

Preservation of Probiotic Bacteria in Various Food Products

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Objective: When fortifying foods with probiotic bacteria it's necessary to maintain the cell's viability throughout the product's shelf-life. This work describes the survival of stabilized probiotics in many food types with varying moisture content.

Materials and Methods: Using the Protect&Deliver™ encapsulation technology (ABN, Columbia, Maryland, US) probiotic bacteria were stabilized and dried by evaporation, or lyophilized with common cryoprotectants, and added to infant formula ($A_w=0.20$), nut butter spread ($A_w=0.25$), acidic drink mix ($A_w=0.27$), fiber supplement ($A_w=0.20$), breakfast cereal ($A_w=0.40$) and muesli bars ($A_w=0.34$). The probiotic enriched foods were stored for extended periods of time and analyzed by microbial plating to monitor the cell's long-term viability.

Results and Conclusions: Stability trials with infant formula, nut butter spread, acidic drink mix, and breakfast cereal showed the encapsulated probiotics losing an average of $0.90 \pm 0.55 \log$ CFU/g after 12-18 months in storage, while the controls averaged $3.59 \pm 1.79 \log$ CFU/g losses in 5 months. The fiber supplement trial ran for 17 months with the encapsulate losing $0.03 \log/g$, and the control losing $1.64 \log/g$. Testing in muesli bars showed the encapsulate losing only $0.84 \log/g$ after 6 months, while the control lost $3.96 \log/g$ in 2 months.

Using ABN's stabilization technology, probiotics can be provided in a broad array of food products, creating new opportunities while significantly reducing the need for over formulation.

