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Food Waste Generation: A Case Study in Taman Pura Kencana and Taman Universiti

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Abstract: Food waste generation has become an unbearable issue faced by the world. Food waste consists of two classifications, which are food that was edible before it was thrown and food that was inedible before it was thrown. The aim of this study is to identify food waste generation in Taman Pura Kencana and Taman Universiti. Besides, this study also aiming on establishing food waste composition in Taman Pura Kencana and Taman Universiti. The flow of this case study begins with literature review based on previous studies to gain information needed in this study. Then the sample size of population in Taman Pura Kencana and Taman Universiti is determined by Raosoft Sample Size Calculator. In order to quantify food waste generation by the community, briefing on the procedure must be done to ensure the community understands the process well. Followed by making time arrangement with the community. The last procedure will be weighing the food waste generation and data collection. For food waste composition analysis, the procedure began with sampling food waste. The next procedure was sorting food waste into few categories. Weighing each food category comes next and lastly the data has been recorded. Based on the result, total food waste generation by community in Taman Pura Kencana and Taman Universiti were 1206.59 kg and 445.63 kg respectively. For food waste composition, there were seven food categories which are vegetables and fruits, meat, fishes and bones, eggshells, pastries, noodles, chips and others. The highest composition was others category which consist of rice, poor-shaped food and non-food. As a conclusion, the community in Taman Pura Kencana generated more food waste than community in Taman Universiti and the most common type of food waste composition is rice. From the study, it is intended that this case study can contribute in reducing food waste generation in the future.

1. Introduction

Food waste is nonetheless a massive problem that must be reduced to achieve a sustainable food supply chain [1]. Food waste may occur at any stage of the food supply chain, either during production, processing, retail and consumptions [2]. There are two classification of food waste which are food that was edible before it was thrown and food that was inedible before it was thrown. The difference between these two classifications is one of them is avoidable. Although the food is inedible before it was thrown, food waste generation can be reduced using the right approach.

Food waste has a variety of environmental consequences, including water, land, fertiliser, and energy consumption, biodiversity loss, and climate change [3]. The use of environmental education on food waste has been found to have a significant impact on food waste reduction [4]. High generation rate of food waste may affect in certain aspects. In environmental aspect, it will give a big impact on the environment such as the release of methane gas and clogging of landfills. Food waste's effects on the environment knowledge contribute to increasing on energy usage, government policy on household food waste management, and government raising awareness of the impact of food waste on the environment. Environment knowledge, government policy and awareness were found to have a significant impact on household food waste reduction [1].

According to [5], Malaysia has reached over 40,500 tonnes of waste generated daily. Almost half of them is food waste. Waste generation are discarded materials that will be disposed on the landfills. Because landfilling is now the most effective waste disposal option for a wide range of materials, the majority of rubbish ends up in landfill [6]. Food waste quantification is one of the methods to identify the amount of food waste generated. The most prevalent technique is to quantify serving waste and plate waste from lunches and dinners over a period of 1-3 weeks [7]. In this case study, the food waste generation will be quantified by weighing in kilograms 2 times a week for 3 months. Food composition analysis will be done every Wednesday for 3 weeks. The population included are households and restaurants in Taman Pura Kencana and Taman Universiti.

2. Materials and Methods

The study focuses on quantification of food waste generation and food composition analysis in Taman Pura Kencana and Taman Universiti.

2.1 Materials

This study used Raosoft Sample Size Calculator to determine the sample of population. The population were households and restaurants in Taman Pura Kencana and Taman Universiti. There were 668 households and 12 restaurants in Taman Pura Kencana [8]. In Taman Universiti, there were 572 households and 24 restaurants [9].

