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Research Group for Insect
Production & Processing

WP 3: Insect Processing

VACUUM PACKAGING AS STORAGE AND TRANSPORT STRATEGY FOR LIVING OR KILLED BLACK SOLDIER FLY LARVAE

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The insect logistic chain



- Transport of living or killed insects
- Within or between companies/distributors/consumers/...



- Storage of living or killed insects
- Before, during or after a production or processing stage

Stabilisation!

Transport and storage of insects

	Living insects	Killed insects
Stabilisation aim	Retain high survival	Retain high product quality
Influencing factor(s)	Respiration	Killing method Microbial activity → safety!



Current practices:

- Packed in bags, boxes, ...
- Open in trays

Current practices:

- Refrigerated or frozen
- Dried



Vacuum packaging?

- Technology exists, also for large quantities (bulk)
- Applied for respiring and non-respiring products
- Low investment for companies



Storage of vacuum-packaged black soldier fly larvae

1. Storage of vacuum-packaged living BSFL

- Two trials
- Survival rate and gas composition (O_2/CO_2 concentration)
- Impact of storage temperature (ambient or 15 °C)



2. Storage of vacuum-packaged killed BSFL

- Two trials
- Killing by blanching or freezing (incl. thawing)
- Gas composition (O_2/CO_2 concentration) and microbial counts
- Impact of storage temperature (ambient or 4 °C)



Storage of vacuum-packaged black soldier fly larvae

- Experimental set-up
 - 40 packages of 200 g larvae each
 - PE/EVOH/PA high barrier bags, 200 x 250 mm
 - Multivac vacuum chamber, no gases
 - Packaging and storage under following conditions:

Vacuum conditions Storage temperature	"No" vacuum (750 mbar)	Strong vacuum (35 mbar)
Room temperature	10 packages	10 packages
15 °C (living BSFL) 4 °C (killed)	10 packages	10 packages

- Storage in a dark environment
- Temperature was logged



Results living BSFL

Article

Potential of Fermentation and Vacuum Packaging Followed by Chilling to Preserve Black Soldier Fly Larvae (*Hermetia illucens*)

Leen Van Campenhout ^{1,2,*}, Dario Lachi ^{1,2} and Dries Vandeweyer ^{1,2}

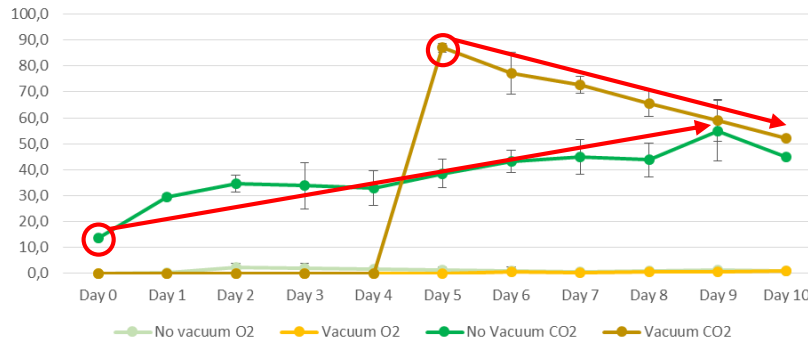
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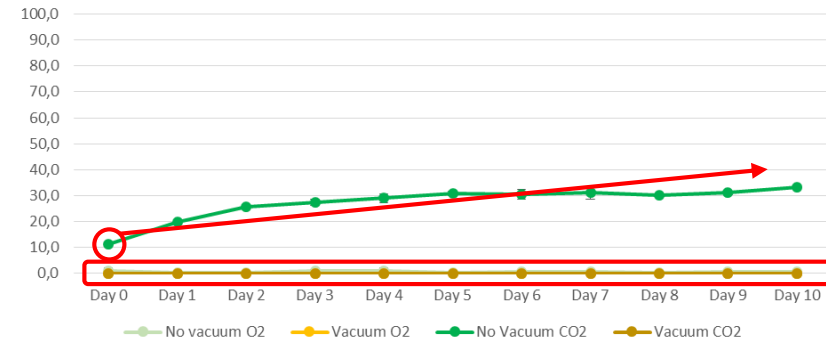
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• Gas composition in the packages