Stability of *Bifido* sp. in Infant Formula A_w 0.20, 40°C, 12 Months

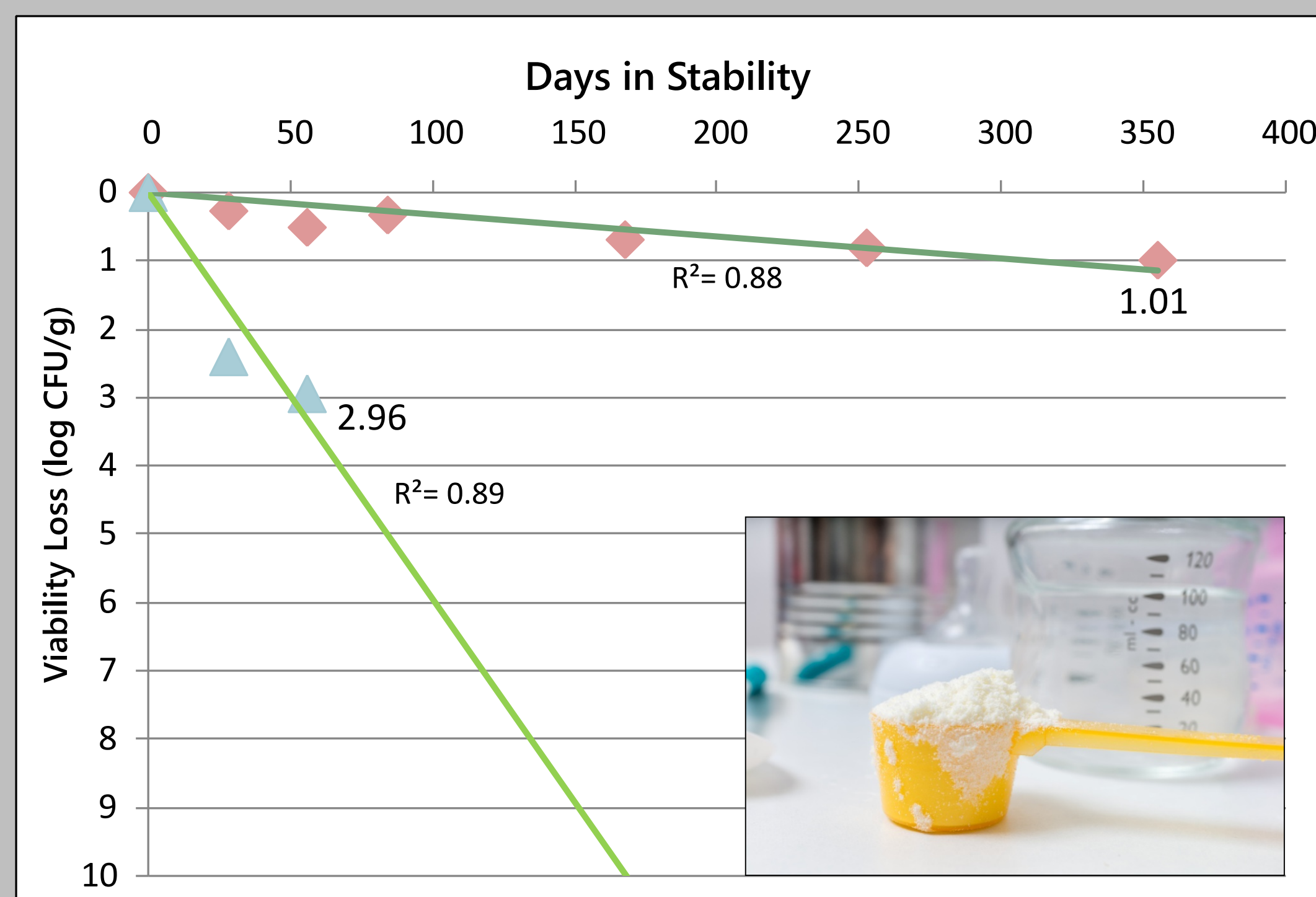


Fig 1: Survival of *Bifido* sp. in infant formula (A_w 0.20) incubated at 40°C. Freeze-dried probiotics (with added sugar cryo-protectants) lost 2.96 log CFU/g in 56 days, while stabilized bacteria only lost 1.01 log CFU/g after 1 years time.

