

INTRODUCTION

## Food safety risks associated with home freeze drying

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Home freeze drying is gaining popularity as interests in consuming raw or minimally-processed

foods and preserving foods have increased among consumers, and purchasing a pilot- or

kitchen-scale freeze dryer has become affordable. However, home freeze dried foods are

potentially hazardous foods as they can be contaminated during preparation, equipment

loading, and packaging. Most consumers lack knowledge of the freeze drying process to

Also called lyophilization, it is a stabilizing process in which a substance is first frozen

and then the solvent is reduced -- first by sublimation, followed by desorption -- to

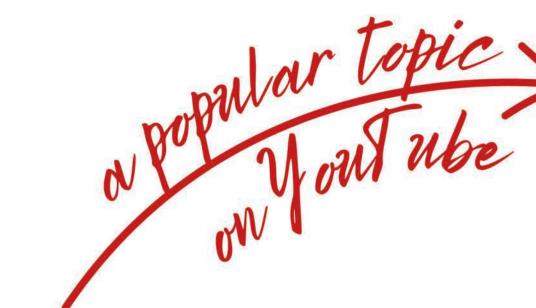
values that will no longer support biological activity of chemical reactions.

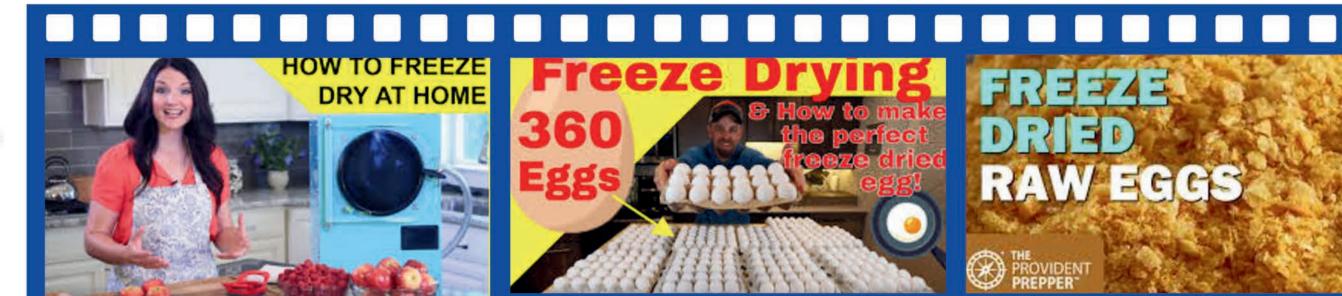
adequately control their dryer and determine corrective actions.

low water activity

What is freeze drying?

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# **TAKEAWAYS**

Most in-home freeze dryers are nonprogrammable, and can only be run like the Standard Mode of the Scientific Model used in this study. As such, users lack the ability to set vacuum pressure, shelf-temperature, processing times to control their freeze drying operations. Also, there are no thermocouples available to monitor product temperature during freeze drying, which is helpful in determining when the sublimation stage has completed.

Based on the Standard Mode pressuretemperature-time profiles in this study, inhome freeze dryers can be inconsistent in their operations. The only corrective action users can make when a process deviaton occurs is to add more drying time.

Using Standard Mode, between 1.2-1.6 log reductions were achieved for generic *E. coli* and *L. innocua* in freeze-dried raw scrambled eggs. E. faecium was most resistant (0.06-0.09 log reduction).

Final moisture contents (< 1 %) and water activities (< 0.1) were very low. However, users should be careful about relying on product appearance alone when judging whether freeze drying has been completed. "Meltback" can be observed only by cutting the "dried" products in half to check for moist centers.

