WASTE MANAGEMENT IN HOSPITALITY FACILITIES WITH A SPECIAL REFERENCE TO THE OBJECTS OF VEGAN NUTRITION

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Abstract: Nowadays, vegan facilities prepare a variety of food. Due to insufficient knowledge of food standards or preparation of a larger number of portions than specified, there is an excess of food that turns into waste. By throwing food waste in nature, it directly affects the environment and nature, where it appears as a cause of climate change. The prevention of waste reduction is the preparation of small portions of food. Another way is waste recycling, as well as reuse. In this research work, the focus is primarily on food waste, which is an integral part of municipal waste. Of the total waste produced in the European Union, 10% is municipal waste, which is generated in households, schools, hospitals, and catering facilities. Most of the food waste that is thrown away is still usable for human consumption, and the rest should be used as feed for animals or plants. Waste management includes the activities of collection, transportation, recycling and disposal and other waste processing. Food is lost throughout the entire food supply chain. In the catering sector, the average food loss is around 20%.
Keywords: Waste management, types of waste, food waste, waste reduction, waste recycling

1. INTRODUCTION
Due to mass production of food as well as consumption, waste is created. First of all, its disposal in nature has a harmful effect on the physical, chemical and biological properties of the environment, which leads to its pollution. By acting on these properties, it has a negative impact on the health of all living beings, climate change occurs, and it has a negative impact on economic activities. According to EEA (2014) states that the large and diverse number of products on the market, as well as single-person households, contribute to the creation of an increasing amount of waste. A large amount of products also means a large amount of various types of waste that needs to be processed in different ways in order to dispose of as little waste as possible in landfills a comprehensive review of generated waste is difficult due to the large number of different types of waste and the fact that large amounts of waste are found in illegal landfills. In order to reduce the amount of waste in the environment, the European Union sets three key principles in its documents:
waste reduction,
1. *prevention of waste generation,*
2. *recycling and*
3. *re-use improvement of final disposal and monitoring of waste.*
According to the place of origin, waste is divided into:
1. *communal, i*
2. *technological waste.*
According to its properties, waste can be divided into:
1. *dangerous and*
2. *inert waste*
In this research work, the focus is on food waste, which is an integral part of municipal waste. Of the total waste produced in the European Union, 10% is municipal waste, which is generated in:
1. *households,*
2. *schools,*
3. *hospitals,*
4. *catering establishments.*
According to HAOP data (2015), 65% of municipal waste is biodegradable waste. It is estimated that 1.3 billion tons of food waste is produced annually (FAO 2013). It is relevant that on an annual basis, 1/3 of the food produced for human consumption is thrown away, while there are 840 million malnourished people in the world (FAO, 2013).

Most of the food waste that is thrown away is still usable for human consumption. and the rest should be used as feed for animals or plants (Ferris et al., 1995). Food loss occurs in all food production processes from harvesting to consumption, and reducing food loss is a potential solution to world hunger (Betz et al., 2014). Economic savings from reduced food waste production could be used to fight hunger and improve food security.

The reduced production of food waste would lead to significant economic savings. The money saved could be used to fight hunger and improve food security. Improving the efficiency of the food chain would help reduce consumer costs and make food more accessible to households with lower incomes. "Food waste is a difficult problem to solve because there is no complete knowledge about it and solutions due to the fact that a large number of people and opinions are involved and it is also related to other food-related problems such as health and is related to wider problems such as not income equality" (FUSION, 2016). In order to ensure enough food for ever-increasing human populations, it is necessary to adopt sustainable strategies aimed at reducing food losses in the entire food supply chain (Foresight, 2011).