Mean gas content (%) - Room temperature storage



Mean gas content (%) - 15 °C storage



- Immediately after packaging, [CO₂] rose quickly towards 11-13%, while [O₂] dropped to 0% in packages without vacuum

• No vacuum:

- [O₂] remained below 1.5% during the whole storage period
- [CO₂] rose in time, towards ± 50% at room temperature storage, towards 40% at 15 °C

• Vacuum:

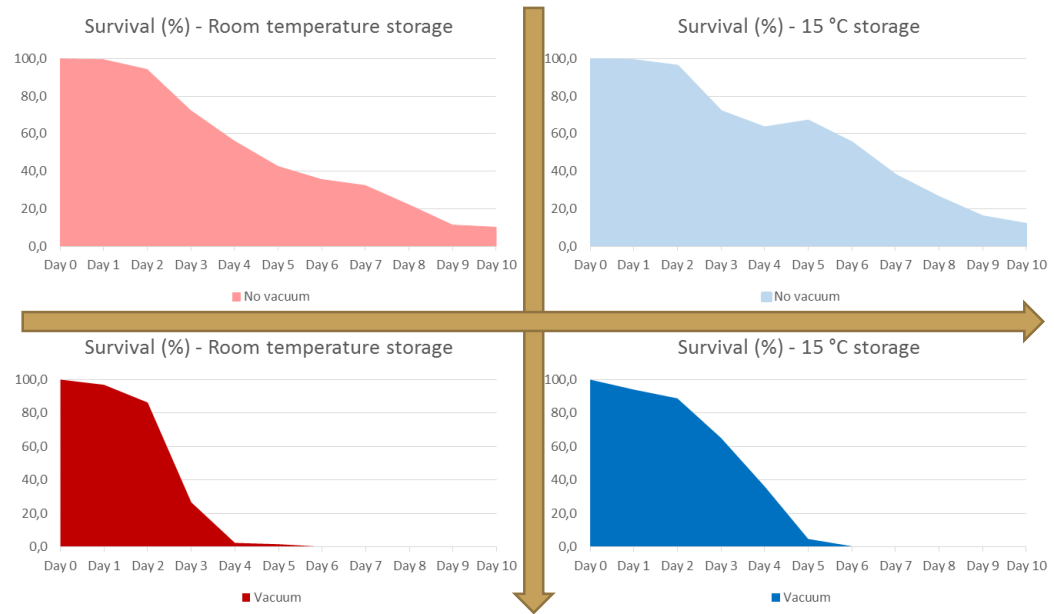
- As from Day 5, vacuum in packages at room temperature was broken
- [CO₂] has risen up to > 65-75%, but decreased in time from then → microbial activity?