2.2 Methods

There were 2 methods to achieve this study objectives. The first one is quantification method. The food waste was collected for two times a week for three months. The selected day to weigh the food waste was on Sunday and Thursday. Before the collection, the community were briefed on the procedure and were informed on not to mix solid waste and other types of waste with food waste. Time was arranged with households and restaurants to collect the waste on the stated days. During the collection process, the food waste generated was weighed in kilogram(kg) and recorded accordingly. The collection of food waste was assisted by SWM Environment Sdn. Bhd. Figure 1 below shows the quantification of food waste generation process.
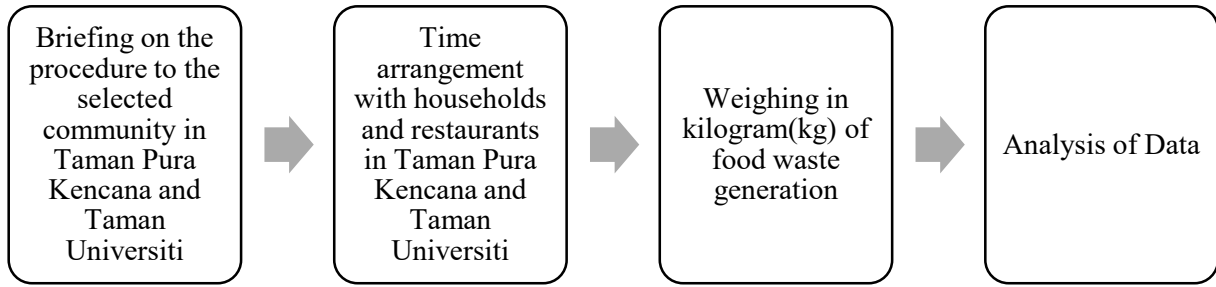
Figure 1: Process chart of quantification of food waste generation process

For food waste composition analysis, the process was carried out once a week for 3 weeks. In the first process of composition analysis, the sample of food waste was obtained among the total of food waste generated by community in Taman Pura Kencana and Taman Universiti. After obtaining the sample, the food waste was weighed and mixed evenly to get consistent composition for each sub sample of food waste. Sample of food waste was divided in quarter to get four sub samples. In each sub sample, food waste was separated by each group of food category. Each group of food category from each sub samples was weighed in kilograms(kg) and lastly, the result will be shown in percentage. Figure 2 shows the process of food waste composition analysis.
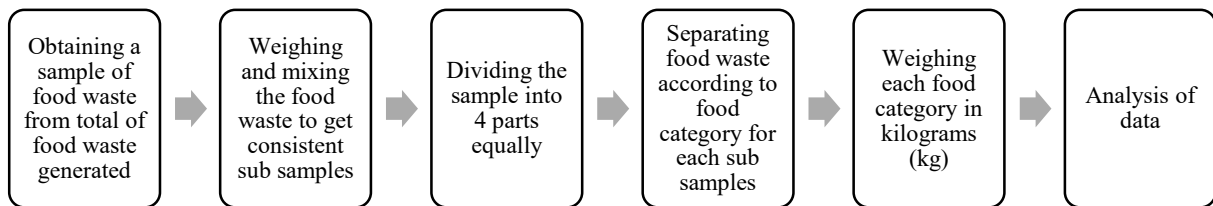

Figure 2: Process chart of composition analysis of food waste process

3. Results and Discussion

This section discussed the food waste generated for 3 months in Taman Pura Kencana and Taman Universiti, total of food waste generation in 3 months in Taman Pura Kencana and Taman Universiti and results for food waste composition analysis. Food waste generation data will show the exact numbers of food waste generated for 3 months. For food waste composition analysis, the result will be shown in statistical form.