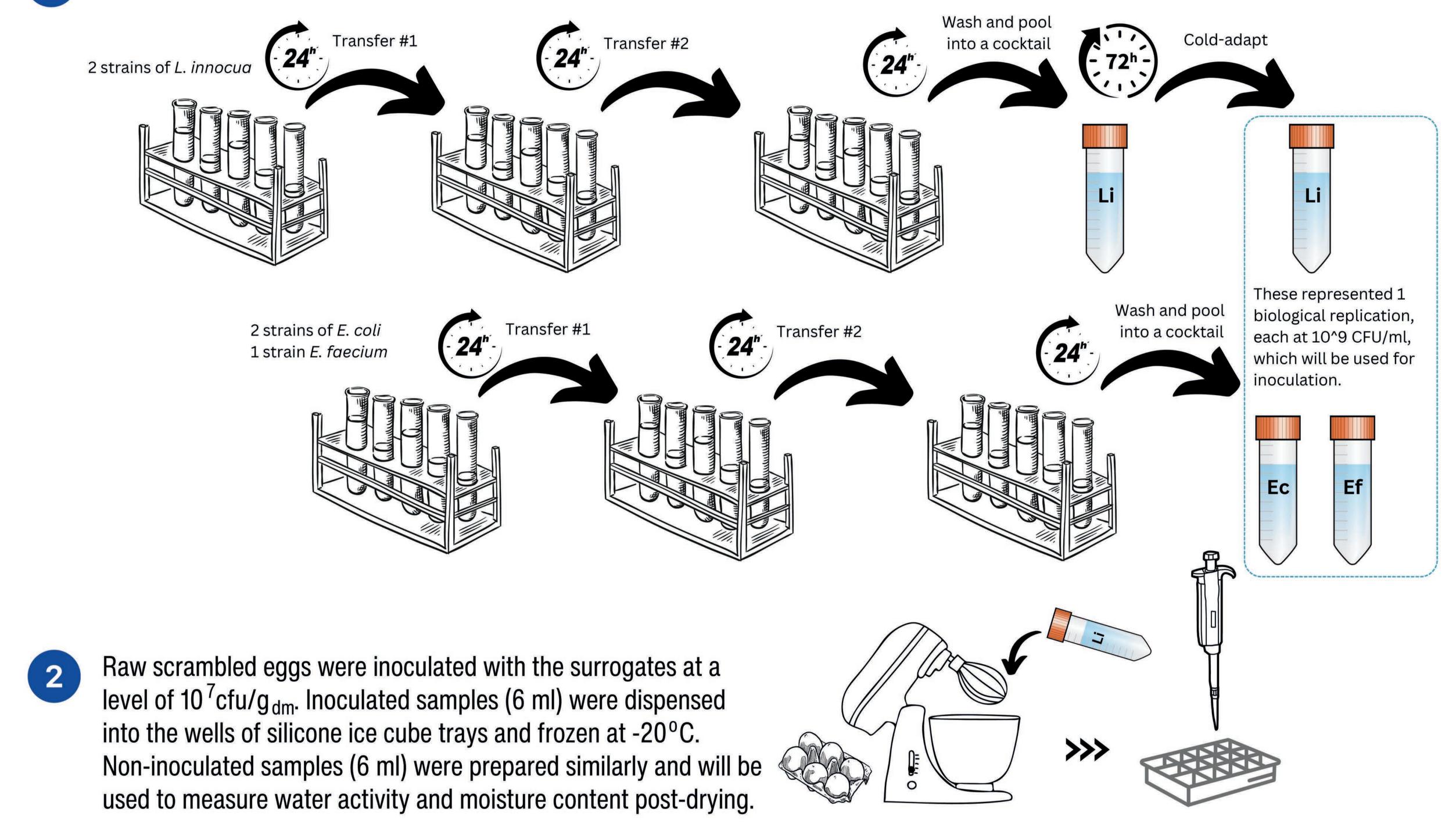


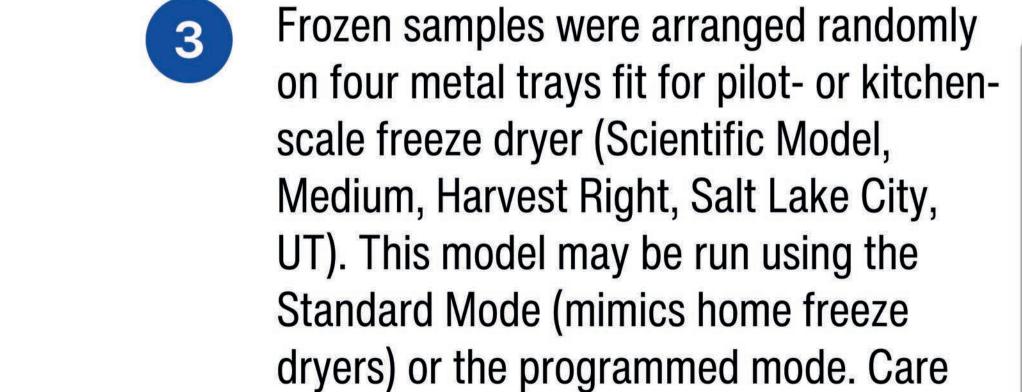
### processes (> 1080 min or 18 h) and decreased drying efficiency.

