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LOGISTIC REGRESSION MODEL FOR PREDICTING MICROBIAL GROWTH AND ANTIBIOTIC RESISTANCE OCCURRENCE IN SWIFTLET (*Aerodramus Fuciphagus*) FAECES

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Abstract: This study proposes a logistic model of the environmental factors which may affect bacterial growth and antibiotic resistance in the swiftlet industry. The highest total mean faecal bacterial (FB) colonies counts (11.86±3.11 $\log_{10}$ cfu/ g) were collected from Kota Samarahan in Sarawak, Malaysia, and the lowest (6.71±1.09 $\log_{10}$ cfu/g) from Sibu in both rainy and dry season from March 2016 till September 2017. FB isolates were highly resistant against penicillin G (42.20±18.35%). *Enterobacter* and *Enterococcal* bacteria were resistant to streptomycin (40.00±51.64%) and vancomycin (77.50±41.58%). The model indicated that the bacteria could grow well under conditions of higher faecal acidity (pH 8.27), dry season, higher mean daily temperature (33.83°C) and faecal moisture content (41.24%) of swiftlet houses built in an urban area with significant regression ($P<0.0005$, $N=100$). The probability of the development of antibiotic resistance (%) increased 0.50 times if the faecal acidity increased by one unit with significant contribution to the prediction ($P = 0.012$). Understanding how these microbial species react to environmental parameters according to this model, allowed us to estimate their interaction outcomes and growth, especially in an urban environment, which may pose a health hazard to people.

Keywords: Antibiotic resistance, bird, faeces, microbial growth, model.

Introduction

The swiftlet nest industry in Sarawak, Malaysia, has been growing tremendously over the past few years. A swiftlet house contains a large number of birds, resulting in a high density of nests and faeces. Many bacteria are able to grow in swiftlets' faeces (Nyakundi & Mwangi, 2011). Swiftlet houses built in an urban area cause noise and faeces pollution, with birds flying around, especially near food stalls. The concentration of bacteria in a swiftlet house, especially in the faeces, may contaminate the environment, causing harmful diseases to humans and also to the swiftlet bird itself.

Microbial growth, especially bacteria, is influenced by physical or chemical conditions of the environment. Some bacteria are unable to grow if environmental conditions change but some bacteria can tolerate diverse conditions. Bacterial multiplication depends strongly on the suitability of environmental factors and the availability of metabolic energy sources (Egli, 2015). Environmental conditions strongly affect microorganism viability, differentiation, growth and reproduction. There are intrinsic and extrinsic factors that influence microbial growth (Wolf-Hall & Nganje, 2017). Intrinsic factors refer to the characteristics of the media, such as moisture content, acidity and nutrient content, while the extrinsic factors the environment surrounding the media, such as temperature and time. Each bacterial species has a particular environmental range in which they grow optimally and cause infection (Porter, 2013). The close relationship between these factors provide us with a better understanding of how the environment can affect bacterial growth.

Water is vital and plays an important role in microbial multiplication. Bacteria cannot grow without water, except spore-forming bacteria which can survive for years without water (Stevenson *et al.*, 2015). The moisture