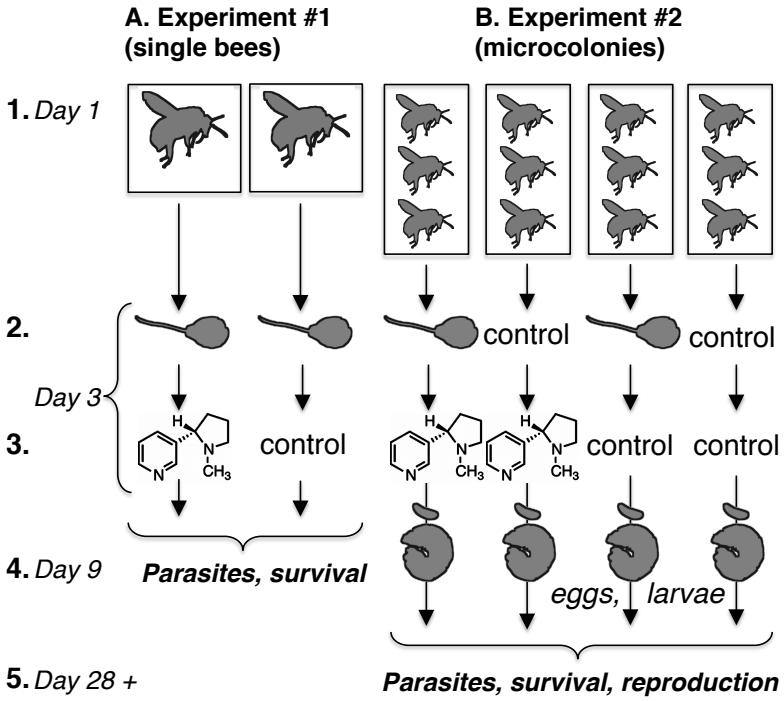
ELECTRONIC SUPPLEMENTARY MATERIAL

Supplementary figure

Figure S1. Schematic of experimental design. 1. Single bees in vials (Experiment #1) or trios of bees in microcolony containers (Experiment #2) were fed *ad libitum* 30% sucrose solution and pollen for two days. 2. On day three, we inoculated all bees in Experiment #1 and two of four treatment groups of bees in Experiment #2 with *Crithidia bombi*. 3. We then began experimental nectar treatments, a 30% sucrose solution with or without one of eight secondary metabolite compounds for single bees, or control vs. anabasine for microcolonies. 4. We assessed parasite load and survival on day nine for single bee experiments. 5. We assessed parasite load, survival and reproduction after day 28 for the microcolony experiment.



Supplementary tables

Table S1. Experiment 1: Effects of eight secondary metabolites and experimental covariates on *Crithidia bombi* cell density in the intestines of the host *Bombus impatiens*. An AIC selection procedure was used to select best-fit ANCOVA models for each analysis. For main effects, Cohen's *d* effect sizes were calculated from model least square means and error terms. Statistically significant differences are indicated in bold.

Compounds	Main Effects						Covariates	
	Mean (Log_{10} (cells*mL^{-1}))	SE	SS	F	P	Cohen's *d*		
Alkaloids								
Anabasine	5.33	0.18	3.90	13.77	**0.001**	-1.36	Colony	$F_{1,26}$ = 6.22, **P = 0.02**
Control	6.05	0.15					Inoculum	$F_{1,26}$ = 2.43, **P = 0.05**
							Radial Cell (mm)	$F_{1,26}$ = 2.43, P = 0.13
Caffeine	6.12	0.23	0.32	0.50	0.49	-0.37	Colony	$F_{1,21}$ = 1.32, P = 0.29
Control	6.42	0.33					Radial Cell (mm)	$F_{1,21}$ = 2.32, P = 0.14
							Weight (g)	$F_{1,21}$ = 1.01, P = 0.33
Nicotine	6.48	0.14	1.41	7.67	**0.01**	-0.97	Colony	$F_{1,29}$ = 3.78, **P = 0.01**
Control	6.89	0.12					Radial Cell (mm)	$F_{1,29}$ = 4.80, **P = 0.04**
							Weight (g)	$F_{1,29}$ = 1.26, P = 0.27
Cyanogenic Glycosides								
Amygdalin	6.00	0.17	0.11	0.19	0.67	-0.11	Colony	$F_{1,53}$ = 1.05, P = 0.42
Control	6.08	0.18					Experimental Trial	$F_{1,53}$ = 3.78, P = 0.06
							Exp. Trial* Treatment	$F_{1,53}$ = 0.80, P = 0.37
							Radial Cell (mm)	$F_{1,53}$ = 1.16, P = 0.29
							Weight (g)	$F_{1,53}$ = 0.06, P = 0.80
Iridoid Glycosides								

Aucubin	5.98	0.19	0.57	2.15	0.15	-0.63	Colony	$F_{1,44} = 1.38$, P = 0.25
Control	6.30	0.22					Radial Cell (mm)	$F_{1,44} = 1.05$, P = 0.31
							Weight (g)	$F_{1,44} = 1.40$, P = 0.24
Catalpol	5.89	0.18	1.03	3.89	**0.05**	-0.80	Colony	$F_{1,44} = 1.38$, P = 0.25
Control	6.30	0.22					Radial Cell (mm)	$F_{1,44} = 1.05$, P = 0.31
							Weight (g)	$F_{1,44} = 1.40$, P = 0.24
Phenolics								
Gallic Acid	6.47	0.16	0.48	1.38	0.25	-0.36	Colony	$F_{1,38} = 2.95$, **P = 0.01**
Control	6.68	0.16					Radial Cell (mm)	$F_{1,38} = 1.94$, P = 0.17
							Weight (g)	$F_{1,38} = 2.19$, P = 0.15
Terpenoids								
Thymol	5.87	0.15	2.29	7.89	**0.01**	-0.90	Colony	$F_{1,38} = 0.91$, P = 0.35
Control	6.36	0.14					Inoculum	$F_{1,38} = 8.86$, P = **0.001**
							Radial Cell (mm)	$F_{1,38} = 0.52$, P = 0.48
							Weight (g)	$F_{1,38} = 0.18$, P = 0.67

