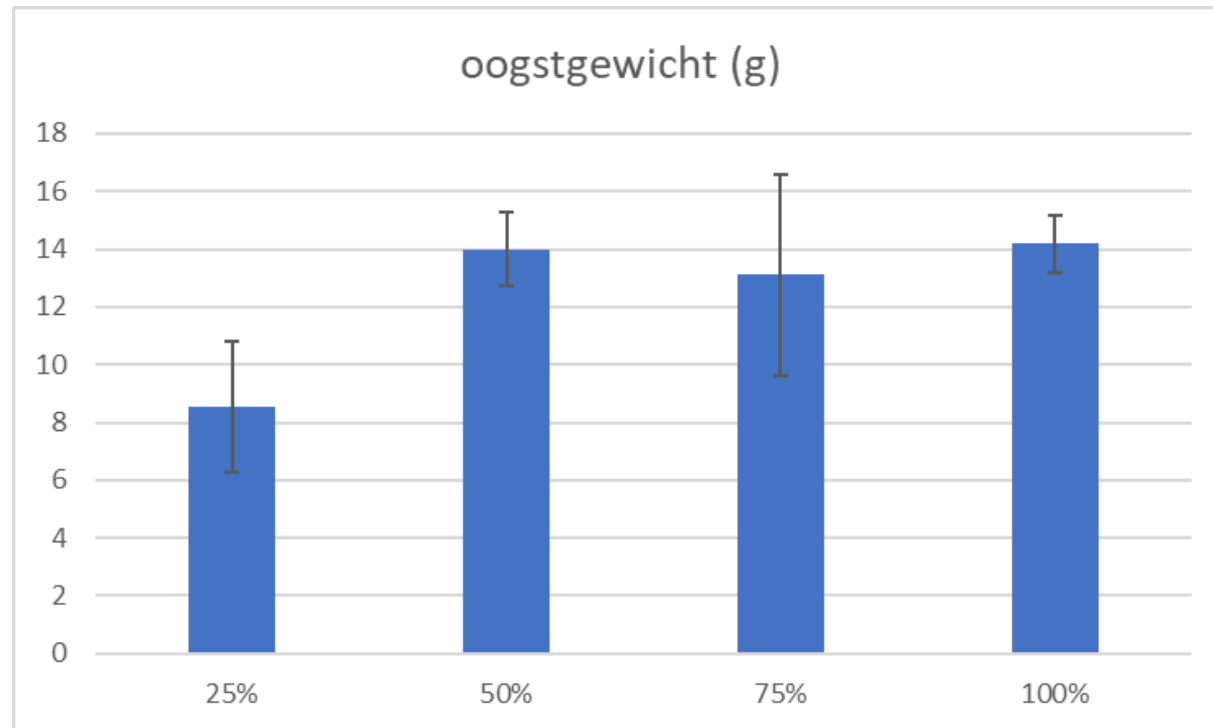
— Experimental diet (100 larvae of 5-6 days, 70% water)

Lysine (control = chicken feed)

	25%	50%	75%	100%
kippenmeel	7,5	7,5	7,5	7,5
suiker	10,44	10,44	10,44	10,44
ASP	0,604	0,604	0,604	0,604
GLU	1,444	1,349	1,271	1,192
HIS	0,107	0,107	0,107	0,107
GLY	0,162	0,162	0,162	0,162
THR	0,186	0,186	0,186	0,186
ALA	0,402	0,402	0,402	0,402
ARG	0,118	0,118	0,118	0,118
CYS	0,041	0,041	0,041	0,041
VAL	0,223	0,223	0,223	0,223
MET	0,075	0,075	0,075	0,075
PHE	0,212	0,212	0,212	0,212
ILE	0,185	0,185	0,185	0,185
LEU	0,322	0,322	0,322	0,322
LYS	0,000	0,095	0,173	0,252
TRY	0,033	0,033	0,033	0,033

