Tenebrio molitor as a Source of Insect Protein

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Tenebrio molitor L. (Coleoptera: Tenebrionidae)

Development time at 27ºC:
Egg 7-8 days
Larva 90-140 days
Pupa 7-8 days

Instars: Developmental plasticity exhibiting from 11 to 18 instars.
Some authors have reported up to 21 instars.

Adult longevity: 80-180 days.

Fecundity: 90-200 eggs per female.

Most Common Commercial uses of *Tenebrio molitor* in The United States

Food for bird breeding, finches

Feed for wild birds, particularly Blue Birds:
http://www.sialis.org/feeder.htm
http://www.nabluebirdsociety.org/

Food for carnivore reptile pets, gecko, bearded dragon, etc.

Food for small mammalian pets, hedgehogs, mice, rats etc.

Fishing lure and bait.

Organic fertilizer

Food and supplements for exotic species in zoos

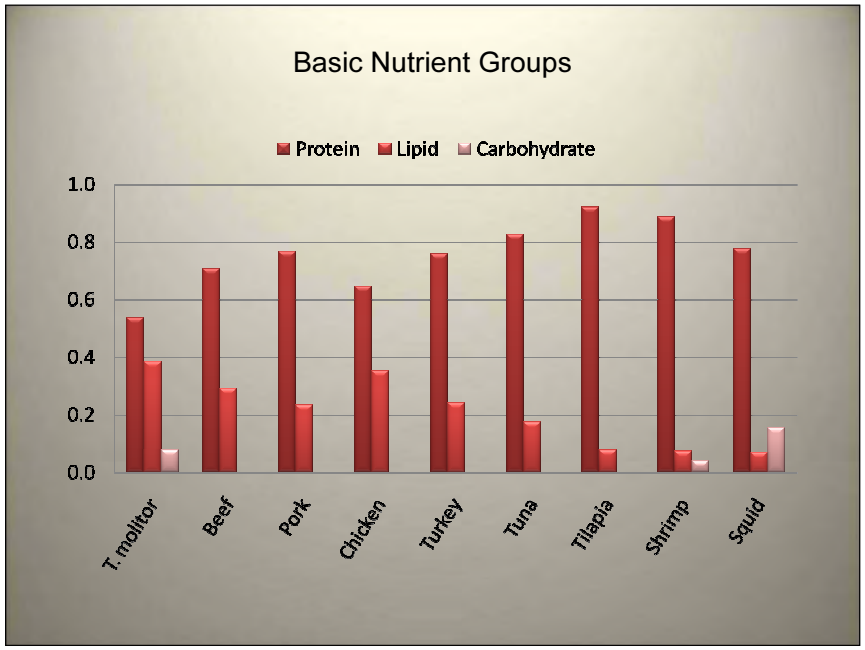
Potential Uses of *Tenebrio molitor* that may Lead to Large Scale Commercialization

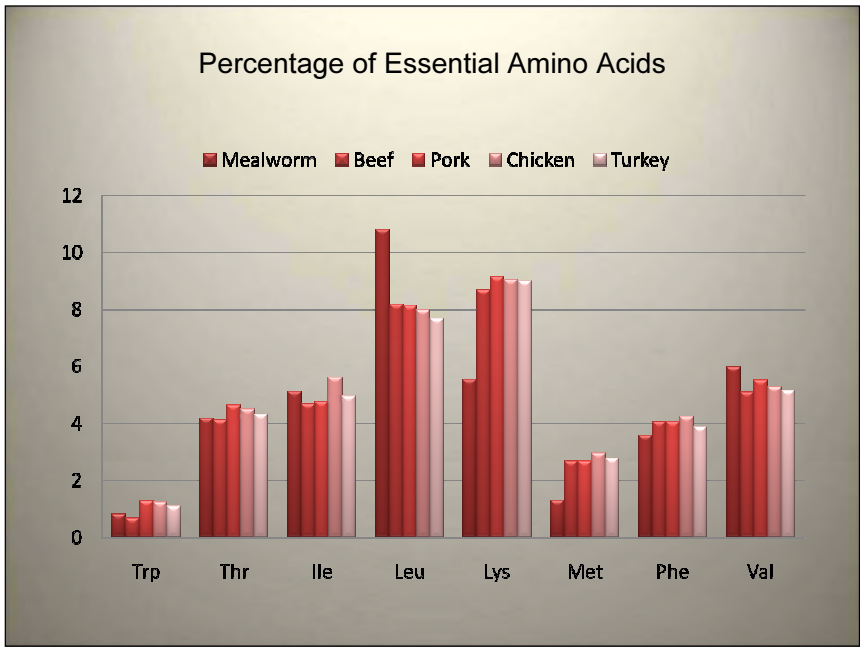
Aviculture as feed or protein supplement:
Ramos-Elorduy et al. 2002
Klasing et al. 2000