Stability of *Bifido* sp. in Nut Butter A_w 0.25, 25°C, 14 Months

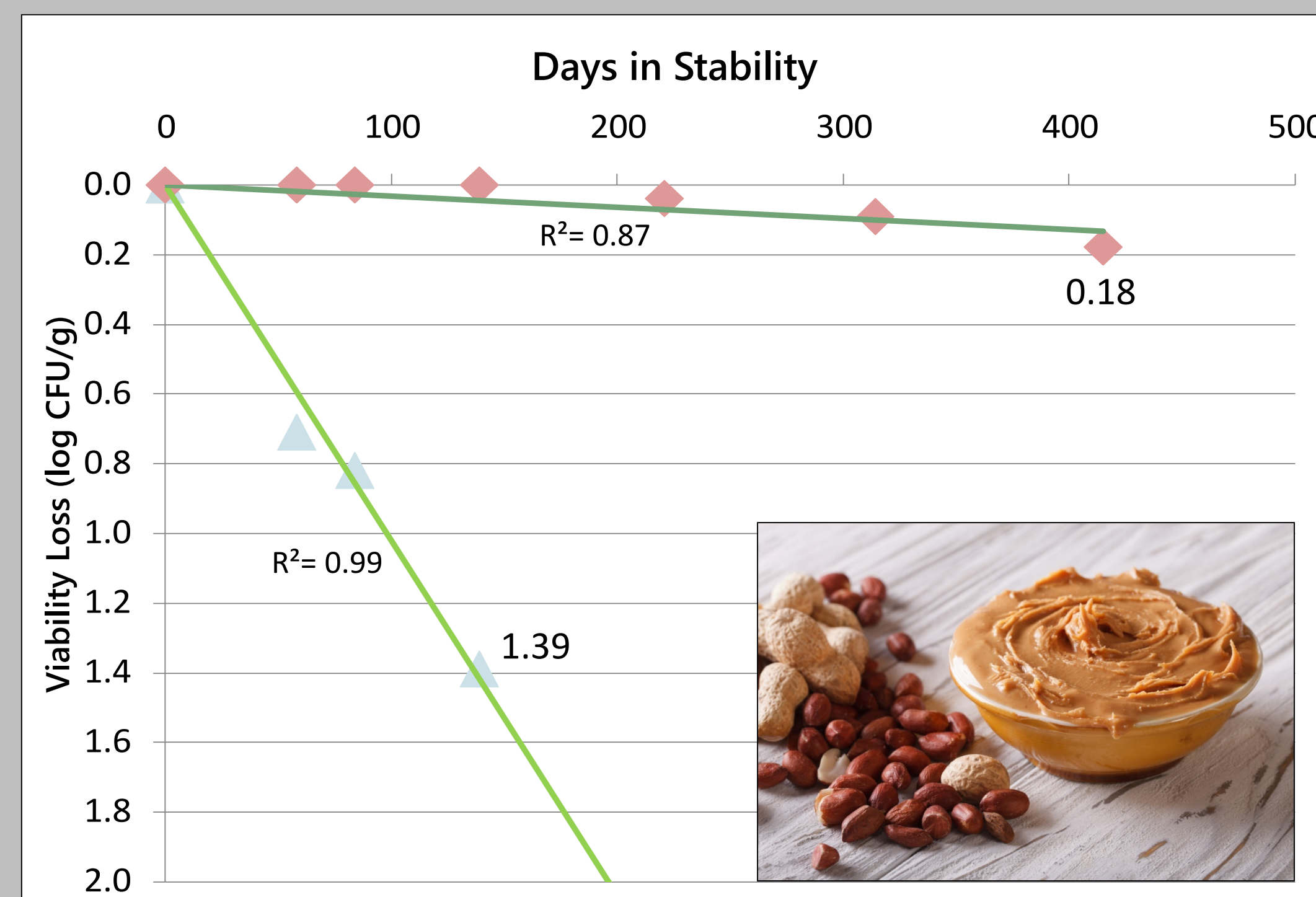


Fig 2: Survival of *Bifido* sp. in nut butter spread (A_w 0.25) incubated at 25°C. Non-stabilized or stabilized probiotics were mixed in nut butter spreads and the closed jars were stored at 25°C for over a year. Probiotic survival in the closed jars was measured periodically. The non-stabilized probiotics lost 1.39 log CFU/g within 5 months while the stabilized probiotics survived for more than a year with a loss of only 0.18 log CFU/g.