### CASE STUDY: Freeze drying raw scrambled eggs

#### **MATERIALS AND METHODS**

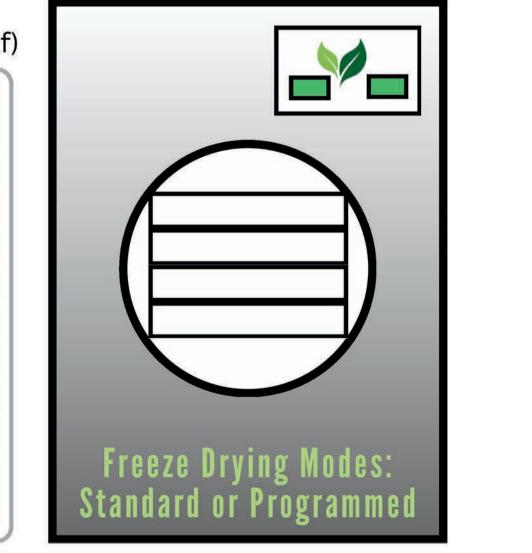
Listeria innocua, generic Escherichia coli, and Enterococcus faecium were cultivated in tryptic soy broth (TSB) prior to inoculating raw eggs.





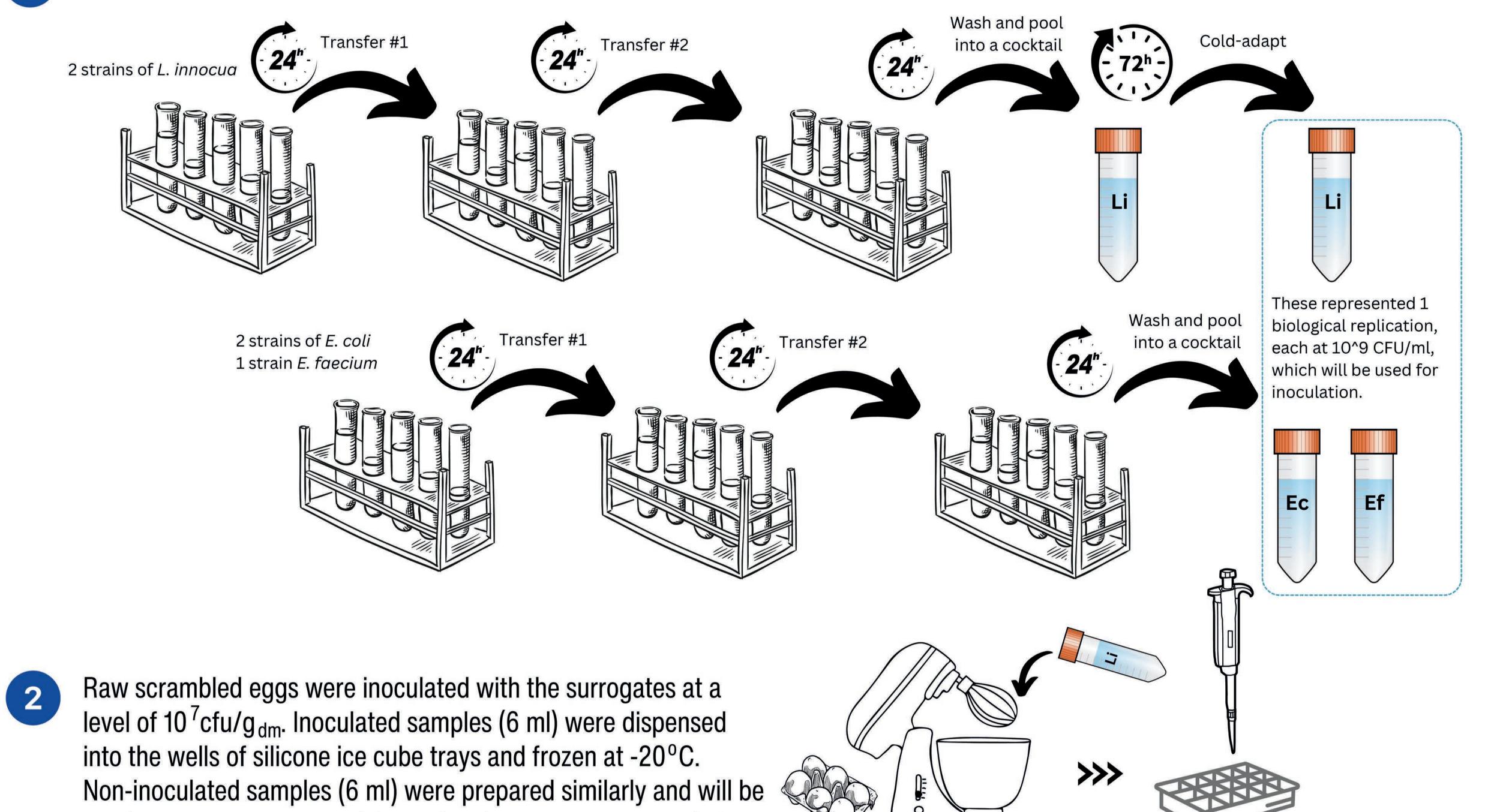
was taken so that each tray contained





four subsamples of each surrogate.

Control (non-freeze dried) and freeze-dried samples were tested for the following properties: (a) water activity, (b) moisture content, and (c) microbial plate counts. Water activity was measured with a water activity meter (HC2A-AW, Rotronic, Burlington, VT). Moisture content with a vacuum oven at 25 mmHg and 100°C. Microbial counts for Listeria innocua, generic E. coli, and E. faecium were conducted using Oxford Listeria agar, MacConkey agar, and Bile esculin azide agar, respectively. Incubation conditions were 32°C for 48 for *L. innocua* and 37°C for 24 h for both *E. coli* and E. *faecium*.



#### **OBJECTIVES & MOTIVATION FOR THIS STUDY**

Temperature

Figure 1. Freeze drying process depicted

on the phase diagram of water.

