The Effect of Quaternary Ammonium Compounds in Common Household Cleaners on the Growth of Mealworms

Gokul Achaththekoot | 20-21

Background & Purpose

Quaternary Ammonium Compounds

- Antimicrobial agents commonly used to get rid of bacteria
- Found in disinfecting agents, fungicides, cleaners, and air fresheners

For This Project

- Ammonium hydroxide (NH_4OH)
  - Tested in concentrations of 1%, 1.5%, and 3%
  - Positive control: Windex Glass Cleaner (12%)
  - Toxic to aquatic life and can cause severe skin burns/eye damage
- Benzalkonium Chloride
  - Tested in concentrations 0.005%, 0.01%, and 0.02%
  - Positive Control: Lysol Disinfecting Spray (0.1076%)
  - Required in fume hood by itself, is not to be inhaled/ingested or skin/eye contact

Background & Purpose, cont.

Mealworms

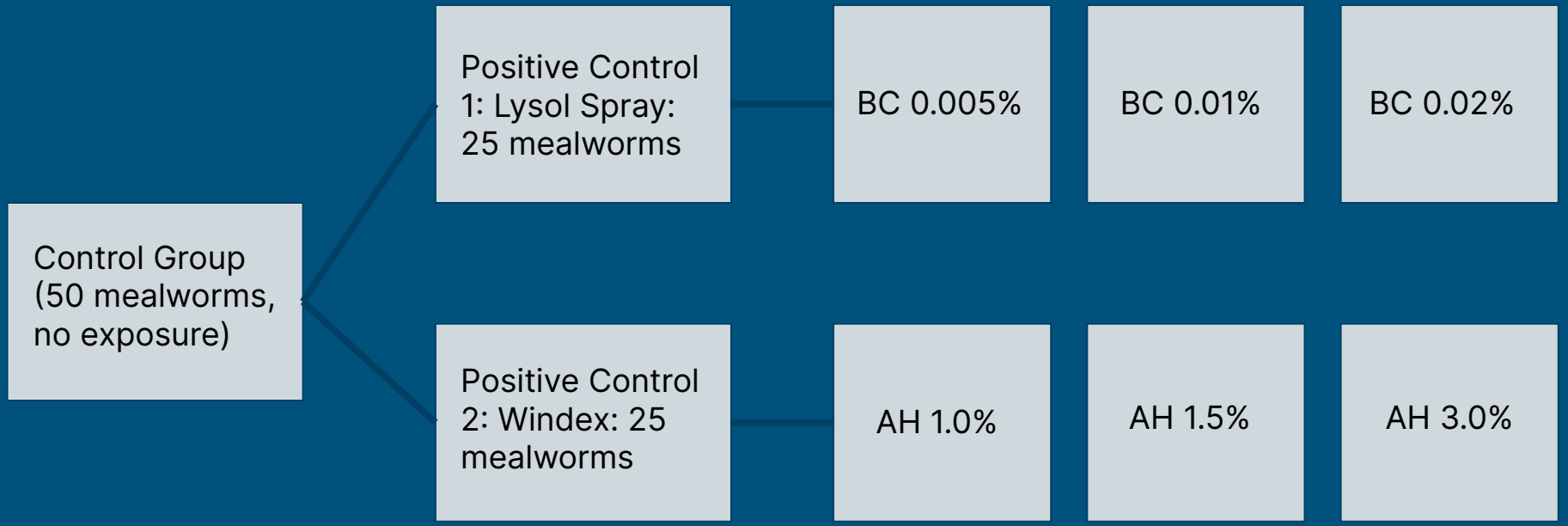
- Are used in multiple research projects to assess the effect of x on behavior
- Have a reliable life-cycle, so researchers are able to assess the effects of certain compounds on growth/length of cycles
- Also have similar receptors (acetylcholine) to humans that respond to fumes and growth status as humans would but in a much shorter time period (Collins et al, 2017)

Question & Hypothesis

How does the different concentration of 2 different QAC compounds present in common household cleaners affect the growth of mealworms?