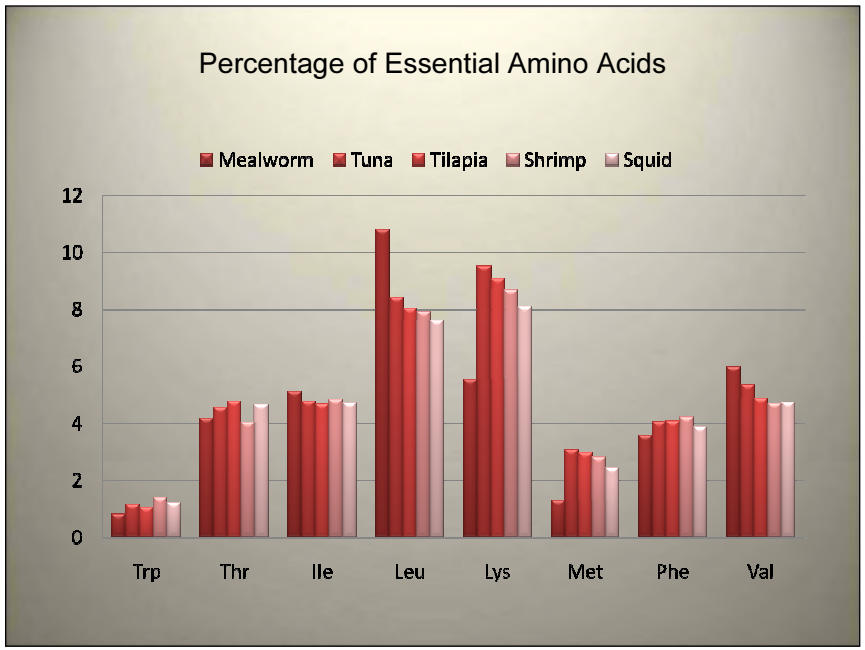
Aquaculture as feed for farmed fish:
Ng et al. 2001

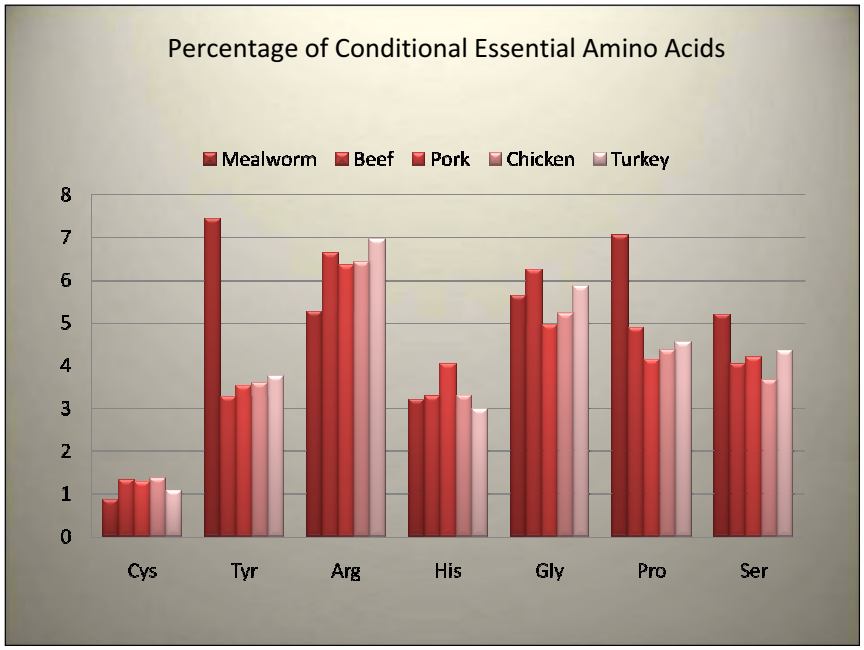
Human consumption:
Ramos Elorduy 1997
Aguilar-Miranda et al. 2002

