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Multi-classification of Freshness from Leftover-cooked Food in Malaysian Foods using Machine Learning.

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Abstract. The objective of this study is to implement machine learning (ML) to identify and classify the level of contamination in leftover cooked foods based on its aroma. An evaluation on the smell profiles using as a model local Malaysian lunch or evening foods that have always been stored as leftover cooked food is done in this study. To capture the data, a simple e-nose application is built and affixed to the food containers, which will accommodate four types of sensors sensitive to different gases and is programmed using the Arduino platform. To determine the aroma categorization of leftover Malaysian cuisine, samples are examined using RStudio. The results in this study demonstrated satisfactory performances by k-Nearest Neighbours (k-NN), Support Vector Machines (SVM), and Random Forest (RF) with accuracies ranging from 87.5% to 100% using the oversampling and undersampling techniques. Unfortunately, Linear Discriminant Analysis (LDA) gave poor performances (19.64% – 58.93%) in classifying the contamination level of the samples. Hence, the results obtained gave an indication that the electronic nose presented in this research was a promising for classification of contamination level for leftover cooked foods, allowing food to be better anticipated as to whether it is still edible or not.

I. INTRODUCTION

Food loss and waste (FLW) is a critical issue because of the high socioeconomic costs associated with it, as well as its relationship to waste management and climate change challenges [1]. It also has become a growing concern worldwide, especially in the developing countries where this problem has become severe, including Malaysia. Food waste is defined as the use of food intended for human consumption for non-human consumption, the redirection of food to feed animals, or the disposal of edible food [2]. Certain scholars have used the term "food loss" similarly with "food waste" [3]. Others, on the other hand, have distinguished between the two, with "food loss" referring to food waste at the start of the value-added chain and "food waste" referring to food waste at the completion [4].

Food that spills, degrades, deteriorates abnormally in quality, such as bruising or wilting, or is otherwise lost before reaching the consumer is referred to as "food loss." Food loss is common in the food value chain during the stages of production, storage, processing, and distribution. It's frequently an unintentional consequence of a farming method or a technical limitation in storage, infrastructure, packaging, or marketing [5]. Food waste, on the other hand, refers to food that is of acceptable quality and appropriate for consumption but is not consumed because it has been rejected before or after it has perished. The retail and consumption stages of the food value chain are where

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