Stability of *L rhamnosus* in Acidic Beverage Mix A_w 0.27, 25°C, 15 Months

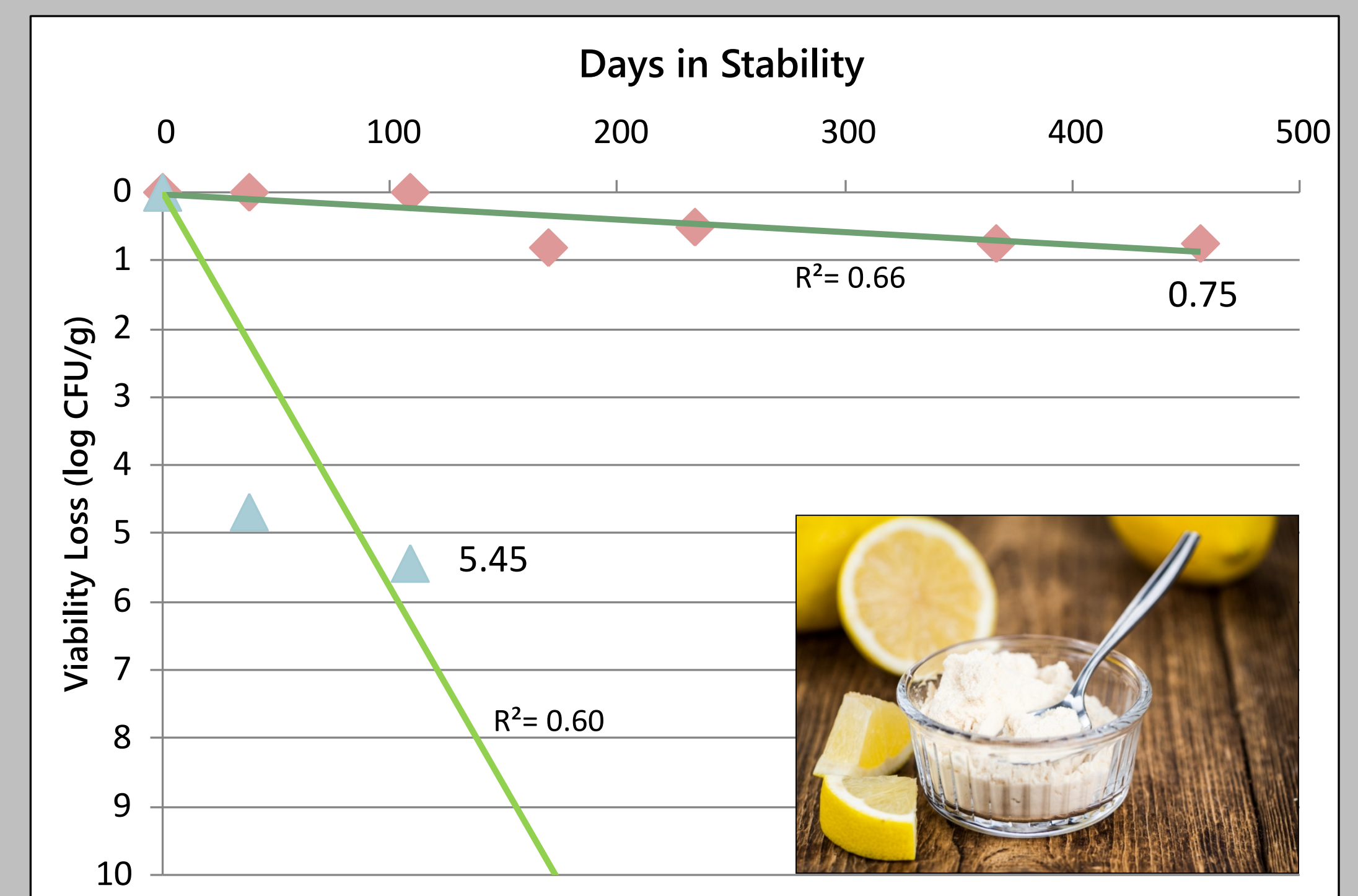


Fig 3: Survival of *L. rhamnosus* in acidic powdered beverage mix (A_w 0.27) was incubated in sealed packages at 25°C for over a year. Non-stabilized or stabilized probiotics were added to the beverage mix and the probiotic survival in the sealed packages was measured periodically. The non-stabilized probiotics lost 5.45 log CFU/g in about 4 months while the stabilized bacteria survived for 15 months with a loss of only 0.75 log CFU/g