1. Learn how in-home freeze dryers work, i.e., what level of control do users have over the process, and

**Water Activity** 

Figure 2. Properly designed freeze drying processes remove

over 90% of moisture from the food product, making them

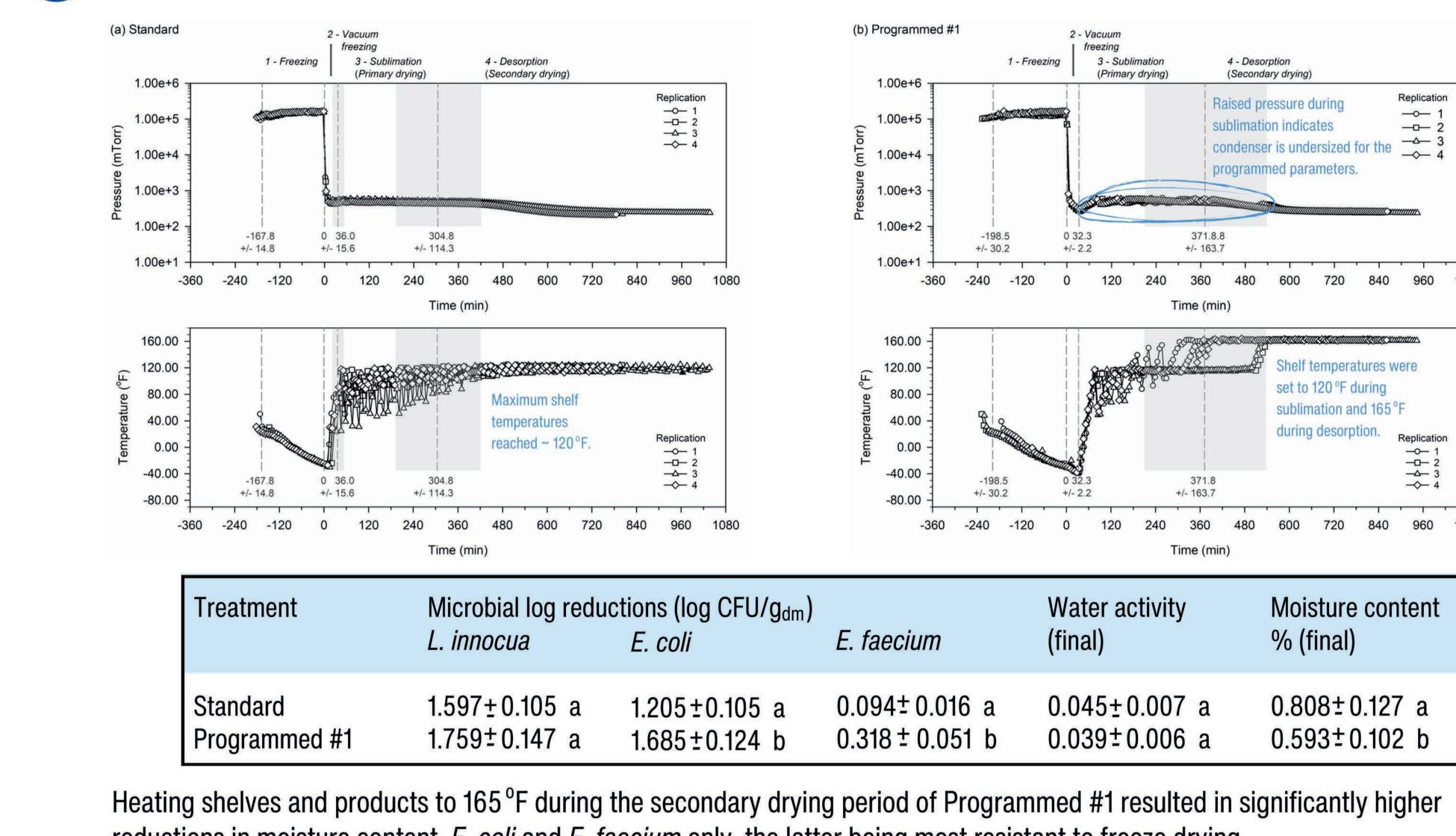
shelf-stable, but susceptible to lipid oxidation.

2. What level of "lethality" can one get with in-home freeze dryers using raw scrambled eggs as a case study.

The information provided herein are useful for extension and K-12 educators as more entrepreneurs, cottage food producers, and students have access to home freeze dryers. Manufacturers of home freeze dryers promote using the technology and their equipment to make lightweight, nutritious meals and snacks, free of additives, preservatives or chemicals, for all members of the household -- adults, kids, elderly parents, and companion animals. Much of the information readily available online from manufacturers and home freeze drying practitioners are focused on food quality, not food safety.

