USE OF FOOD-GRADE INGREDIENT TREATED NETS TO CONTROL HAM MITES ON DRY CURED HAM

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Tyrophagus putrescentiae (Schrank, ACARI) is a cosmopolitan mite species that may infest dry-cured hams due to their high fat and protein contents (Macchioni et al., 2002; Cui, 2014)), their intense flavor, molds that grow on the surface of the hams (Garcia, 2004), and the environmental temperature and humidity in the curing and aging rooms. Currently, the only effective approach to control mite infestations on dry-cured ham is to fumigate the ham aging house with using methyl bromide. However, this fumigant has been phased out of production on an international scale since it is listed as an ozone depleting substance in the atmosphere in the Montreal Protocol (Fields & White, 2002). Even though methyl bromide is not currently produced for the dry-cured pork industry in the United States, this industry is able to use any stockpiles of methyl bromide that are available within the United States. However, methyl bromide use will eventually not be an option for the industry, which makes it necessary to research effective and economical alternatives to methyl bromide that can be used in the dry-cured ham industry.

Use of food-grade coatings on the ham surface that are composed of polysaccharides and propylene glycol were effective at controlling mites on the laboratory benchtop without affecting the sensory qualities of dry-cured ham (Zhao et al., 2016). Application of ham nets treated with these food-grade coatings on ham cubes also received promising results at the benchtop level (Data not published). In Spain, hams are covered with lard to manage mite infestations (Garcia, 2004). Use of a lard coating on dry-cured ham cubes was effective at controlling mite infestations on the laboratory benchtop (Zhao et al., 2016), but it may affect ham aging because of limited moisture and oxygen permeability. The objective of this study was to determine the most effective formulations applied on ham nets with respect to controlling mite survival and reproduction.

In this study, ham nets were infused with food-grade gums and low, medium, or high concentrations of propylene glycol (PG). The gums that were used include xanthan gum (XG) and the combination of carrageenan (CA) and propylene glycol alginate (PGA). Ham cubes (2.5 cm^3) were wrapped with treated and

untreated nets and placed in ventilated jars. Two sets of mite infestation studies were conducted. One experiment included XG + PG treated nets, and the other experiment consisted of CA + PGA + PG treated nets. For each set of experiments, three batches of samples were prepared and placed in a dark cabinet controlled at room temperature and a relative humidity of 70-80%. For the mite inoculation experiments, twenty adult mites were introduced to ham cubes of each batch on the first day of storage, and at 4 weeks and 8 weeks storage, respectively. This was done to evaluate the long-term effectiveness of treated nets at controlling mite survival and reproduction. Two weeks after inoculation, the mites that were present on ham cubes, nets, and jars were counted under a microscope. This experiment was conducted twice, first with a relative humidity of 70 ± 5 % for the first four weeks and then increased to 80 ± 5 % for subsequent testing.

Results indicated that the number of *T. putrescentiae* in the assays was less ($P<0.05$) on ham cubes with applied gum and PG treated nets when compared to the number of mites on untreated or gum only treated ham cubes over the 10-week storage period of the experiment. Mite inhibition was dependent on the PG concentration. The number of mites decreased as PG concentration increased although there was no statistical difference ($P>0.05$) among the low, medium and high PG treatments. Medium and high concentrations of PG treatments showed the highest mortality rate and lowest reproductive rate of mites; on average, less than 6 mites were found on these treatments as compared to hundreds of mites on untreated ham cubes. In addition, the fungal growth increased as the relative humidity increased, and higher relative humidity facilitated mite growth and reproduction. However, use of medium or high concentrations of PG treated nets controlled mites at both the low (70 % RH) and high (80 % RH) relative humidity.

The present study indicated that incorporating PG into ham nets, as a natural processing control, inhibited the growth and reproduction of *T. putrescentiae* and mold growth on dry-cured ham cubes in benchtop experiments. Previous experiments proved that sensory quality attributes were not affected during the aging process. The gum and PG treated nets should be considered for use during ham aging to control mite infestations. Additionally, preliminary results suggested that nets infused with the combination of gum, PG, and lard were potential alternatives to control *T. putrescentiae* infestations. Further research will be conducted to determine the efficacy of using coating treated nets on whole hams.

References:

Abbar, S., Amoah, B., Schilling, M. W., & Phillips, T. W. (2016). Efficacy of selected food-safe compounds to prevent infestation of the ham mite, Tyrophagus putrescentiae (Schrank) (Acarina: Acaridae), on southern dry cured hams. Pest Manag Sci, 72(8), 1604-1612.

Cui, Y. (2014). When mites attack: domestic mites are not just allergens. Parasit Vectors, 7, 411.

Fields, P. G., & White, N. D. (2002). Alternatives to methyl bromide treatments for stored-product and quarantine insects. Annu Rev Entomol, 47, 331-359.

Garcia, N. (2004). Efforts to control mites on Iberian ham by physical methods. Exp Appl Acarol, 32(1-2), 41-50.

Macchioni, F., Cioni, P. L., Flamini, G., et al. (2002). Acaricidal activity of pine essential oils and their main components against *Tyrophagus putrescentiae*, a stored food mite. J Agric Food Chem, 50(16), 4586-4588.

Zhao, Y., Abbar, S., Phillips, T. W., Williams, J. B., Smith, B. S., & Schilling, M. W. (2016). Developing food-grade coatings for dry-cured hams to protect against ham mite infestation. Meat Sci, 113, 73-79.