3.1 Sample Calculation

With a 10% margin of error and an 80% confidence level, the obtained sample was 39 sample population in both residential areas. However, this study was able to obtain 48 sample respondents in Taman Pura Kencana and 42 in Taman Universiti, and these respondents were able to reduce the margin of error from 10% to 8.92% and boost the percentage of confidence level from 80% to 84.5%. When a study has more than 30 samples, the sample size might be considered acceptable [8]. Figure 3 shows the example of sample calculation using Raosoft Sample Size Calculator.
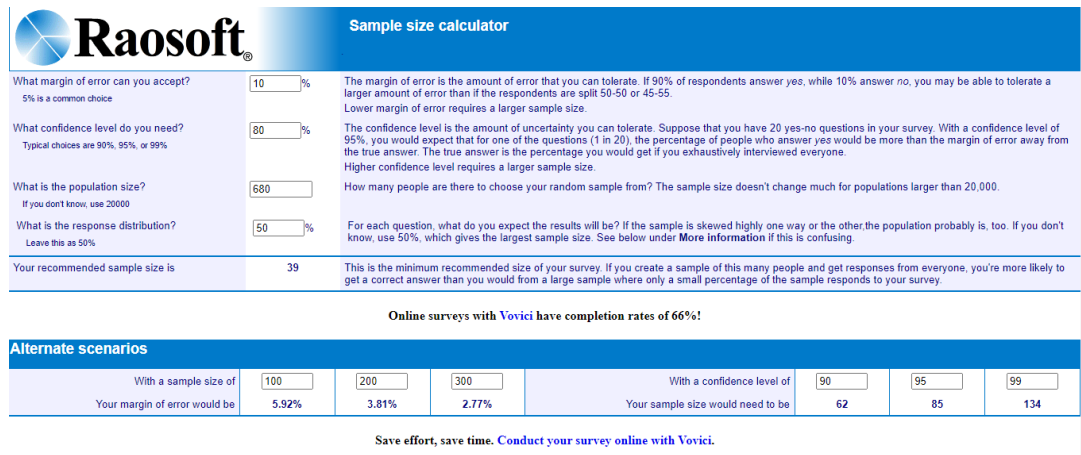
Figure 3: Calculation of sample population in Taman Pura Kencana

3.2 Food Waste Generation for 3 Months

Food waste generation in both Taman Pura Kencana and Taman Universiti were collected 2 times a week for 3 months. From the data collected in each residential, the total of food waste generation for each month is shown in Table 2.

Table 2: Food waste generated in Taman Pura Kencana and Taman Universiti for 3 months

Food Waste Generation	Taman Pura Kencana	Taman Universiti
1st Month	381.92 kg	86.51 kg
2nd Month	377.47 kg	113.38 kg
3rd Month	447.20 kg	245.74 kg

The total of food waste generated for each month in 3 months in each residential area was shown in Table 2. During the first month, community in Taman Pura Kencana generated 381.92 kg of food waste while 86.51 kg in Taman Universiti. Followed by the second month, food waste generation in Taman Pura Kencana decreases to 377.47 kg compared to the first month. Taman Universiti community generated 113.38 kg of food waste during the second month. Lastly, on the third month, both Taman Pura Kencana and Taman Universiti generated 447.20 kg and 245.74 kg of food waste respectively which are the highest amount of waste generation in 3 months.

3.2.1 Comparison of Food Waste Generation in 3 Months between Taman Pura Kencana and Taman Universiti

According to the number of populations in both residential areas, Taman Pura Kencana have 668 households while Taman Universiti consists 572 households. However, based on the number of participants in this case study, Taman Pura Kencana have 38 of households as participants meanwhile there are 37 of household participants in Taman Universiti. The food waste generated by these participants is shown in figure 3.
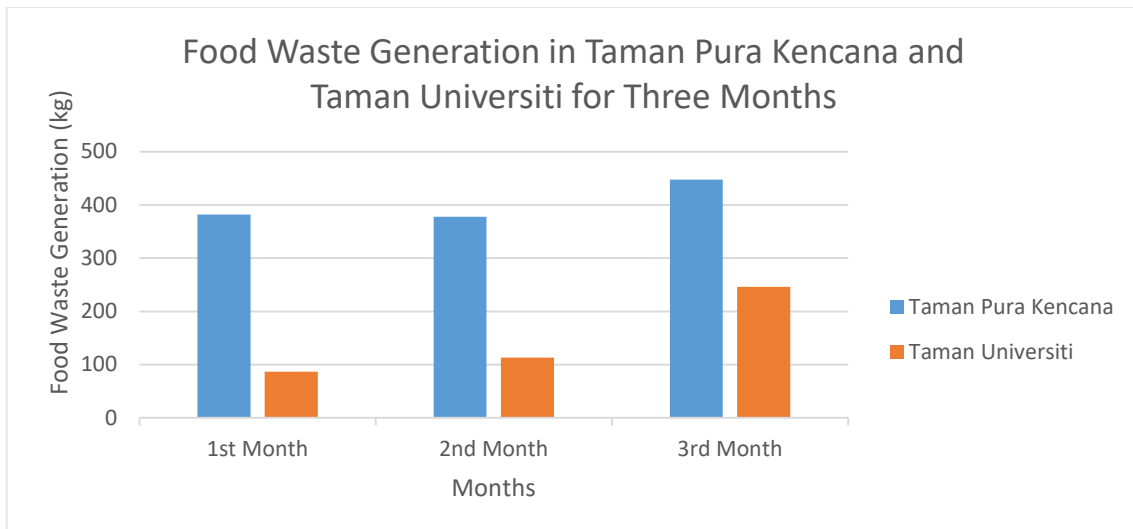
Figure 4: Comparison of food waste generation in both residential areas for 3 months

