

## Valorisation of Pineapple Core Waste-Derived Bromelain as a Sustainable Bioactive Agent Against Periodontitis-Associated Biofilms

**Nursyamimi Nasuha Suhaimi**

Centre for Medical Laboratory Technology Studies, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), Selangor Branch, Puncak Alam Campus, Selangor, Malaysia

Atta-ur-Rahman Institute for Natural Product Discovery (AuRIns), Universiti Teknologi MARA (UiTM), Selangor Branch, Puncak Alam Campus, Selangor, Malaysia

**Nur Ayunie Zulkepli**

Centre for Medical Laboratory Technology Studies, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), Selangor Branch, Puncak Alam Campus, Selangor, Malaysia

Atta-ur-Rahman Institute for Natural Product Discovery (AuRIns), Universiti Teknologi MARA (UiTM), Selangor Branch, Puncak Alam Campus, Selangor, Malaysia

**Fatimah Salim**

Atta-ur-Rahman Institute for Natural Product Discovery (AuRIns), Universiti Teknologi MARA (UiTM), Selangor Branch, Puncak Alam Campus, Selangor, Malaysia

**Norehan Mokhtar**

Dental Simulation & Virtual Learning Research Excellence Consortium, Department of Dental Science, Advanced Medical & Dental Institute, Universiti Sains Malaysia, Pulau Pinang, Malaysia

**Mohd Khairul Ya'kub**

Smart KJ Agro (Asia) Plt, Bandar Amanjaya, 08000 Sungai Petani, Kedah, Malaysia

### Abstract:

Bromelain, a cysteine protease enzyme complex naturally present in pineapple (*Ananas comosus*), possesses notable proteolytic properties. In this study, bromelain extracted from MD2 pineapple core waste was explored as a natural bioactive compound for mitigating biofilm-associated oral infections. The persistent biofilm formation underlying periodontitis represents a significant therapeutic challenge, thereby highlighting the potential of enzymatic agents such as bromelain for biofilm disruption. The effects of bromelain exposure on 3D-biofilm structure and bacterial morphology were evaluated using dual-species biofilms of *Streptococcus mutans* and *Fusobacterium nucleatum*, two major periodontopathogenic bacteria. Bromelain was isolated via ammonium sulphate precipitation followed by ultrafiltration, yielding ultrafiltrated bromelain (UFB). Microscopic visualization (40× magnification) demonstrated notable disruption of the biofilm structure, with reduced surface coverage and density