

## The Influence of *Lactobacillus* Species on Nosocomial Pathogens' Biofilm

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### Abstract

The word probiotic comes from the Latin meaning "for life". Lactic acid, acetic acid, and propionic acid are produced by bacteria such as *Lactobacillus* and *Bifidobacterium*. Such compounds lower the pH and prevent pathogenic bacteria from multiplying [1]. When the adhesion force between the attachment surfaces is stable, the bacteria cell communication system, called the quorum sensing (QS) system, is triggered. Bacteria use these signaling molecules to regulate virulence factors, secondary metabolite synthesis, biofilm formation, and communication with the host and other microbes depending on population density [2]. The aim of this study is to observe the potential use of probiotics against nosocomial pathogens' biofilms (*Staphylococcus aureus*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Enterococcus faecalis*).

The objective of the study is to identify the interactions between probiotics *Lactobacillus* and nosocomial pathogens, to observe the ability of *Lactobacillus* spp. to degrade the mature biofilm of nosocomial pathogens and to assess the influence of pH on the biofilm degradation activity of *Lactobacillus* spp. by using agar-well diffusion method and biofilm degradation assay [3].

All pathogens had no zone of inhibition on MHA for pH-adjusted LAB-CFS. The zone of inhibition (ZOI) can be seen in Table 1. No ZOI was observed for LAB-CFS against *E. faecalis* ATCC 29212. All zones made by the unadjusted pH of LAB-CFS on the tested pathogens showed high ZOI were more than 10 mm in diameter which indicate that the LAB-CFS have substances that produce an antibacterial effect [4]. No antibacterial activity was observed when the CFS pH was adjusted to almost neutral.

In Figure 1, unadjusted pH of LAB-CFS for LF 37 shows the highest percentage of biofilm degradation in *K. pneumoniae* ATCC 13883 (50.88%) and unadjusted pH of LAB-CFS for LC 83, *P. aeruginosa* ATCC 17934 (21.88%) shows the lowest percentage of degradation. In Figure 2, the pathogen that shows the highest percentage of degradation using adjusted pH of LAB-CFS for LF 37 is *K. pneumoniae* ATCC 13883 (69.72%). The lowest percentage of degradation when using adjusted pH LAB-CFS for LC 83 is *E. faecalis* ATCC 29212 (25.77%). Since the percentage of biofilm degradation is higher in neutralized LAB-CFS, according to [5], sodium lactate, a neutralised form

of lactic acid, or other novel low molecular weight active compounds could explain the antimicrobial or anti-biofilm activity.

Table 1: Zone of inhibition for pH-unadjusted CFS

| Organisms                       | CFS    | U<br>(mm) |
|---------------------------------|--------|-----------|
| <i>K. pneumoniae</i> ATCC 13883 | LF 37  | 12.6      |
|                                 | LCR 31 | 11.1      |
|                                 | LF 85  | 10.4      |
|                                 | LC 83  | 12.7      |
| <i>P. aeruginosa</i> ATCC 17934 | LF 37  | 12.3      |
|                                 | LCR 31 | 13.0      |
|                                 | LF 85  | 12.2      |
|                                 | LC 83  | 12.7      |
| <i>S. aureus</i> ATCC 9144      | LF 37  | 13.3      |

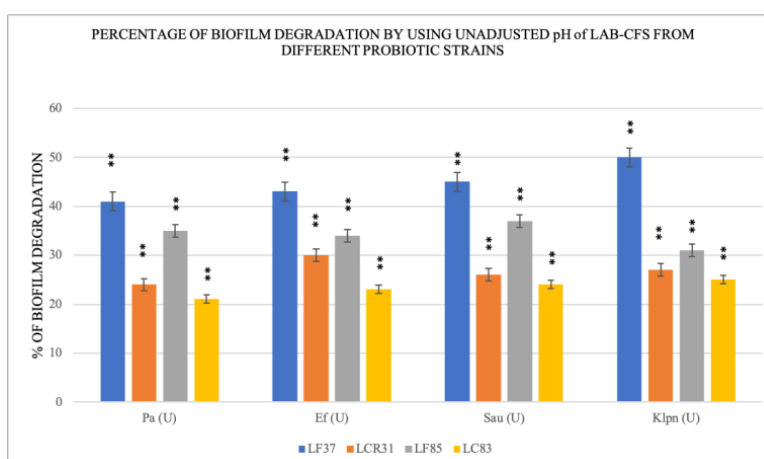


Figure 1: Percentage of biofilm degradation using unadjusted pH of LAB-CFS from different probiotic strains

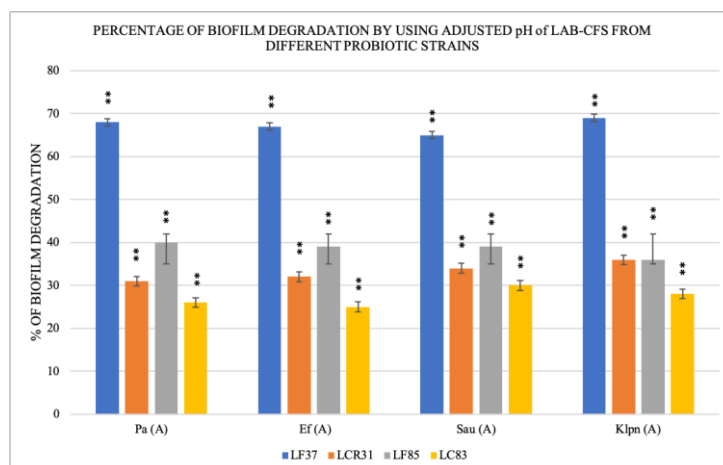


Figure 2: Percentage of biofilm degradation using adjusted pH of LAB-CFS from different probiotic strains

In conclusion, the unadjusted pH of LAB-CFS contains substances that can be used as antimicrobial and antibiofilm. However, the adjusted pH of LAB-CFS can only be used as antibiofilm but not as antimicrobial. This is because only the unadjusted pH of LAB-CFS produced a zone of inhibition in the agar well diffusion method. This is probably due to the acidic condition of LAB-CFS itself. For biofilm degradation, both adjusted and unadjusted pH of LAB-CFS were able to degrade mature biofilm, but the adjusted pH of LAB-CFS showed more biofilm degradation activity suggesting that low pH of LAB-CFS did not contribute to the biofilm degradation.

### Keywords

Nosocomial infections, Biofilm degradation, Cell-free supernatant

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