There was a huge difference of food waste generation between these two residential areas as the number of although the number of participants is almost the same. Based on Figure 4, community in Taman Pura Kencana generated more food waste than community in Taman Universiti. This may occur due to MCO. During MCO, people spent most of their times at home. Taman Pura Kencana residential area mostly consists family group of households. While in Taman Universiti, a lot of university students rent houses and those houses might not be occupied during MCO period because of students were at their hometown. Therefore, the waste generated in Taman Universiti was lesser than in Taman Pura Kencana. It might also occur due to population social class. Taman Pura Kencana is known as a residential area for elite social group such as higher education teachers, businessman, researchers and upper middle-class society. As a consequence of this residential area occupied with this social class, food waste generation rate might increase because of their secure finance. They might buy food in bulk or in a large quantity and it may lead to waste. As for community in Taman Universiti, most of the residents are university students, university staffs and middle- and lower-class society. Most of the community practice frugal living and resulting to less food waste generation.

3.2.2 Total of Food Waste Generation

This section will discuss the total of food waste generation by these two residential areas in 3 months. The number of food waste generation is shown in Table 3 and Figure 4.

Table 3: Total of food waste generated in Taman Pura Kencana and Taman Universiti

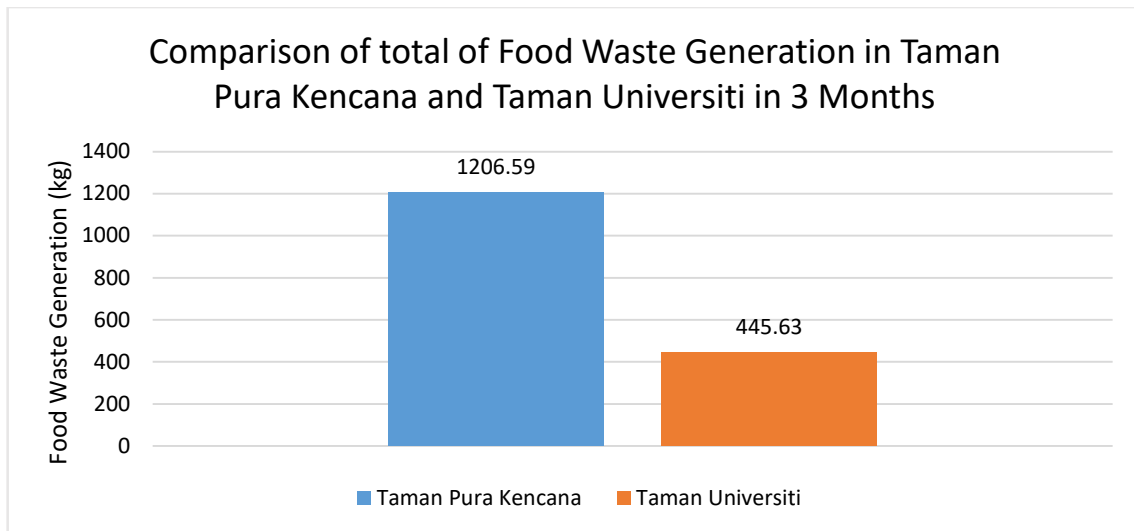| Residential Area	Taman Pura Kencana	Taman Universiti
Total of food waste generated in 3 months	1206.59 kg	445.63 kg
$\sum =$	1652.22 kg	

