SUMMARY

Growth curves were determined for Salmonella, and in some cases Escherichia coli O157:H7, and Listeria monocytogenes, on in-hull pistachios and hulled floater and sinker pistachios. Reductions of Salmonella during pistachio drying were estimated. These data and industry input were used to estimate the impact of delays during the postharvest handling of pistachios. Delay in drying influenced levels of Salmonella in floater pistachios and, to a lesser extent, in sinker pistachios. The heat resistance of Salmonella, E. coli O157:H7, L. monocytogenes, and surrogate Enterococcus faecium under dry and moist heat conditions was characterized. The data support Salmonella as the appropriate target pathogen for pistachios and provide evidence that thermal processes validated for this organism will reduce E. coli O157:H7 and L. monocytogenes by similar or greater levels. The data support the use of E. faecium NRRL 2354 as a surrogate organism for validating thermal processes in reducing Salmonella on pistachios.

OBJECTIVES

Objective 1. To identify points during postharvest handling of pistachios where foodborne pathogens (Salmonella, E. coli O157:H7 and L. monocytogenes) may be reduced, controlled or amplified.

Objective 2. To determine the impact of pistachio moisture and nut form (kernel or inshell) on the heat sensitivity of Salmonella, E. coli O157:H7, L. monocytogenes, and E. faecium inoculated pistachios.

METHODS

A cocktail of Salmonella, E. coli O157:H7 or L. monocytogenes was inoculated at 3 log CFU/g of in-hull or hulled pistachios and incubated under commercially-relevant conditions (37°C and 90% RH). Growth curves were developed over a 30 h period. A quantitative model of Salmonella growth was derived from laboratory and industry data (Fig. 1). Simulations were run using Monte Carlo simulation software (@RISK, Palisades Decision, Newfield NY). In-shell pistachios or laboratory and industry data (Fig. 1). Simulations were run using Monte Carlo growth was derived from Salmonella, E. coli O157:H7 and L. monocytogenes relevant conditions (37°C and 90% RH). Growth curves were developed over 3 log CFU/g of in-hull or hulled pistachios and incubated under commercially-relevant conditions with similar or greater levels. The growth resistance of Salmonella was similar to E. faecium (Fig. 4), and the same as or greater than strains of E. coli O157:H7 and L. monocytogenes, under dry and moist conditions.

RESULTS TO DATE

There was no significant difference in the growth of Salmonella on early or late harvest in-hull pistachios but the growth rate and final concentrations of Salmonella on floaters was significantly (P < 0.05) higher than that on sinker pistachios. Growth of Salmonella on inshell pistachios with ≤25% or ≥25% hull adhering to the shell surface was similar for the first 8 h of incubation. After 8 h, no growth of Salmonella was observed for floaters with ≥25% hull but populations increased on pistachios with ≥25% hull (Fig. 2). The model of postharvest handling predicted greater populations of Salmonella on floater pistachios, with drying delays having the greatest influence on final levels (Fig. 3). Growth of Salmonella was similar to E. coli O157:H7 and greater than L. monocytogenes (Fig. 2B). The heat resistance of Salmonella was similar to E. faecium (Fig. 4), and the same as or greater than strains of E. coli O157:H7 and L. monocytogenes, under dry and moist conditions.

BENEFITS TO THE INDUSTRY

These data support Salmonella as the appropriate target pathogen for pistachios and provide strong evidence that thermal processes validated for this organism will reduce E. coli O157:H7 and L. monocytogenes by similar or greater levels. The data also provide evidence that E. faecium NRRL 2354 is an appropriate surrogate organism for validating thermal processes for pistachios. The quantitative model developed by this project provides a tool that the industry can use to evaluate potential food safety risks associated with harvest delays.

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