



## **Techno-economics and Life Cycle Assessment of Bioreactors**

### **Post-Covid19 Waste Management Approach**

Edited by:

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## CHAPTER 10

# Sustainable engineering of food waste into high-quality animal feed using a drying technology

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### 10.1 Introduction

Management of solid waste has become a serious concern as well as a major challenge for developing and developed countries throughout the world. The rate of waste generation is increasing every day due to the significant growth of the world population (Woon & Lo, 2013). Moreover, the increasing rate of waste generation may also be influenced by higher economic development and the rate of urbanization. It is estimated that by 2100, the amount of waste generation will be three times greater than the current amount (Villalba et al., 2002). In Malaysia, total estimated municipal solid waste (MSW) generation had increased from 1998 to 2010 which is 8 million tons per year and the amount is estimated to be nearly 10 million tons per year by 2020 (Johari et al., 2012). Due to the amount of waste that produces increases, it causes the capacity of solid waste to be disposed of increases and the space and lifespan of the landfill will be decreased

Universiti Teknologi Malaysia (UTM) is one of the institutes in Malaysia that facilitates the initiative from food waste to animal feedstock. The process of food waste into animal feed has been carried out inside UTM's Waste Hub, named as Bio-Recycling Waste. Food waste will be processed every day to feed the animals inside the UTM's orchard. In addition, the main source of the food waste is from the food court in UTM which is called Arked Meranti (rebranding as Kafe Lestari). The bins which contain raw food waste is collected every day and sent to the UTM orchard for processing purpose. However, the safety of animal feeds is in doubt due to the presence of bacteria during the processes such as *E. coli*. Hence, this research will describe the effective method to reduce the presence of pathogens in food waste during the process of recycling. The outcomes of the chapter will provide an idea to reduce the pathogens present in food waste as well as increase the safety of using food waste to feed the animals.

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## 10.2 Applied processing for food waste into animal feed

The processing site of the production of animal feeds was located at "UTM Bio-Recycling Waste Hub." Firstly, this process used food waste is collected from Kafe Lestari, one of the student food courts in UTM.

Every day, the bins full of raw food wastes at Kafe Lestari were collected and sent to the Bio-Recycling Waste Hub for the food waste-animal feeds processing. The waste generated was in wet conditions since it is raw waste mixed with other waste like plastics, straws, toothpicks, and so on. Then, wastes from the bins were poured on a dripping table for segregation purposes. Food waste was segregated manually from the other waste. This is because food waste is the only source that can be used as raw materials in the preparation of animal feeds. In addition, a dripping table is used to collect the leachate from the wastes. After the segregation process, the wet food waste was left for a day on a dripping table for natural drying purposes. Further, food wastes were mixed with coconut husk as it helps to smoothen the grinding process due to food wastes containing objects which hard to have grinded like chicken bones. Coconut husks also help to provide the additional protein content in the food waste. During the process, food wastes were sprayed 5–6 times a day by using in-house effective microorganism (EM) products. This is to avoid odor problems and prevent the flies from alighted on the food wastes as it might be the cause of the development and presence of pathogens. This process might take up several days to reduce the moisture content in the

food waste by removing any leftover water content. The targeted maximum percentage of moisture content during the process is 20% which is anticipated to be more effective for further processing.

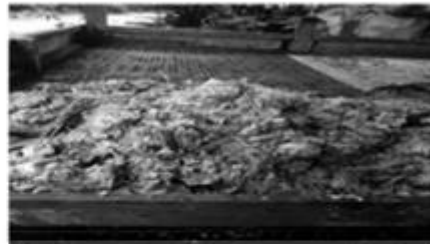
The mixture of coconut husk with food waste was further grounded using the grinder machine. The longest time taken for the grinding process is 1 h. After that, the ground food wastes were undergone for the drying process. The drying method is used to reduce again the moisture content and presence of bacteria as drying is considered as one of the simplest processes to remove excess water from the food waste (2015). Further, the grounded food wastes were dried for 2 days by using a modulated fan. A drying table was used to carry out this process. However, the drying process might cause nutrient losses in food waste. Finally, after 2 days of drying, the end products are ready to be used as animal feedstock. Fig. 10.1 shows the pictorial chart of food waste-animal feeds conversion.

### 10.2.1 Drying technology

The drying method was used in the process of recycling food waste into animal feeds at the UTM farm to reduce moisture content and the presence of pathogens in the animal feeds. Regulated fan, oven, and solar



1. Food wastes from Kafe Lestari



2. Segregation of food wastes on dripping table and left it for a day



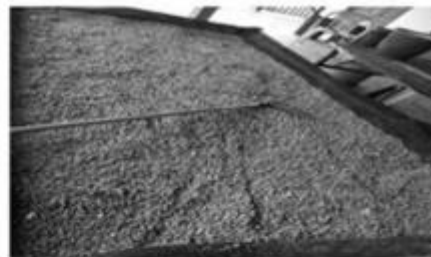
3. Food wastes mixed with coconut husks



4. Grinding process



5. Grinded food waste



6. Grinded food waste undergo drying process



7. End products are ready to be used as animal feedstock

**Figure 10.1** Pictorial representation of food waste-animal feeds conversion. *No permission required.*

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