

SCREWWORM DIET

THE BLOOD STORY

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CURRENT LARVAL DIET

Spray-dried whole bovine blood	6%
Spray-dried egg	5%
Milk substitute	4%
Gelling agent (Aquatain) (or Cellulose Fiber – 5%)	1.85%
Water	83%
Formalin	0.12%

Spray-Dried Whole Bovine Blood

• Protein	85 %
• Fat	1 %
• Fiber	1 %
• Ash	5 %
• Moisture	7 %
• Minerals	~1%

(Calcium, Magnesium, phosphorus, sodium, potassium, Chloride, Iron, Zinc and Copper)

Fresh Bovine Blood

(Sodium Citrate as anticoagulant)

- Plasma 65-70%
 - Cell mass 30-35%
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- Protein (plasma protein – 1/3) 17 %
- Fat 0.231 %
- Carbohydrates 0.07 %
- **Water 80 %**
- Minerals 0.62 %

(Iron: 36 mg /100 g blood)

Nutrient Components in Plasma and Cell Concentrate (%)

	<u>PLASMA</u>	<u>CELL</u>
• Protein	80	87
• Fat	1.5	2
• CHO	5	3
• Moisture	7	3
• Minerals	6.5	5

Amino Acid Composition of Bovine Blood

Amino Acids	Plasma (mg/100 g protein)	Cell
Alanine	5	9.5
Arginine	3	2
Aspartic acid	10	11
Cystine	2	<1
Glutamic acid	14	8
Glycine	3	4.5
Histidine	4	6
Isoleucine	3	<1
Leucine	9	14
Lysine	7.5	10
Methionine	<1	<1
Phenylalanine	5	8
Proline	5	3
Serine	6.5	5.5
Threonine	6.5	5
Tryptophan	1	1
Tyrosine	5	2
Valine	6.5	8.5

(Duarte et al. J. Agric. Food Chem. 1999)

Minerals in Plasma and Cell Concentrate (mg/100 g)

	<u>PLASMA</u>	<u>CELL</u>
• Calcium	60	8
• Magnesium	10	4.5
• Phosphorus	101	64
• Sodium	2500	505
• Potassium	330	95
• Iron	-	253
• Zinc	1.5	4
• Copper	1.5	<1

Inedible Poultry Eggs

(Spray-Dried)

- Protein 47 %
- Fat (Total Lipid) 40 %
- Moisture 3%
- Ash 3 %
- Carbohydrate 4 %
- Vitamins ~1 %
(A, D, E, K, Thiamin, Riboflavin, Niacin, B₆, Pantothenic acid, Choline)
- Minerals ~2 %
(Calcium, Iron, Magnesium, Phosphorus, Potassium, Sodium, Copper, Manganese, Selenium)

Milk Substitute

- Protein 35 g

- Carbohydrate 42 g

- Total Fat 2.5 g

- Water 4 g

- Ash 8 g

- Vitamins ~1.5 g

A, B₁, B₂, B₃, B₆, B₇, B₁₂, C, D, E,
FOLATE, PANTOTHENIC ACID,

- Minerals ~3 g

CALCIUM, COPPER, IRON,
MAGNESIUM,
PHOSPHORUS,
POTASSIUM, SODIUM
ZINC

(Calva Products and USDA Nutrition Data)

BLOOD PRODUCTS FROM APC

- AP 300 – Spray-Dried Whole Blood
(No longer manufactured)
- AP 301 – Spray-Dried Animal Blood Cells
(Available)
- AP 820 PM – Bovine Animal Plasma
(Available)