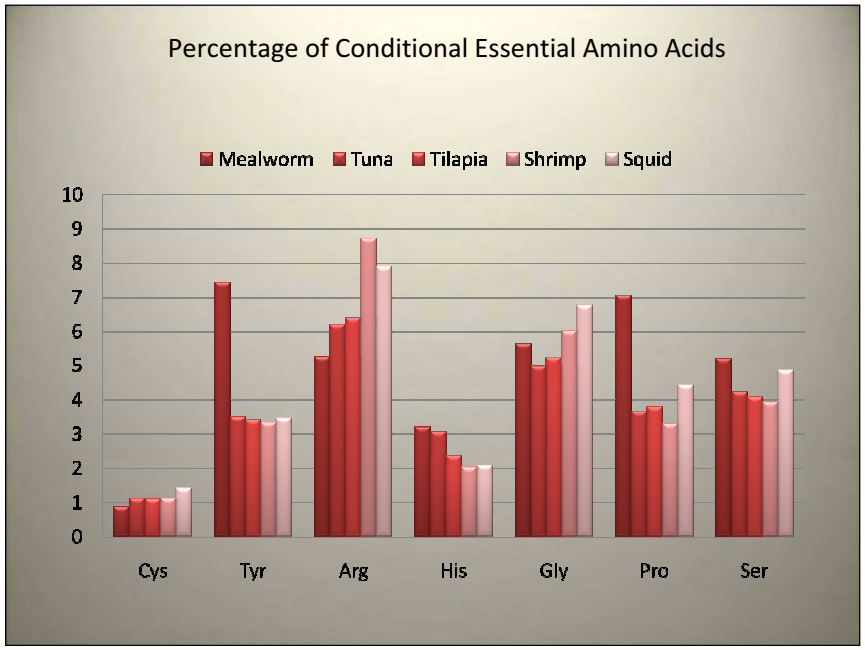
Production of Biological control agents:
De Clercq et al. 1998 (*Podisus maculoventris* (Heteroptera: Pentatomidae))
Grundy et al. 2000 (*Pristhesancus plagipennis* (Heteroptera Reduviidae))
Zanuncio et al. 2001 (*Podisus nigrispinus* (Heteroptera: Pentatomidae))
Shapiro-Ilan et al. 2008 (Entomopathogenic nematodes)