Figure 5: Comparison of total of food waste generation in Taman Pura Kencana and Taman Universiti

Table 3 and Figure 5 shows the total of food waste generated in 3 months for each residential area. Taman Pura Kencana community generated 1206.59 kg of food waste meanwhile in Taman Universiti, the community generated 445.63 kg of food waste in 3 months. The total of food waste generation in both residential areas in 3 months is 1652.22 kg.

3.3 Composition of Food Waste

3.3.1 Sampling

The sample of food waste was obtained from the food waste generated by community in Taman Pura Kencana and Taman Universiti for composition analysis. This case study used a sampling method which is quartering method. Quartering method started with choosing a main sample, divided into 4 parts to form sub samples [10]. In this case study, the bulk food waste was placed inside 30 litres pail drums. The number of pail drums may vary according to the food waste generated during the collection day. The most occupied pail drum are selected as main sample and weighed. Next, the food waste was mixed to get evenly distributed components of food. Followed by dividing the main sample into four parts and use those components as sub samples.

(a)

(b)

Figure 6: (a) Main sample (b) Main sample divided into 4 sub samples

3.3.2 Sorting

During sorting, food waste was separated by its food category. This process was manually by hand using equipment such as scoop, tray and requires a sorting area. For safety, gloves were required in this process to prevent hands from getting cut and exposed to sharp things and dangerous chemicals [11]. Sorting takes place in each sub samples. Based on the process, there are a total of seven food categories in this case study which was shown in Figure 7.

Figure 7: Food waste sorted according to food categories

3.3.3 Weighing Each Food Category

This process comes after sorting each sub samples according to the seven food categories. Weighing should be done accurately in order to get the precise data [12]. By using a weighing scale, each food categories in each sub samples are weighed for 3 weeks and recorded in table 4, 5, and 6.

Table 4: Mass of each food categories during Week 1

Main Sample 1 = 30 kg					
Sub-samples **Food Categories**	Sub-sample 1 (7.5 kg)	Sub-sample 2 (7.5 kg)	Sub-sample 3 (7.5 kg)	Sub-sample 4 (7.5 kg)	Total (kg)
Vegetables and Fruits	2.90	2.10	3.20	2.59	10.79
Pastries	0.15	0.16	0.10	0.12	0.53
Meat, Fishes and Bones	0.45	0.85	0.52	0.89	2.71
Eggshells	0.15	0.09	0.20	0.34	0.78
Chips	-	-	-	-	-
Noodles	-	-	-	-	-
Others (Poor shaped food, non-food)	3.85	4.30	3.48	3.56	15.19

During the first week of food waste composition analysis, the main sample weigh 30 kg and divided into four parts which resulting 7.5 kg each. The total of vegetables and fruits in main sample 1 was 10.79 kg. For pastries, the total mass was 0.53 kg. Meat, fishes and bones weigh 2.71 kg in main sample 1. Eggshells weigh 0.78 kg and lastly the others category weigh the heaviest among other categories which was 15.19 kg.

Table 5: Mass of each food categories during Week 2

Sub-samples Food Categories	Main Sample 2 = 30 kg				
	Sub-sample 1 (7.5 kg)	Sub-sample 2 (7.5 kg)	Sub-sample 3 (7.5 kg)	Sub-sample 4 (7.5 kg)	Total (kg)
Vegetables and Fruits	0.55	0.95	0.95	1.10	3.55
Pastries	0.30	0.25	0.40	0.25	1.20
Meat, Fishes and Bones	0.20	0.20	0.45	0.45	1.30
Eggshells	-	0.05	0.05	-	0.10
Chips	0.30	0.10	0.15	0.20	0.75
Noodles	-	-	-	-	-
Others (Poor shaped food, non-food)	6.15	5.95	5.50	5.50	23.10

For main sample 2 in the second week of food waste composition analysis, vegetables and fruits weigh 3.55 kg out of 30 kg. Followed by pastries, the total mass for pastries was 1.2 kg. Meat, fishes and bones weigh 1.3 kg while eggshells only weigh 0.1 kg. The mass of chips is 0.75 kg and once again others category has the heaviest mass which was 23.1 kg.