— Results

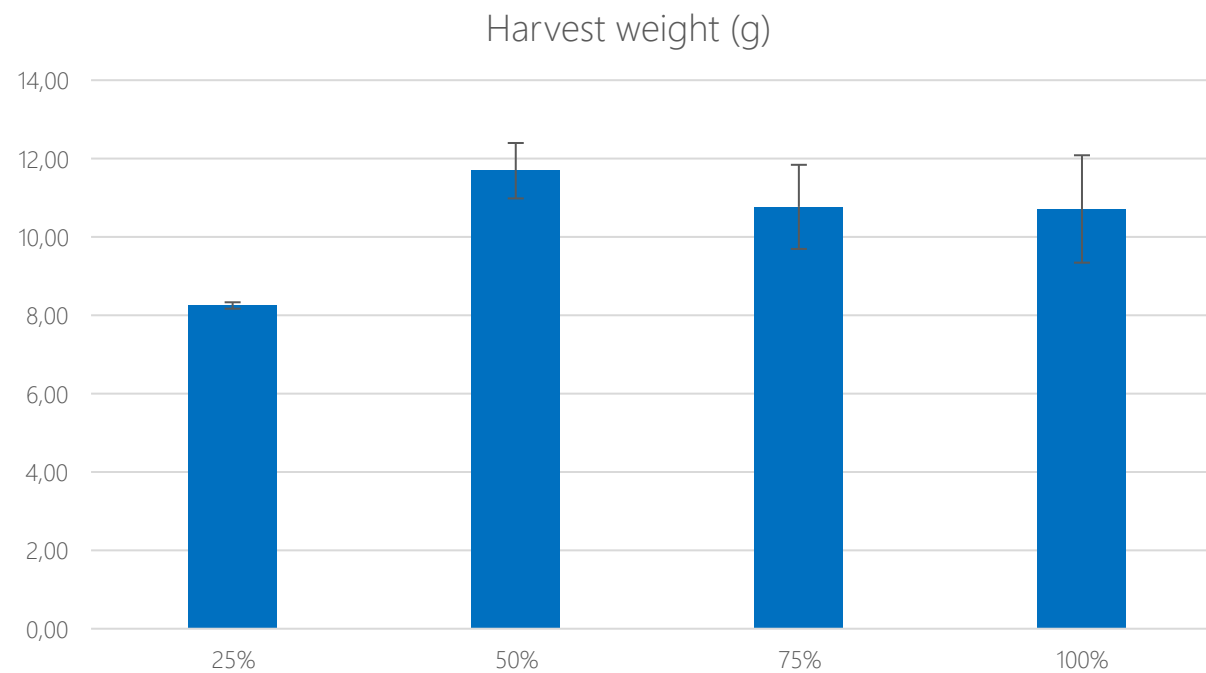
Lysine



100% = 1.05 g/100 g DM

— Results

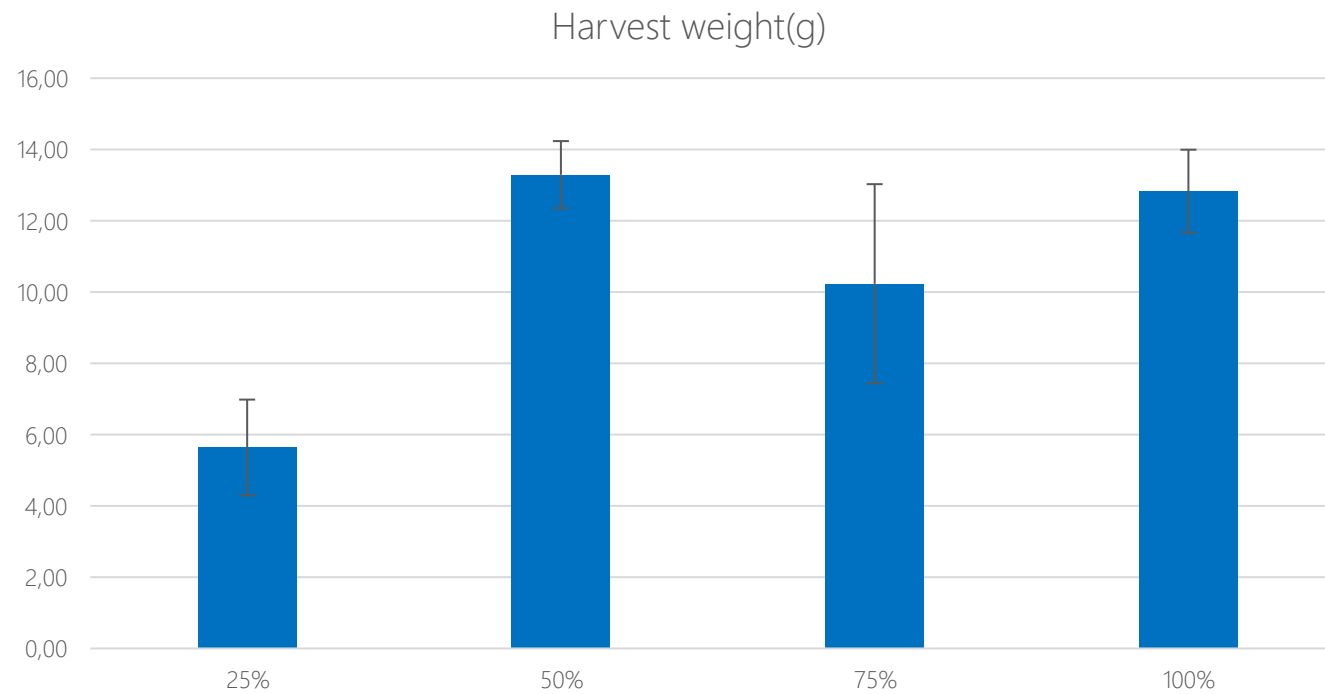
Methionine



100% = 0.31 g/100 g DM

— Results

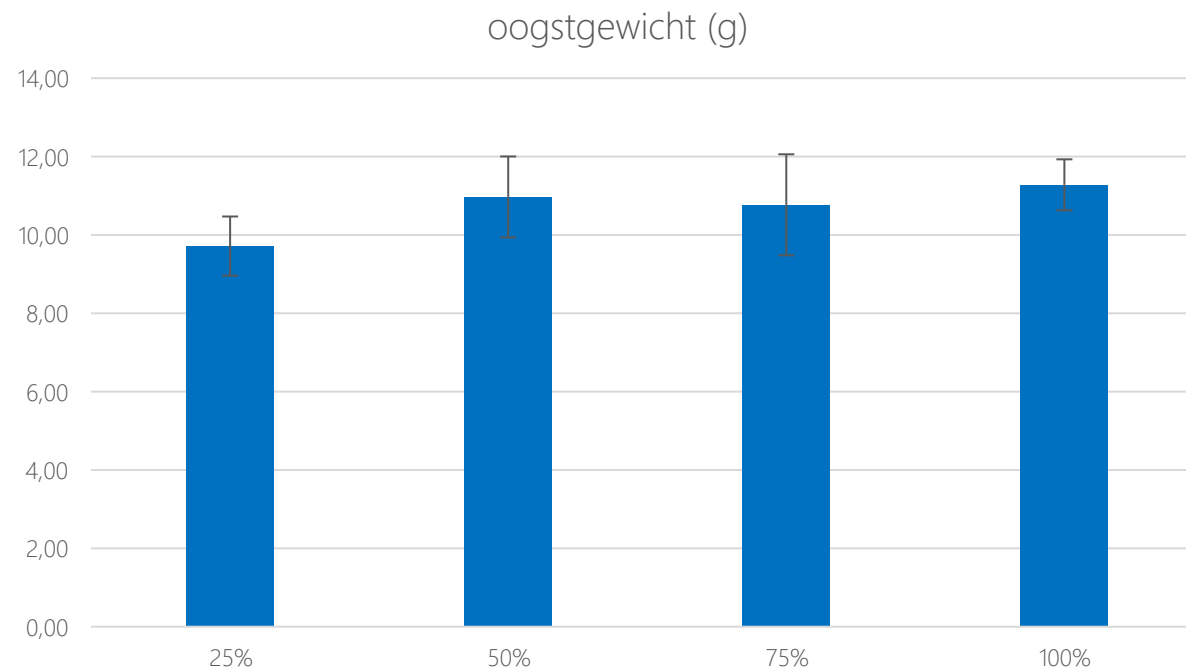
Threonine



100% = 0.97 g/100 g DM
A lot of mortality at 25 %

— Results

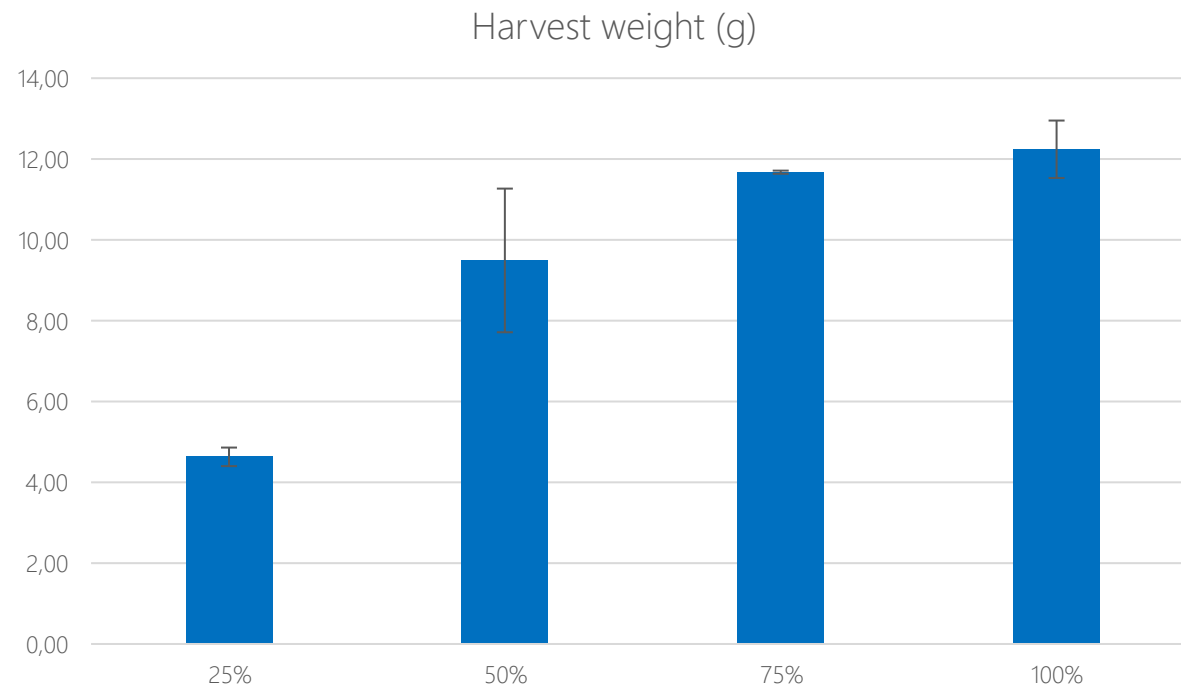