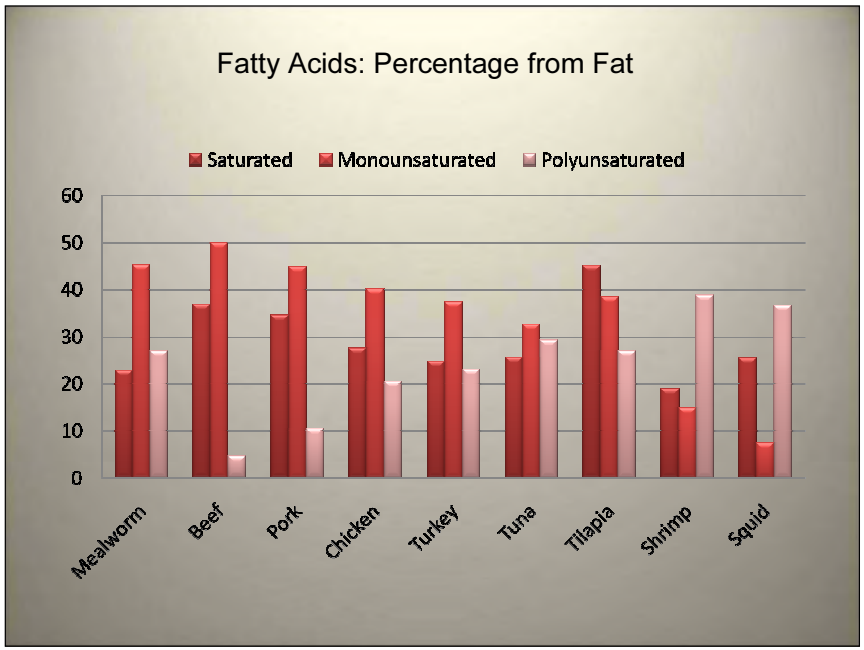


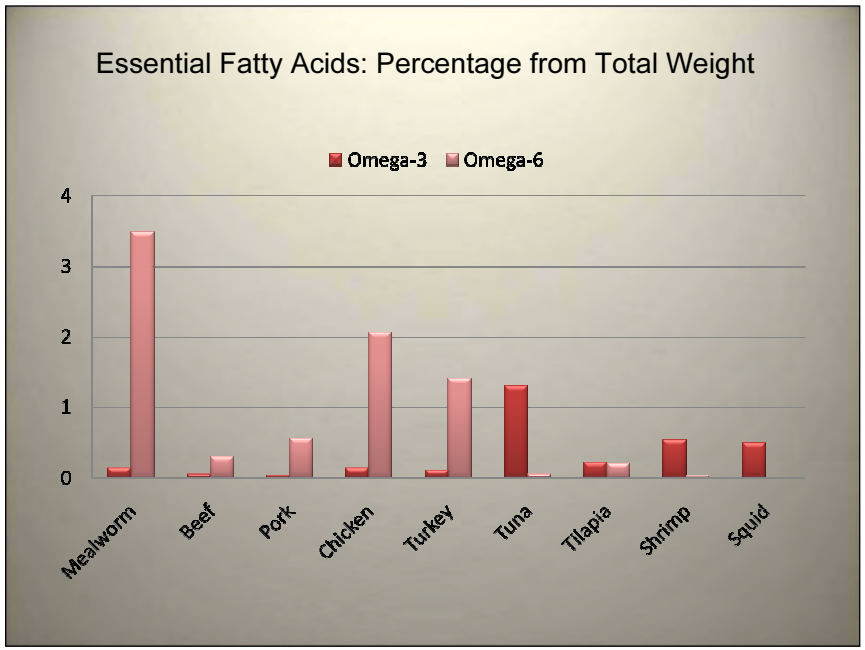





Percentage of Conditional Essential Amino Acids
Mealworm
Beef
Pork
Chicken
Turkey
8
7
6
5
4
3
2
1
0
Cys
Tyr
Arg
His
Gly
Pro
Ser


Percentage of Conditional Essential Amino Acids
Mealworm
Tuna
Tilapia
Shrimp
Squid
10
9
8
7
6
5
4
3
2
1
0
Cys
Tyr
Arg
His
Gly
Pro
Ser


Fatty Acids: Percentage from Fat
Saturated
Monounsaturated
Polyunsaturated
60
50
40
30
20
10
0
Mealworm
Beef
Pork
Chicken
Turkey
Tuna
Tilapia
Shrimp
Squid


Essential Fatty Acids: Percentage from Total Weight
Omega-3
Omega-6
4
3
2
1
0
Mealworm
Beef
Pork
Chicken
Turkey
Tuna
Tilapia
Shrimp
Squid