➔ Rise in CO₂ slower at 15 °C

➔ Vacuum conditions remain longer at 15 °C

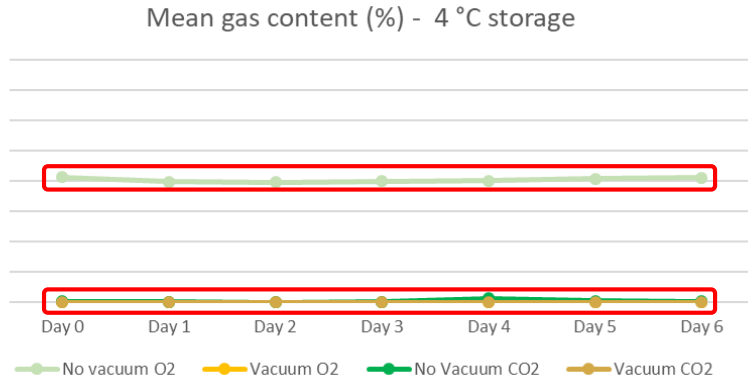
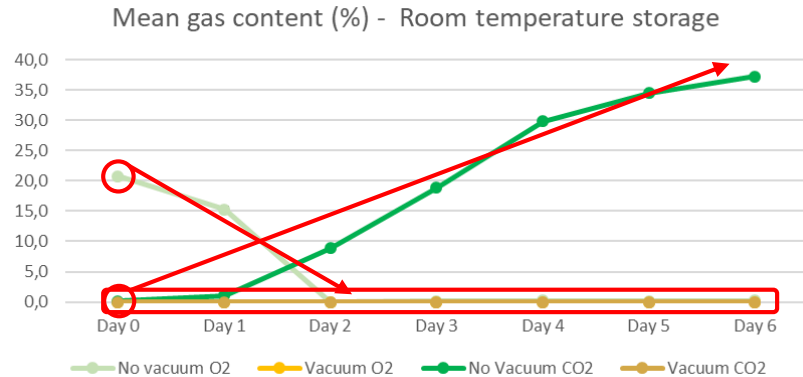
Results living BSFL

- Survival rate of the larvae
 - Impact of vacuum
 - Survival rate ↓ faster under vacuum
 - Impact of temperature
 - Survival rate ↓ faster at room temperature
 - Only 5 °C difference (19.9 ↔ 14.9 °C)!



Results killed (blanched) BSFL

- Gas composition in the packages



- No vacuum:

- [O₂] dropped to < 1% as from Day 2 at room temperature storage
- [CO₂] rose in time, towards ± 35% at room temperature storage
- Stable gas concentrations during refrigerated storage

→ Microbial activity at RT

→ Important impact of storage temperature

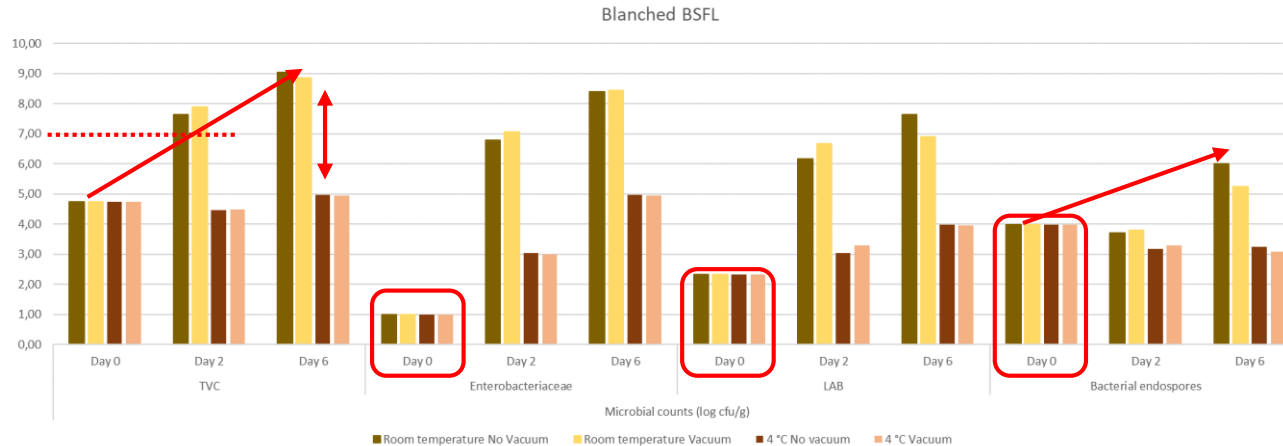
- Vacuum:

