# PROBIOTIC POWDER IN A PEMMICAN MODEL

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## I. INTRODUCTION

Pemmican is a meat product principally comprised of dried meat and fat that has a played a significant role throughout history as a source of sustenance in cold, harsh climates for some Indigenous peoples, fur traders, polar explorers, military and police [1]. Acclaimed for its high nutrient density and long shelf life, pemmican shows potential as a culturally appropriate food for use as emergency provisions to alleviate periods of food insecurity or in crisis situations. Furthermore, given its high proportion of fat (up to 50%), pemmican appears a good vector for the delivery of probiotic bacteria as demonstrated in cocoa butter [2] allowing for added health benefits to an emergency provision. The objective of this study was therefore to determine the stability of probiotic bacteria in a pemmican model.

## II. MATERIALS AND METHODS

Meat processing: Commercial vacuum-packaged frozen pork loins were thawed at room temperature (RT) for 21 h. Longissimus dorsi (LD) lean was isolated, minced (batches of about 25 kg; 3.5 mm plate hole diameter) and spread onto stainless steel trays (45.5 x 60.0 x 2.8 $cm^3$, about 2 kg per tray) and dried in a Harvest Saver tray dryer (R5-A, Commercial Dehydrator Systems, Eugene, OR, USA) at 45°C and air speed 1 $m^3/s$ until an Aw <0.5. The dried meat was reduced to a coarse powder in a food processor, vacuum packaged and stored at -40°C. Pork loins were purchased on five different days and processed independently to give five true repetitions, each being a mix of at least six loins.

Pemmican: Dried loin (about 160 g) was finely ground in a coffee grinder. Commercial probiotic powder (*Lacticaseilactobacillus rhamnosus* R0011, Lallemand Health Solutions, Montréal, QC, Canada; 0.8 g) was mixed into the ground loin (80 g), followed by filtered beef tallow (50°C; 80 g). Balls (10 g) were formed, individually vacuum packaged and stored in cardboard boxes at RT or 4°C. Pemmican with added cranberry was made following the same process using finely ground loin (65 g), probiotic powder (0.8125 g), dehydrated cranberry bits (16.25 g) and tallow (81.25 g).

Enumeration of bacteria: The method was adapted from Champagne et al. [3,4]. Rehydrating medium (RM; 15 g/l Bacto peptone, 10 g/l tryptone, 5 g/l yeast extract, 2 g/l Tween 80) was brought to 37°C. A pemmican ball (10 g) was added to RM (240 ml) in a sterile 500 ml glass jar and blended (Osterizer blender, Fort Lauderdale, FL, USA) at maximum speed for 30 s, incubated at 37°C for 15 min, and blended for another 30 s. An aliquot (1 ml) was transferred to 1 g/l peptone water (9 ml). Serial 1:9 dilutions were made in 0.1% peptone water and plated in 55 g/l MRS broth with 15 g/l agar using the pour plate method. The plates were incubated at 37°C for 48 h under anaerobic conditions (5% $CO_2$, 10% $H_2$, 85% $N_2$). Probiotic powder (1 g) that had been stored in the same conditions as the pemmican balls was used as a control.

Statistical analyses: Graphs with SEM error bars were prepared with Excel software. Statistics were carried out with SigmaPlot (V15, 2022, Inpixon). Pairwise multiple comparison procedures were made using the Student-Neuman-Keuls system. Microbial CFU data showed variations which could reach >2 log10 in range, therefore, to stabilize variance, all CFU data for each assay were converted to log10 values, and statistical tests were carried out on these log10 conversions.

## III. RESULTS AND DISCUSSION

Viable counts of the probiotic cells were followed over an 18-month period (Figure 1). The data of the pemmican with added cranberry are not presented in Figure 1 because values were very similar to those of the basic pemmican formula. Although cranberry can increase the acidity of the product, it was not sufficient to negatively affect viability of the bacteria.

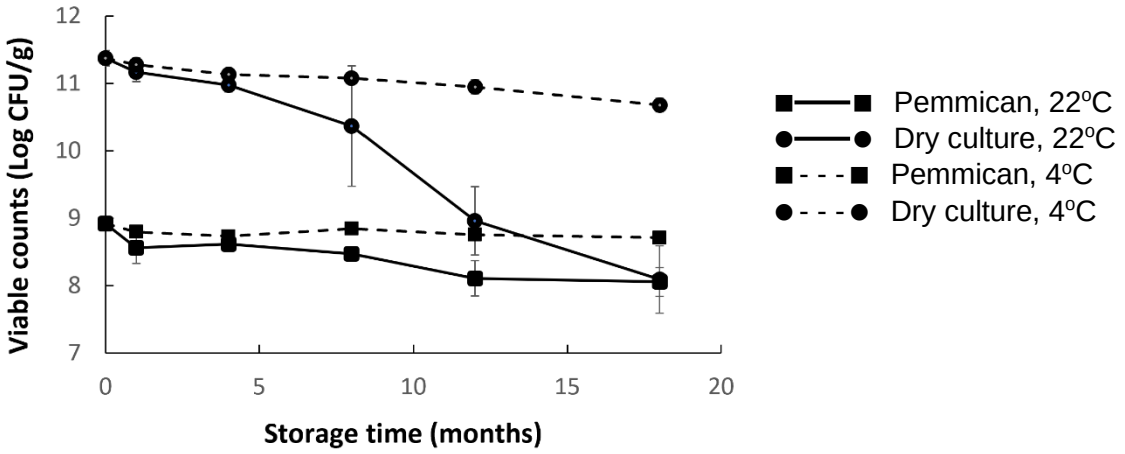


**Figure 1:** Effect of storage temperature on the viable counts of the probiotic strain *L. rhamnosus* R0011 (for clarity, only select SEM [error bars] are given, representative of variation in the other plots).

In both dried culture and pemmican samples, the losses of viability were significantly greater after 8 months of storage at 22°C than at 4°C ($P \leq 0.05$), in agreement with literature [5]. Interestingly, viability losses were higher in the dried culture than the pemmican. This is unusual because adding probiotics to food matrices usually results in strong viability losses [5]. Presumably, this is because the meat was dried and water activity was lower than 0.5 [6]. The high fat content could also contribute to stability, as it can act as a barrier to water and oxygen, particularly when combined with vacuum packaging.

## IV. CONCLUSION

The *L. rhamnosus* probiotic used in this study was very stable in a pemmican model. To be recognised as a probiotic-carrying food, products in Canada must contain ≥1 billion cells per portion. For a 100 g portion, the pemmican model studied meets this requirement, even after 18 months storage at 22°C.

## REFERENCES


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