Phenylalanine



100% = 1.11 g/100 g DM

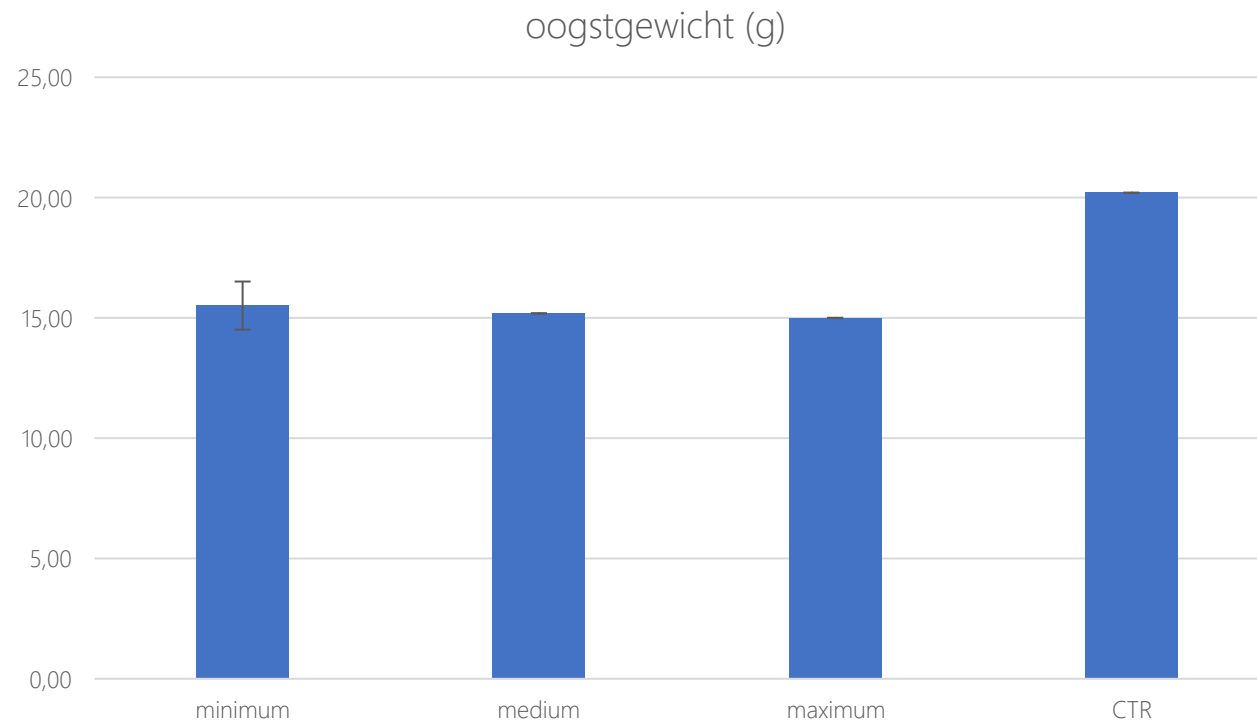
— Results

Tryptophan



100% = 0,17 g/100 g DM
High mortality at 25%

— Verification



Medium= in between minimum and control
Maximum = control

— Overview results

Minimum (FCR= 1.2):

Lysine: 0.53 g/100 g DM → 0.64 g/ 100 g growth

Methionine: 0.16 g/100 g DM → 0.19 g/ 100 g growth

Tryptophan: 0.13 g/100 g DM → 0.16 g/ 100 g growth

Phenylalanine: 0.56 g/100 g DM → 0.67 g/ 100 g growth

Threonine: 0.49 g/100 g DM → 0.59 g/ 100 g growth

— Overview

BSF

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Phenylalanine: 0.56 g/100 g DM → 0.67 g/ 100 g growth

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Mealworm

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Tryptophan: 0.06 g/100 g DM → 0.11 g/ 100 g growth

Phenylalanine: 0.34 g/100 g DM → 0.65 g/ 100 g growth

Threonine: 0.42 g/100 g DM → 0.80 g/ 100 g growth

— Valorizing organic side streams

Projects Bioboost and Entomospeed