- Vacuum retained during whole storage period for both storage temperatures

→ No change in vacuum

Results killed (blanched) BSFL

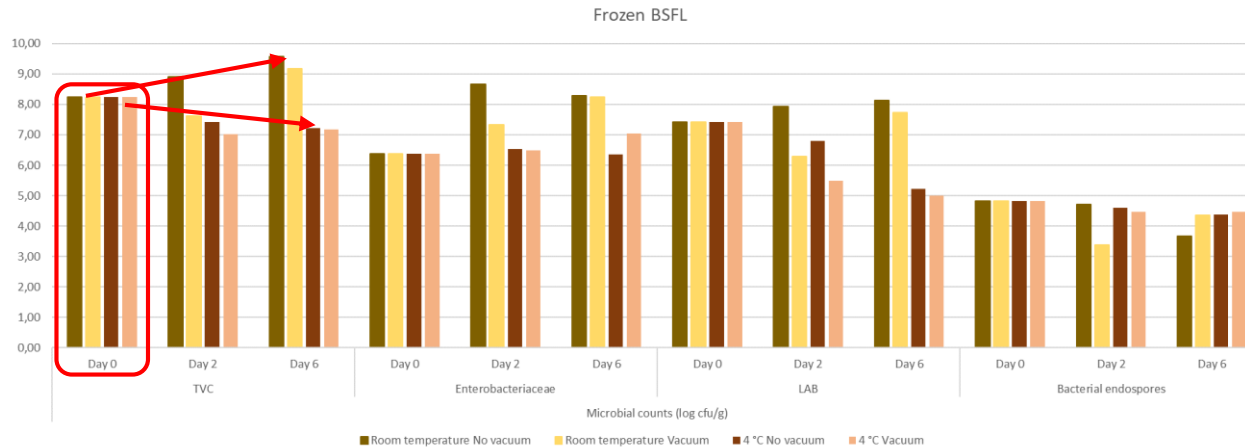
- Microbial counts



- Elimination of certain microorganisms due to blanching → low impact on endospores
- Microbial growth during storage, also number of endospores increases over time
 - Spoilage level (7 log cfu/g) reached after 2 days of storage (room temperature)
- Few (no?) differences between vacuum and no vacuum
- Slower growth of microorganisms at 4 °C

Results killed (frozen) BSFL

- Gas composition changes faster due to higher microbial activity, vacuum (room temperature) is broken after a few days
- Microbial counts



- Still high amount of microorganisms after killing step → High initial counts
- Microbial growth during room temperature storage; stabilisation or slight reduction of counts during refrigerated storage
- No impact of vacuum

Conclusions

1. Storage of vacuum-packaged living BSFL

- BSFL survive several days under vacuum and under high CO₂ concentration
- Survival is better at lower temperature (15 °C) compared to room temperature
- Vacuum packaging has no advantage over non-vacuum packaging

2. Storage of vacuum-packaged killed BSFL

- Initial counts (< killing method) determines microbial activity and growth
- Microbiological quality is better at 4 °C
- Vacuum packaging has no advantage over non-vacuum packaging

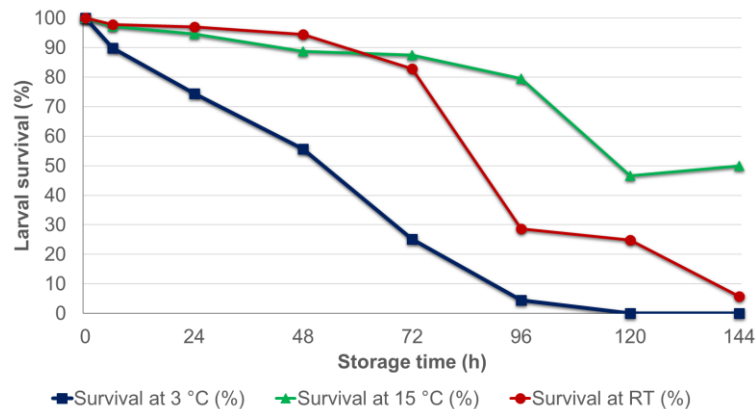
Vacuum packaging cannot replace nor improve chilled storage of living or killed BSFL

Ongoing further research

Transport and storage of living insects in water?

- From vacuum research → BSFL can temporarily survive without oxygen
- Easily applicable
- Combination with washing and/or chilling
- “Pumping” of insects through/to facilities?

- First step: survival of BSFL in water at different storage temperatures



Storage in water possible for a few hours to days, preferably in water > 3 °C





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