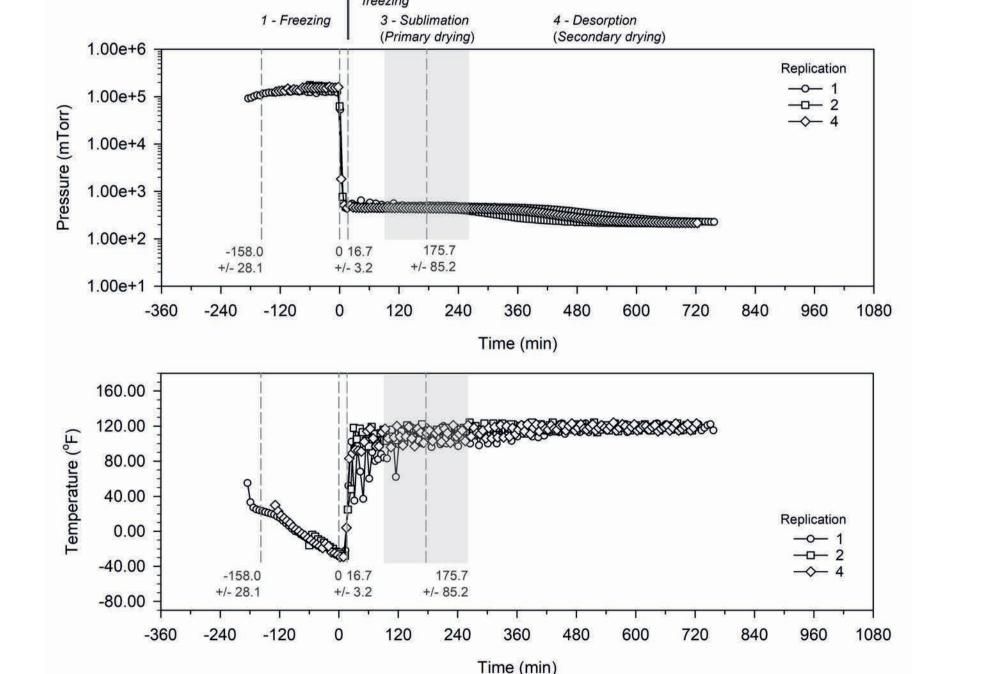
#### **RESULTS AND DISCUSSION**

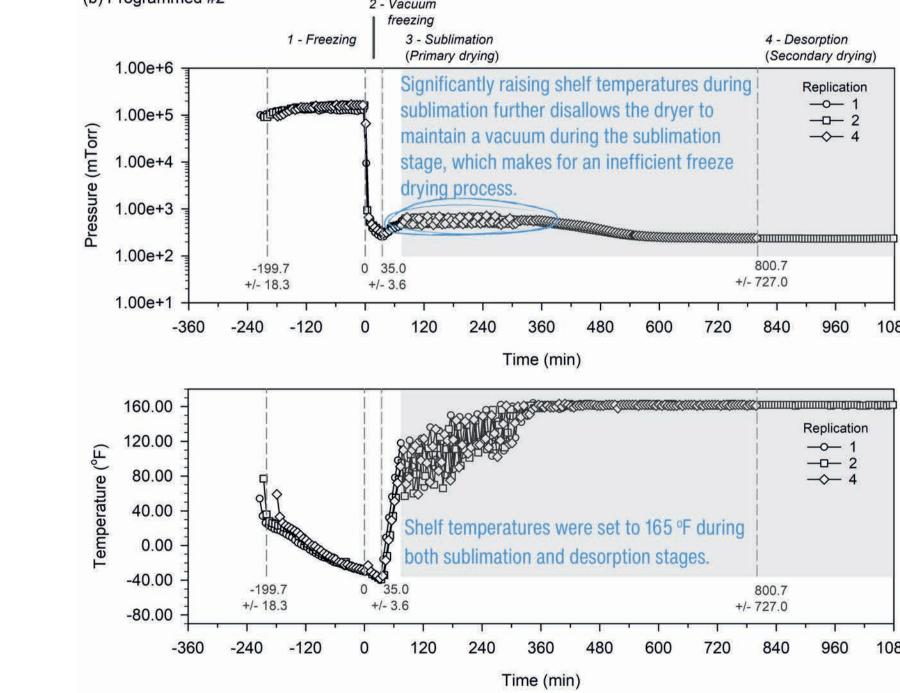
Compare two treatments: Standard Mode vs. Programmed Mode #1



reductions in moisture content, E. coli and E. faecium only, the latter being most resistant to freeze drying.







Treatment	Microbial log redu <i>L. innocua</i>	ıctions (log CFU/g <sub>dm</sub> ) <i>E. coli</i>	E. faecium	Water activity (final)	Moisture content % (final)
Standard Programmed #1	1.507±0.175 a 2.140±0.221 b	1.203 ± 0.112 a 2.610 ± 0.546 b	0.060±0.044 a 0.240±0.070 b	0.056±0.008 a 0.043±0.010 a	0.993±0.205 a 0.447±0.040 b

Subjecting products to 165°F sooner in Programmed #2 led to higher log reductions. However, doing so resulted in much longer