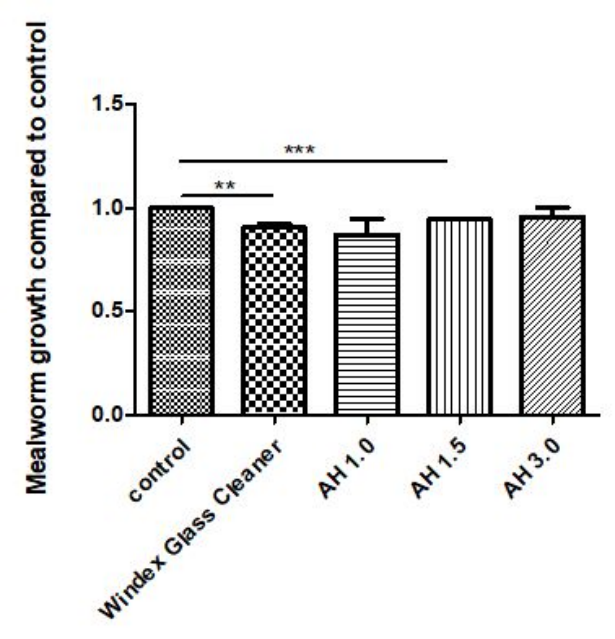
Mealworms that are exposed to QAC's that have a higher concentration of the prevalent compounds [ammonium hydroxide & benzalkonium chloride] will have a retarted mealworm growth compared to the control group and the lower concentrations of the compounds exposed group

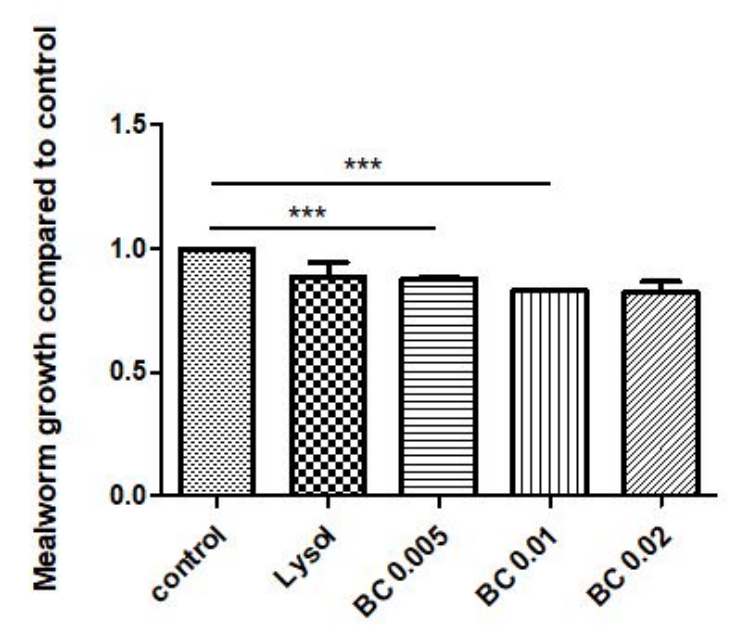
Methodology



Data & Results

- Percentage growth/decrease was taken and compared to control





	P-value (when compared to control)	Significance?
Windex Glass Cleaner	0.0047	Yes (**)
AH 1.0	0.0007	Yes (***)
AH 1.5	0.0004	Yes (***)
AH 3.0	0.4240	NS
Lysol	0.020	Yes (***)
BC 0.005	0.0006	Yes (***)
BC 0.01	0.0002	Yes (***)
BC 0.02	0.0617	NS

Conclusion

Trends

- BC groups regained 90-93% of length, whereas AH groups regained 90-96% of length
  - Most likely a result of more toxic chemicals in BC groups than AH groups
  - In AH groups, the more concentration meant a greater length (1.0 ~ 87%, 3.0 ~ 96%)
- Weight was not considered, as there was a huge variation in the data
  - May have come from possible sources of error or stage at which mealworm was when purchased before experimentation
- BC groups only had 2 trials (due to heavy loss of mealworms) and AH groups had 3 trials

Previous Research

- Analyzing Effect of QAC's on Reproductive Health of Mice (Melin et al, 2014)
  - Found that exposure to more QAC's lead to overall decrease in reproductive success
- The Effect of QACs on Airway Constriction of Mice (Larsen et al, 2012)
  - Found that BAC (Benzalkonium Chloride) QACs led to higher airway inflammation in mice

Conclusion, cont.

Possible Sources of Error

- Differences in state of mealworm prior to experimentation
- Only for 15 minutes for 2 weeks: not a lot of time for the effect to take place
- Cold temperature in environment/being exposed to compounds at various amounts due to evaporation
- Heavy loss of mealworms in Trial 2 of the BC groups
- Mealworms do contract in growth near the pupa stage, so may explain why there was a decrease in growth

Future Research

- Other factors could be measured: reproductive success, overall health, other side effects could be assessed
- Differences in concentration levels/mixture of multiple QAC's could have different effects than having only one

Questions?

Thank you!