Stability of *Bifido* sp. in Fiber Supplement A_w 0.20, 25°C, 12 Months

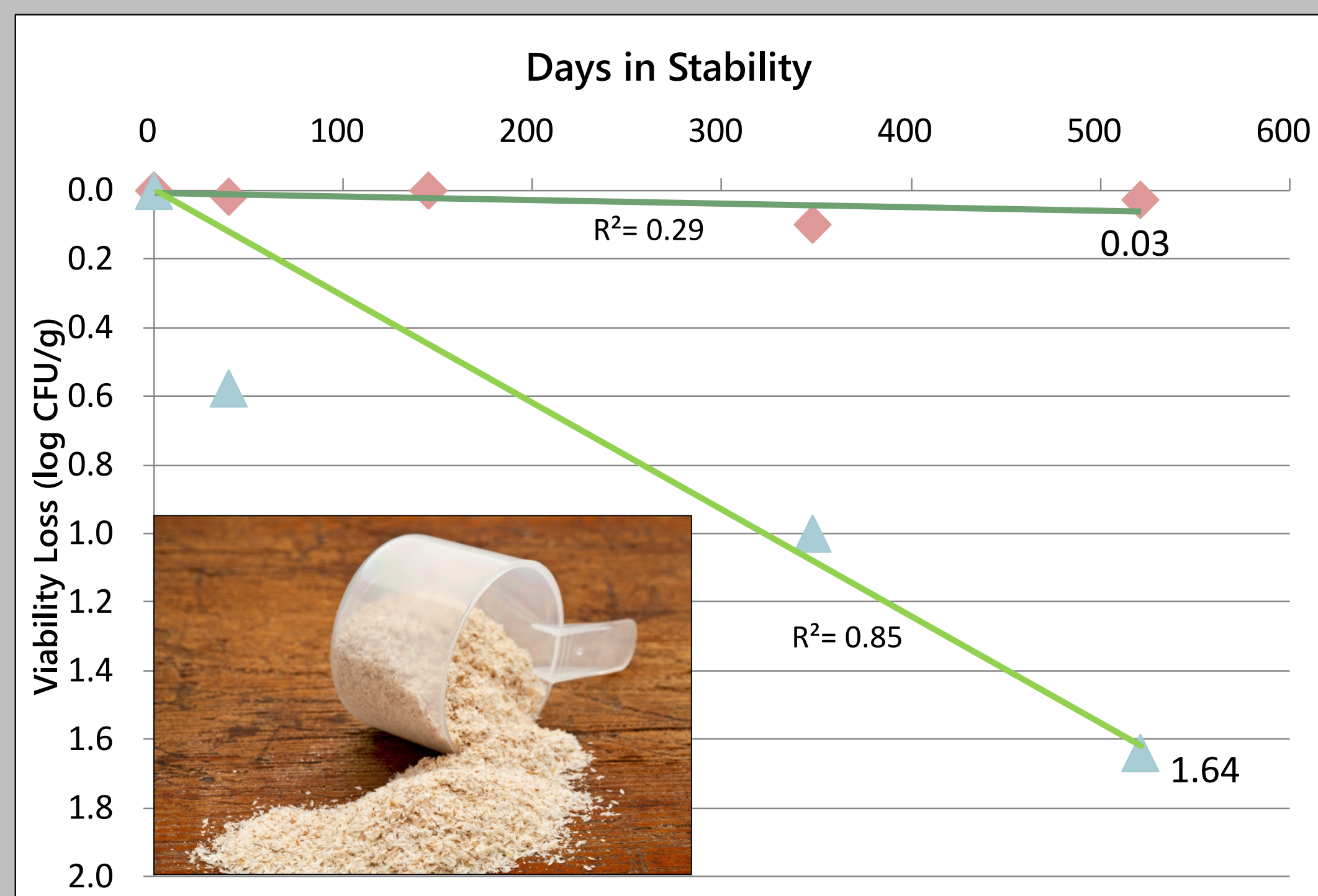


Fig 4: Survival of *Bifido* sp. in a powdered fiber supplement (A_w 0.20) was incubated in sealed packages at 25°C for a year and five months. Non-stabilized or stabilized probiotics were added to the fiber supplement and the probiotic survival in the sealed packages was measured periodically. The non-stabilized probiotics lost 1.64 log CFU/g while the stabilized bacteria survived with a loss of only 0.03 log CFU/g over the duration of the study.