Table 6: Mass of each food categories during Week 3

Sub-samples Food Categories	Main Sample 3 = 30 kg				
	Sub-sample 1 (7.5 kg)	Sub-sample 2 (7.5 kg)	Sub-sample 3 (7.5 kg)	Sub-sample 4 (7.5 kg)	Total (kg)
Vegetables and Fruits	0.60	0.65	0.60	0.85	2.70
Pastries	-	-	-	-	-
Meat, Fishes and Bones	0.10	0.20	0.45	0.20	0.95
Eggshells	0.05	-	-	-	0.05
Chips	-	-	-	-	-
Noodles	0.55	0.25	0.30	0.30	1.40
Others (Poor shaped food, non-food)	6.20	6.40	6.15	6.15	24.90

For main sample 3 in the final week of food waste composition analysis. The heaviest food category was others which is 24.9 kg. Followed by vegetables and fruits, weigh 2.7 kg. During the final week of composition analysis, there are no pastries and chips. Meat, fishes and bones weigh 0.95 kg. Eggshells and noodles weigh 0.05 kg and 1.4 kg respectively.

3.3.4 Food Waste Composition Analysis

This part presents the food waste composition throughout three weeks of sorting and weighing food waste according to each food categories. The data will be presented in pie chart as shown in figure 8, 9 and 10.
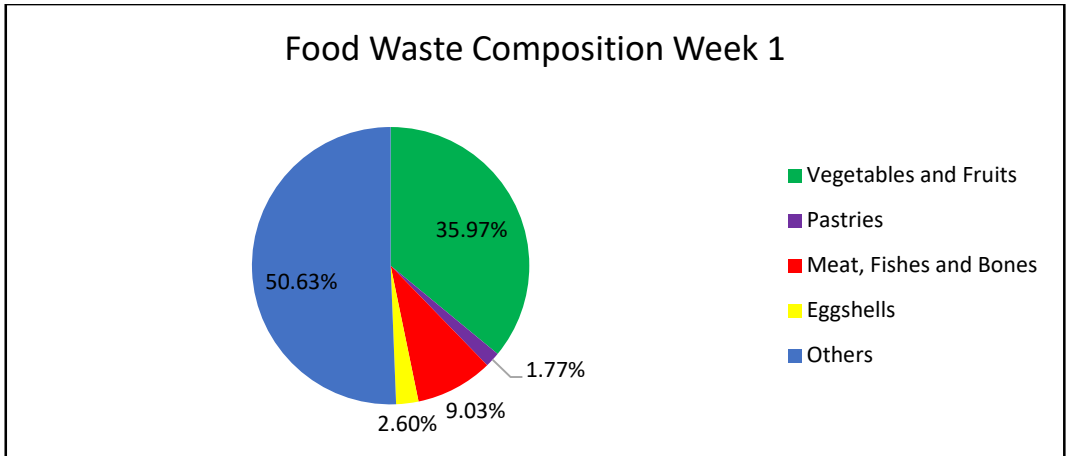
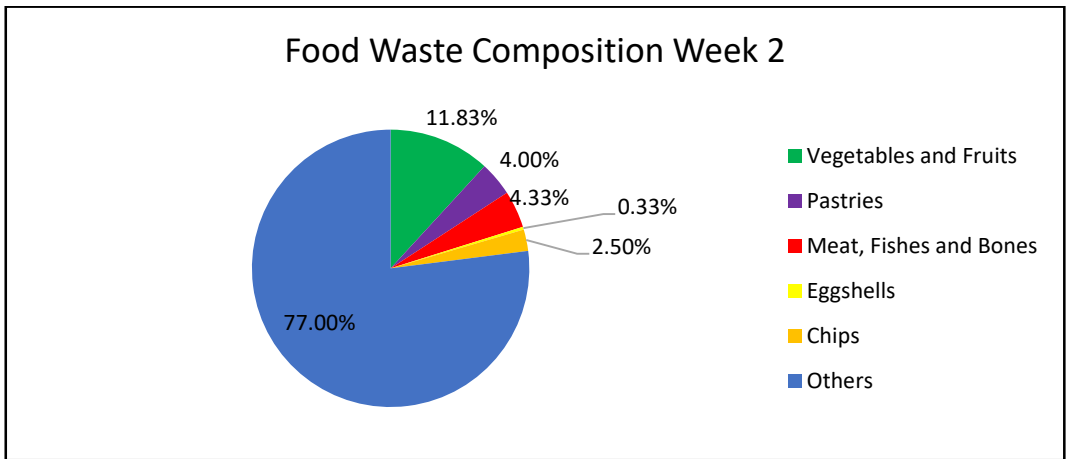**Figure 8: Food waste composition on week 1**

