

Effect of Varied Macronutrient Ratios on Honey Bee Tolerance to IAPV Infection

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Abstract

Honey bees are killed by Israeli acute paralysis virus (IAPV). Because this virus has no cure, it is important to lessen its impact on bees through proper nutrition. This project explores the effects of differing protein to lipid (P:L) ratios in pollen on honey bee susceptibility to this virus.

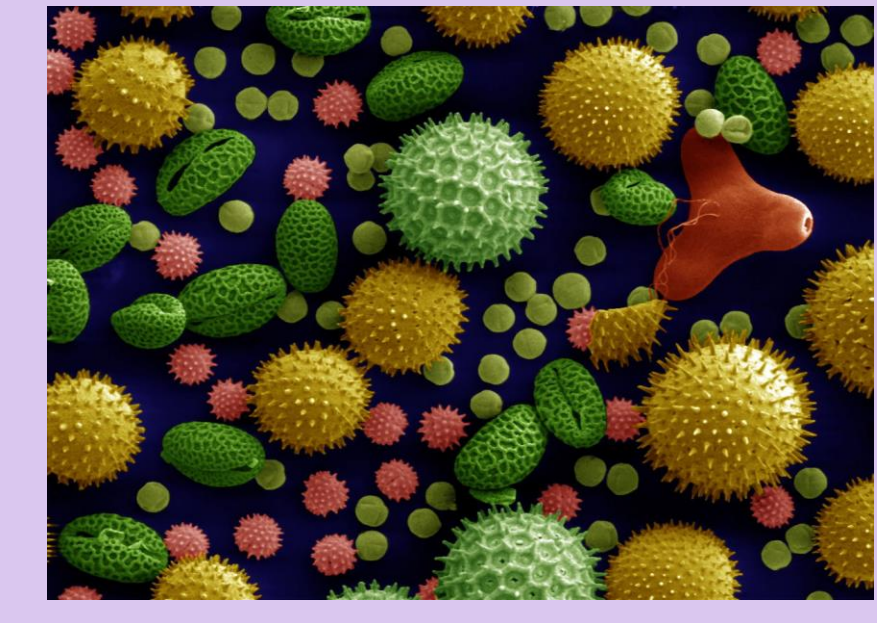
Over three trials, bees in cages were incubated for 3 days to resemble hive conditions. Two doses of IAPV (10^{-3} & 10^{-2}) and a negative control were used, along with five P:L ratios (1.5, 2.5, 11.5, 16.5, & 21.5:1) and a sucrose-only diet. These treatment groups were combined to create a total of 18 treatments (three doses by six diets).

After feeding infected bees diets altered with either casein or canola oil (P or L) mortality was measured every 12 hours. Resulting data found significant differences in mortality rates between diet treatments among bees infected with a 10^{-2} dose. No significant differences between diets were found in the negative control and 10^{-3} groups.

Introduction

The Western honey bee (*Apis mellifera*) contributes to over 15 billion dollars of pollinated crops annually across the USA.¹ Unfortunately, their colonies are declining due to factors like pesticide use, pathogens, parasites, & poor nutrition.¹

- ✦ We are attempting to combat the effects of Israeli acute paralysis virus (IAPV)
- ✦ IAPV inhibits mitochondria in nerves & in the gut, causing paralysis & death¹
- ✦ There are no treatments or cures
- ✦ One way to strengthen a colony is to be sure they have proper nutrition²
- ✦ Eating pollen helps bees with larval development & is their primary protein source³



Colorized SEM of pollen grains, Dartmouth College, 2011

By varying ratios of pollen macronutrients, such as protein & lipids, the efficiency of different diets on mitigating IAPV symptoms can be determined.

This study will attempt to deepen understanding of the importance of honey bee diets & the relation between nutrition & disease resistance.