Stability of *B. longum* in Breakfast Cereal A_w 0.40, 25°C, 15 Months

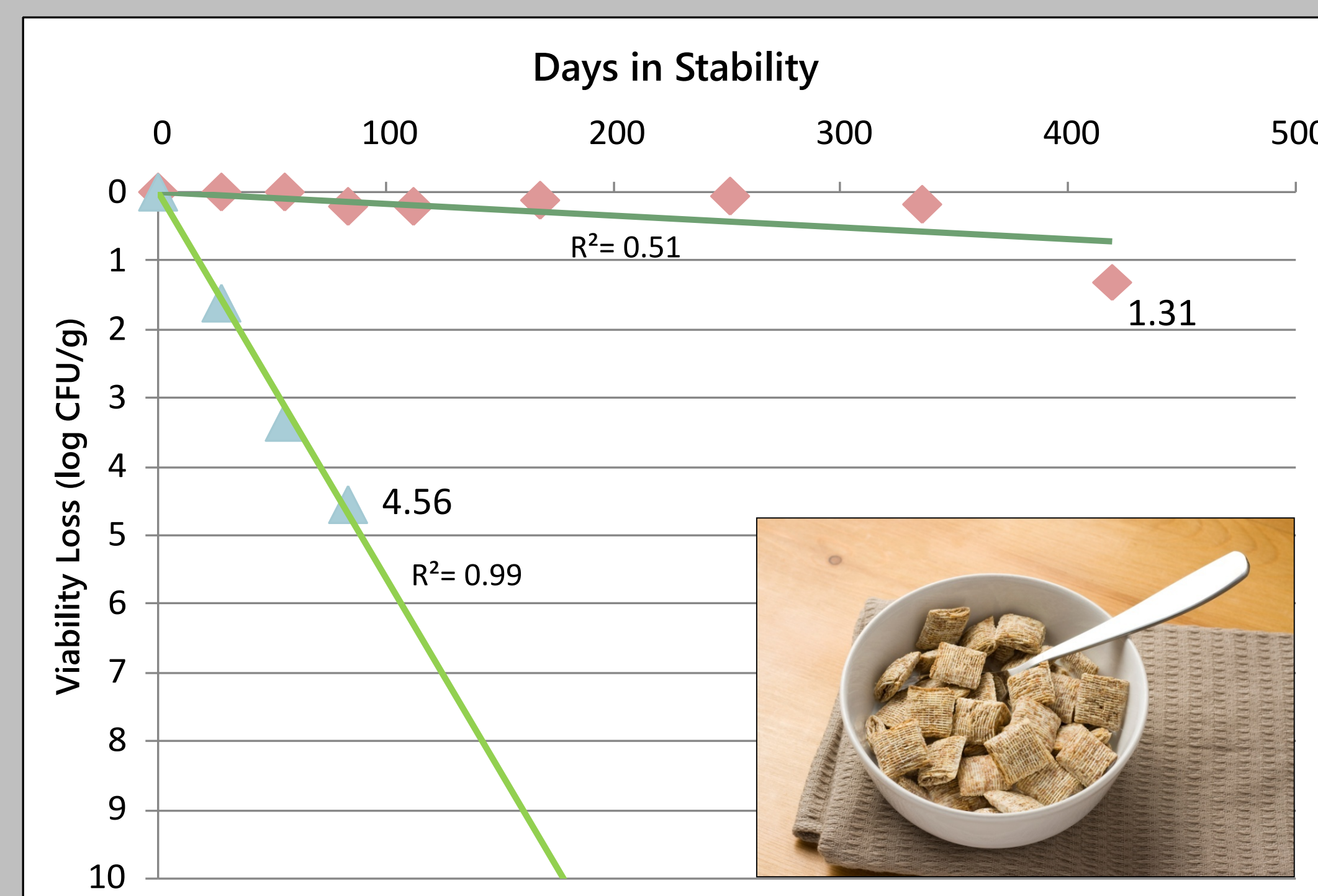


Fig 5: Survival of *B. Longum* in breakfast cereal (A_w 0.40) was incubated in sealed packages at 25°C for a year and three months. Non-stabilized or stabilized probiotics were added to breakfast cereal and the probiotic survival in the sealed packages was measured periodically. The non-stabilized probiotics lost 4.56 log CFU/g in 3 months while the stabilized bacteria survived for 15 months with a loss of only 1.31 log CFU/g

Stability of *B. longum* in Musli Bars A_w 0.34, 25°C, 6 Months



Fig 6: Survival of *B. Longum* in musli bars (A_w 0.34) incubated at 25°C for six months. Non-stabilized or stabilized probiotic was coated on musli bars and the probiotic survival in the sealed packages was measured periodically. Non-stabilized probiotics lost 3.96 log CFU/g in two months while the stabilized probiotics survived for six months with a loss of only 0.84 log CFU.g.