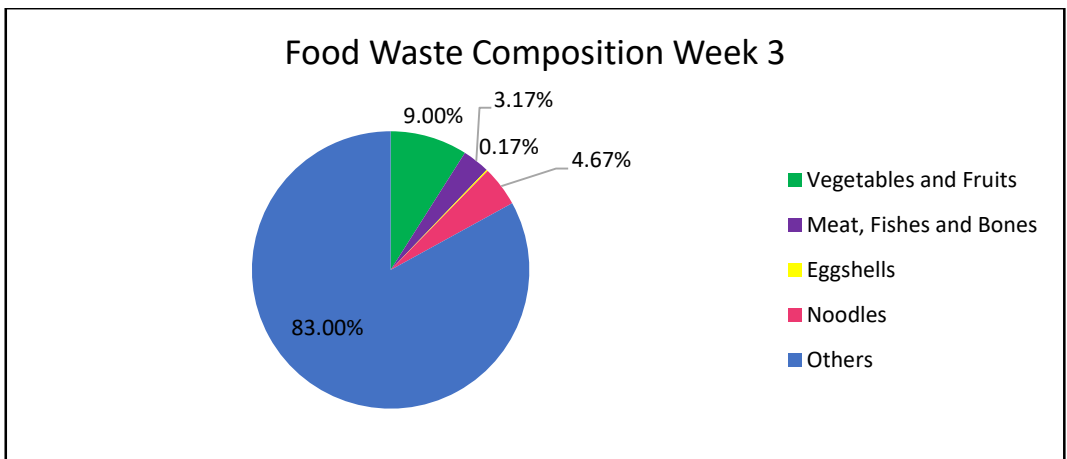**Figure 9: Food waste composition on week 2**

Figure 10: Food waste composition on week 3

Based on the pie charts of 3 weeks of food waste composition, the highest composition is others category. The second highest is vegetables trends and fruits. Meat, fishes and bones are the third highest in overall food waste composition. Pastries was the fourth highest composition. While noodles and chips

have a significant composition in the whole food waste composition analysis. The least composition was eggshells, this occurs due to the density of the food category.

Conclusions

The most common way to quantify food waste was by direct weighing in kilograms (kg). From the analysis, community in Taman Pura Kencana generated a higher amount of food waste compared to community in Taman Universiti. In Taman Pura Kencana, the total food waste generation in 3 months was 1206.59 kg while in Taman Universiti, the total food waste generation is 445.63 kg.

For food waste composition analysis, the method of sampling that have been selected was quartering method. Therefore, the food waste was divided into four parts evenly. From the data analysis, the others category was the most dominant in the composition of food waste. The other category includes rice, gravy, liquid-based food such as soup and pudding, poor-shaped food, non-food such as plastic container, plastic bag, spoon, fork and straws. The second highest was vegetables and fruits. Followed by meat, fishes and bones. Next, the fourth most common food category was pastries. Noodles and chips were the fifth and the sixth place in the common food composition. The least food category was eggshells. Therefore, based on the food waste composition, it can be concluded that the main most common food wasted was rice as rice is in the others categories.

Acknowledgement

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