Improving Mass Production of *Tenebrio molitor*

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   A) Mechanization

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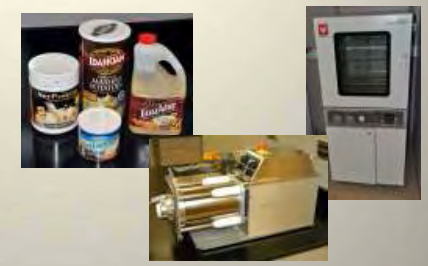


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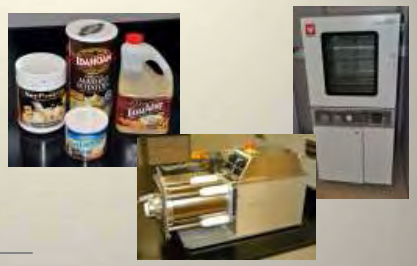

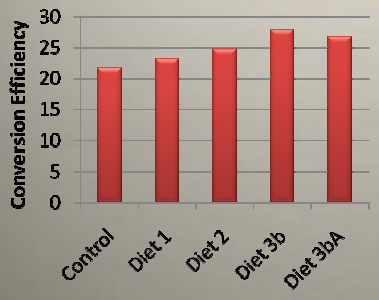

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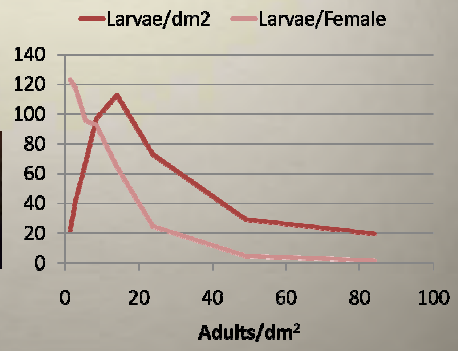

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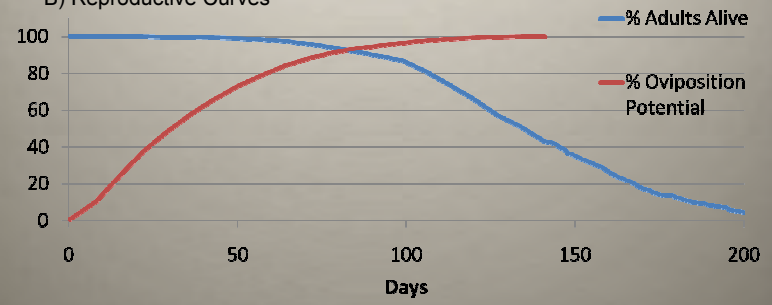

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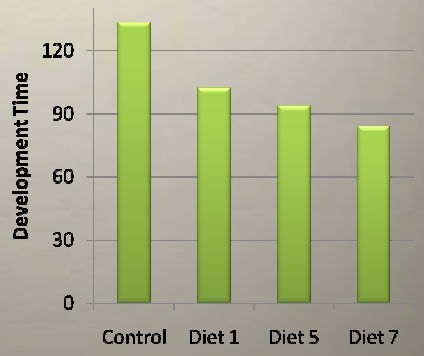

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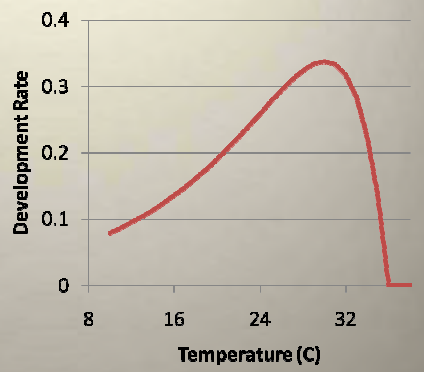

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Larval densities have a significant impact on developmental rates in *Tenebrio molitor*.

Tschinkel and Willson 1971
Weaver and McFarlane 1990
Connat et al. 1991

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Needed Research:

Optimal temperature for population growth.

Optimal larval density for rapid development

Methods of storage

Methods of separation of pupae from larvae and adults from pupae

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And Scott Lee for assembling the separator and other equipment