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Table S2. Experiment 2: Mixed effects models for response variables from anabasine microcolony experiment, including A) bee *Crithidia* load, B) daily consumption of nectar, C) daily consumption of pollen, and D) number of days to first egg production. F-statistics and P-values are given for each fixed effect, and statistically significant results ($P \leq 0.05$) are indicated in bold.

Analysis	Effect	Statistic
A) Parasite count	Nectar treatment	$F_{1, 7.0} = 9.58$, **P = 0.02**
	Day	$F_{1, 6.8} = 10.45$, **P = 0.01**
	Dimorphism	$F_{1, 8.0} = 8.39$, **P = 0.02**
	Nectar treatment*Dimorphism	$F_{1, 7.6} = 6.43$, **P = 0.04**
B) Nectar	Nectar treatment	$F_{1, 65.3} = 5.16$, **P = 0.03**
	Parasite treatment	$F_{1, 43.2} = 2.80$, P = 0.10
	Day	$F_{1, 830.4} = 41.79$, **P < 0.0001**
	Nectar*Day	$F_{1, 869.0} = 1.19$, P = 0.28
	Nectar*Parasite	$F_{1, 32.3} = 0.21$, P = 0.65
	Parasite*Day	$F_{1, 877.5} = 0.78$, P = 0.38
	Number of bees in microcolony	$F_{1, 605.5} = 70.09$, **P < 0.0001**
C) Pollen	Nectar treatment	$F_{1, 43.7} = 2.20$, P = 0.15
	Parasite treatment	$F_{1, 43.6} = 5.98$, **P = 0.02**
	Day	$F_{1, 786.7} = 44.12$, **P < 0.0001**
	Nectar*Day	$F_{1, 777.2} = 0.15$, P = 0.70
	Nectar*Parasite	$F_{1, 43.7} = 0.82$, P = 0.37
	Parasite*Day	$F_{1, 787.8} = 0.12$, P = 0.73
	Number of bees in microcolony	$F_{1, 288.1} = 4.34$, **P = 0.04**
D) Days to first egg	Nectar treatment	$F_{1, 28.2} = 4.26$, **P = 0.05**
	Parasite treatment	$F_{1, 29.1} = 0.03$, P = 0.87
	Nectar*Parasite	$F_{1, 29.5} = 0.13$, P = 0.72

Table S3. Experiment 2: Random effects statistics for mixed model analysis of A) bee *Crithidia* load, B) daily consumption of nectar, C) daily consumption of pollen, and D) number of days to first egg production.

Analysis	Random effect	Variance ratio	Variance component	Standard error	Percent of total
A) Parasite count	Microcolony	0.20	0.02	0.03	16.9
	Residual		0.08	0.03	83.1
	Total		0.10	0.03	100.0
B) Nectar	Source Colony	0.15	0.01	0.01	11.6
	Microcolony/ nectar	0.11	0.01	67,841.13	9.0
	Microcolony/ pollen	-0.03	0.00	67,841.13	0.0
	Residual		0.06	0.00	79.5
	Total		0.08	67,841.13	100.0
C) Pollen	Source Colony	0.01	0.00	0.00	1.2
	Microcolony/ nectar	0.16	0.03	104,184.27	13.8
	Microcolony/ pollen	-0.14	-0.02	104,184.27	0.0
	Residual		0.17	0.01	85.1
	Total		0.20	104,184.27	100.0
D) Days to first egg	Source colony	1.08	8.11	5.65	52.0
	Residual		7.50	2.03	48.0
	Total		15.60	5.95	100.0

Table S4. Experiment 2: Likelihood ratio tests for penalized and full models from a proportional hazards model of anabasine microcolony bee survival including both fixed and random effects. Data are Chi-squared values, degrees of freedom, P-values, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Statistically significant results ($P \leq 0.05$) are indicated in bold.

Likelihood ratio test	χ^2	df	P	AIC	BIC
Integrated log-likelihood	41.2	4.00	**$2.47*10^{-8}$**	33.18	28.3
Penalized log-likelihood	104.05	22.13	**$1.39*10^{-12}$**	59.79	32.82

Table S5. Experiment 2: Effect of nectar diet (anabasine vs. control) and parasite infection on the probability of mortality of bees in the anabasine microcolony experiment. Negative coefficients indicate reduced probability of mortality in the treatment group listed. Statistically significant results ($P \leq 0.05$) are indicated in bold.

Fixed effects	Coefficient	$e^{coefficient}$	Coefficient standard error	Z-score	P
Nectar treatment (control)	0.088	1.092	0.998	0.090	0.930
Crithidia (uninfected)	-2.043	0.130	1.036	-1.970	**0.048**

Table S6. Experiment 2: Variance explained by two random effects, microcolony and colony of origin, in the proportional hazards model of bee survival in the anabasine microcolony experiment.

Random effects	Variable	Standard deviation	Variance
Microcolony	Intercept	2.32	5.38
Colony of origin	Intercept	2.89	8.38