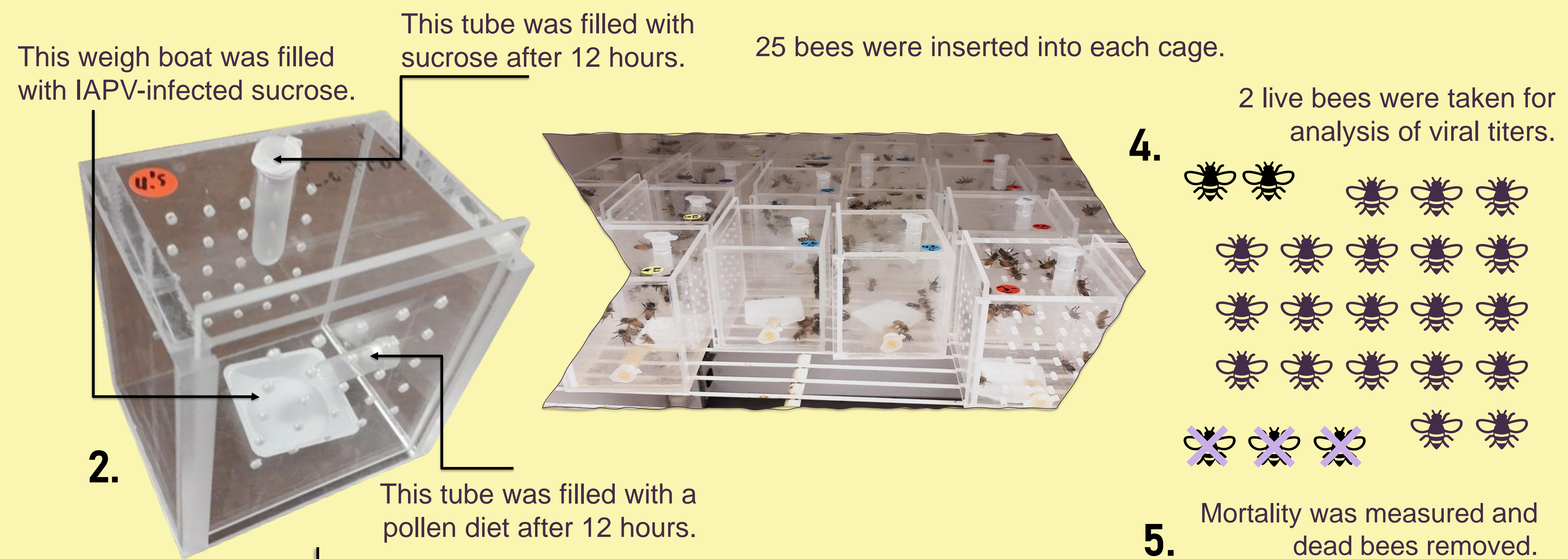
Methods

1. Diet treatments were made by altering pollen with canola oil or casein.
2. Bee cages were assembled with weigh boats full of appropriate virus treatment, filled with bees, and incubated.
3. After 12 hours, sucrose and pollen diets were provided. Bees were incubated for a total of 3 days.
4. At 36 hours, two live bees were taken for analysis.
5. Every 12 hours, mortality data was taken.



Diets were modified with canola oil & casein.

1.	Diet Treatments (P:L)	Virus Treatments		
		No Virus	10^{-3}	10^{-2}
	Sucrose	14 cages	14 cages	14 cages
	1.5:1	14 cages	14 cages	14 cages
	2.5:1	14 cages	14 cages	14 cages
	11.5:1	14 cages	14 cages	14 cages
	16.5:1	14 cages	14 cages	14 cages
	21.5:1	14 cages	14 cages	14 cages



Results

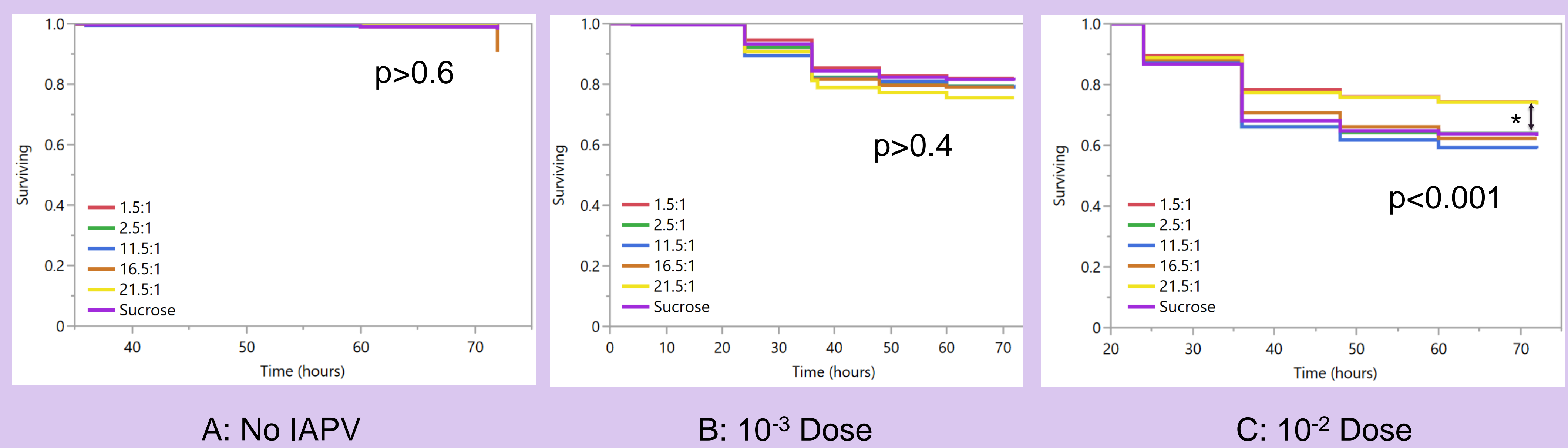


Fig 1. Survival plots for each IAPV treatment. Generated with a Cox proportional hazards model. (A) represents bees not infected with IAPV; no significance. (B) represents bees given a 10^{-3} dose; no significance. (C) represents bees given a 10^{-2} dose; significance found between groups. **1.5 & 21.5 diet groups survived significantly more than 11.5 & 16.5** with a P-value of 0.0004. * represents significance.

Discussion

These results could indicate ways for beekeepers to reduce death from IAPV by providing bees with extreme P:L ratio diets. Significance between diet treatments was only found at a high level of viral infection (10^{-2} dose).

- ✦ **Highest lipid and highest protein diets performed best**
- ✦ They produced significantly less mortality than midrange diets
- ✦ Bees fed a midrange diet of 16.5:1 were approx.
 - ✦ 2.5x more likely to die than bees fed a high lipid diet
 - ✦ 3.3x more likely to die than bees fed a high protein diet

Further investigations into impact of extreme diets on IAPV tolerance are needed.

References

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Acknowledgments

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