SCREWWORM GROWTH AND DEVELOPMENT IN BLOOD CELL BASED DIET

Table 1. Comparison of screwworms reared on six blood cell based diets and a whole blood based control diet (mean $\pm$ SD)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Control
Larval wt, mg	58.14 $\pm$ 4.25	56.61 $\pm$ 6.3	59.73 $\pm$ 4.24	58.73 $\pm$ 3.79	60.74 $\pm$ 4.18	60.96 $\pm$ 6.03	59.84 $\pm$ 3.90
Pupal wt, mg	41.74 $\pm$ 2.20	37.93 $\pm$ 3.25*	42.02 $\pm$ 2.40	43.21 $\pm$ 3.00	45.36 $\pm$ 3.72	45.99 $\pm$ 4.51	42.91 $\pm$ 3.12
No pupae/ 100 mg eggs	1,008 $\pm$ 209	930 $\pm$ 101*	1,053 $\pm$ 161	1,177 $\pm$ 205	1,244 $\pm$ 245	1,055 $\pm$ 198	1,109 $\pm$ 181
% emergence	91.75 $\pm$ 5.57	93.5 $\pm$ 3.66	92.38 $\pm$ 3.96	93.00 $\pm$ 3.89	92.63 $\pm$ 3.54	95.88 $\pm$ 2.75	92.50 $\pm$ 4.60
% female emergence	46.25 $\pm$ 5.78	45.67 $\pm$ 8.25	44.25 $\pm$ 9.63	46.38 $\pm$ 7.96	43.50 $\pm$ 7.23	43.88 $\pm$ 6.36	47.25 $\pm$ 5.31
Eggs laid, g	1.33 $\pm$ 0.13	1.02 $\pm$ 0.1	1.12 $\pm$ 0.05	0.86 $\pm$ 0.18*	1.35 $\pm$ 0.12	1.29 $\pm$ 0.11	1.34 $\pm$ 0.23
% egg hatch	70.47 $\pm$ 13.29*	75.61 $\pm$ 5.3	78.72 $\pm$ 6.64	72.24 $\pm$ 8.02*	81.97 $\pm$ 4.67	81.49 $\pm$ 3.15	79.85 $\pm$ 6.07
Longevity, d	27 $\pm$ 3.21	27 $\pm$ 0.5	23.5 $\pm$ 2.67	22 $\pm$ 0.5	22.5 $\pm$ 1.6	22 $\pm$ 0.5	23 $\pm$ 3.21

*, Means significantly different than the corresponding control values ($P > 0.05$; 2-sample *t*-test). Diet 1, 7% blood cells, 4% egg product, 4% milk substitute, and 1.2% gel (7:4:4:1.2); diet 2, (7:5:4:1.2); diet 3, (6:4:4:1.2); diet 4, (5:5:5:1.2); diet 5, (5:5:5:1.4); diet 6, (5:5:5:1.5); control diet, 6% whole blood, 4% egg product, 4% milk substitute, and 1.2% gel.

(Chaudhury et al. J. Econ. Entomol. 1998)

Ongoing Tests

- **Spray-dried whole blood from California Spray Dry & Blood Cell product from Jerry Ball mixed in 50:50 ratio.**
- **Spray-dried whole blood from California Spray Dry & Blood Cell product from APC (AP 301) mixed in 50:50 ratio.**
- **Blood Cell product from APC (AP 301).**

Alternative Nutrients to Replace,
or Partially Replace Blood?

USE OF SOY PROTEIN

Nutrients in defatted Soy Flour

(100 g)

- Protein – 47 g

Tryptophan, 0.7; Threonine, 2; Isoleucine, 2.3; Leucine, 3.8; Lysine, 3.1; Methionine, 0.6; Cystine, 0.8; Phenylalanine, 2.5; Tyrosine, 1.8; Valine, 2.3; Arginine, 3.6; Histidine, 1.3; Alanine, 2.2; Asp. Acid, 5.9; Glutamic Acid, 9.1; Glycine, 2.2; Proline, 2.8; Serine 2.7

- Fat – 1.2 g

- CHO – 38.4 g

- Vitamins ~ 300 mg

- Minerals ~ 3 g

Preliminary Observations with Soy Protein

- Diet with soy replacing 100% blood:
No survival.
- Diet with soy replacing 50% blood:
Biological yield (no. of pupae/tray), larval weight and pupal weight are lower than control.

Future Research

- Search for alternative nutrient components to replace, or partially replace blood.
- Investigate efficacy of freeze-dried blood to replace spray-dried blood.
- Identify phagostimulant that induces larval feeding.