



**Title:**

Stability and function of an encapsulated probiotic bacterium for foodborne pathogen control

**Authors:**

Linyan Li<sup>1,2</sup>, Xiaoyin Wang<sup>1,2</sup>, Hai Yu<sup>2</sup>, Qi Wang<sup>2</sup>, Martin Lessard<sup>3</sup>, Martin Mondor<sup>4</sup>, Janghan Choi<sup>5</sup>, Chengbo Yang<sup>5</sup>, and Joshua Gong<sup>2\*</sup>

**Affiliation:**

<sup>1</sup>State Key Laboratory of Food Science and Technology, Nanchang University, Nanchang, Jiangxi, China 330047

<sup>2</sup>Guelph Research and Development Centre, Agriculture and Agri-Food Canada, Guelph, ON, Canada N1G 5C9

<sup>3</sup>Sherbrooke Research and Development Centre, Agriculture and Agri-Food Canada, Sherbrooke, QC Canada J1M 0C8

<sup>4</sup>St-Hyacinthe Research and Development Centre, Agriculture and Agri-Food Canada, St-Hyacinthe, QC Canada J2S 8E3

<sup>5</sup>Department of Animal Science, University of Manitoba, Winnipeg, MB Canada R3T 2N2

**\* Correspondence:**

Joshua Gong: e-mail: [joshua.gong@canada.ca](mailto:joshua.gong@canada.ca)

93 Stone Road W. Guelph, ON Canada N1G 5C9

**Abstract:**

*Lactobacillus* are commonly used as probiotics to control enteric infection and promote animal gut health. However, they are heat sensitive, which limits their application. We have developed a novel spray-drying encapsulation technology that resulted in approximately 0.5-log reduction of *Lactobacillus zeae* LB1, a probiotic with the function to control *Salmonella* and ETEC *in vivo*. In the current study, encapsulated LB1 was evaluated for its stability during storage and feed pelleting and for the function on pig gut health. The concentration of encapsulated LB1 was initially  $1.17 \times 10^9$  CFU/g powder. After 14-month storage at 4°C and 22°C in a sealed container, the concentration was decreased to  $9.7 \times 10^8$  and  $1.68 \times 10^8$  CFU/g powder, representing 17.1%

and 85.6% reduction, respectively. In the feed pelleting test, encapsulated or non-encapsulated LB1 was mixed with feed ingredients (Starter for piglets) and then subjected to pelleting process (temperature setting: 80°C; speed: 25 kg/min). The initial concentration of LB1 in feed was  $2.8 \times 10^6$  CFU/g for the encapsulated form and  $3.0 \times 10^6$  CFU/g for the non-encapsulated form. Seven days after pelleting, the concentration of encapsulated LB1 in pelleted and mash feed was  $4.0 \times 10^5$  and  $2.3 \times 10^6$  CFU/g, respectively. In contrast, the concentration of non-encapsulated LB1 in pelleted and mash feed was reduced to  $2.5 \times 10^4$  and  $1.6 \times 10^6$  CFU/g, respectively, representing more than 1-log reduction compared with encapsulated LB1. The mash feed was the feed ingredients without pelleting and served as a control. Thirty days after pelleting,  $2.8 \times 10^5$  or  $1.6 \times 10^6$  CFU/g of encapsulated LB1 was detected in pelleted or mash feed, whereas  $2.0 \times 10^4$  or  $5.0 \times 10^4$  CFU/g of non-encapsulated LB1 was found in pelleted or mash feed, again more than 1-log reduction. To examine the function of LB1 and its combination with colostrum on pig gut health, a pig trial with 80 newly-weaned piglets was conducted. The piglets were equally allocated to five groups: 1) basal diets (control, CTL); 2) basal diets supplemented with non-encapsulated LB1 ( $1 \times 10^8$  CFU/pig per day, NEP); 3) basal diets supplemented with encapsulated LB1 ( $1 \times 10^8$  CFU/pig per day, EP); 4) basal diets supplemented with 5% bovine colostrum (BC); 5) basal diets supplemented with EP and BC (EP-BC, same dose as in Group 3 or 4). After five days' treatment, all the treatment groups showed no significant difference to the CTL group in growth performance. Supplementation of LB1 or colostrum individually did not affect the population size of *Lactobacillus* in the ileum and colon of pigs. However, the EP-BC group had a significantly increased population of *Lactobacillus* in both the ileum and colon (94.57-fold and 23.51-fold, respectively) compared with the CTL group. Currently, the host responses of pigs to the different treatments are under investigation.

Keywords: *Lactobacillus*; Encapsulation; Feed pelleting; Pigs; Gut health