2. RESEARCH OF FOOD WASTE SAMPLES IN HOSPITALITY

A large number of researched samples took place in catering facilities, in. restaurants. Out of a total of 500 plates of food served to the guests, 377 plates remained completely empty after the end of the meal, i.e. consumption. The rest of the food remained on the other 123 plates. So 75% of the food on the plate is waste and about 25% of the food on the plate is consumed. (more details in diagram 1)

*Diagram 1. Investigation of food waste samples from plates*
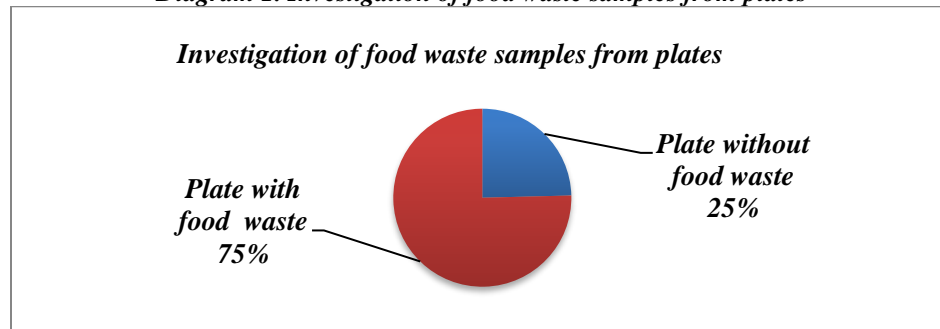
Source: Andrini & Bauen., (2007). Biogene abfalle im kanton Bern. Mengenerhebung. Amt fur Gewasserschutz und Abfallwirtschalf.

There was a total of about 56.64 kg of food on the plates, and the total measured amount of food waste was about 6,951 g of food waste, which means that the average value of waste on the plate was about 56.1 g. The following diagram 2 shows the share of consumed and unconsumed food. The results obtained through the research coincide with the previous research of the authors Andrini and Bauen, who obtained the result of about 50 g of waste that was on the plates after the consumption of guests in catering establishments where meat-based food is served.

Therefore, the percentage of the amount of waste increases to about 87.68%, and 12.32% of food is consumed. More details below, diagram 2.

Diagram 2. Survey of samples of consumed and discarded food from the plate

Survey of samples of consumed and discarded food from the plate
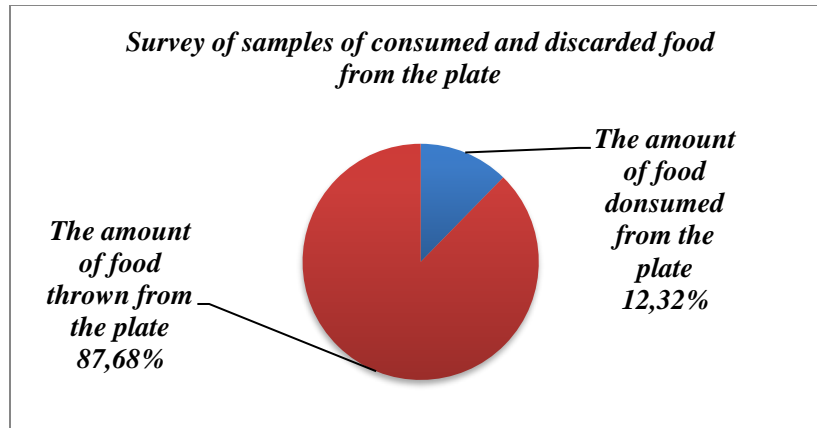
Source: Wong, Y.C.J. (2011). Study of food wastage behavior and optimization methods in canteen. Unpublished. University Stuttgart, Germany.

Further, subsequent researches that were conducted on the subject of food waste in the hospitality industry have obtained different results. Foreign authors Engstrom and Carlsson-Kanyama, Baier and Reinhard, Cordingley and Stephenson state that the average amount of food waste is twice as high as the results obtained in their research, while the author Ferreira claims that in his research this figure is about 200 g per plate. Therefore, the total part of food thrown from the plate that remained unconsumed in this research was about 12.32%, which is twice less than the results obtained by Wong, Betz, et al. The results obtained in this research are twice as low because the research by Betz, et al. carried out in canteens where mainly meat food was served, while the largest amount of food waste was represented by side dishes that are mainly served with the main course. Therefore, in the research carried out by Betz, et al. the results showed that the largest amount of waste is unavoidable waste. Diagram 3 shows the average composition of waste per plate obtained from research in a restaurant serving vegan food.

Diagram 3. Average composition of food waste from plates

Average composition of food waste from plates
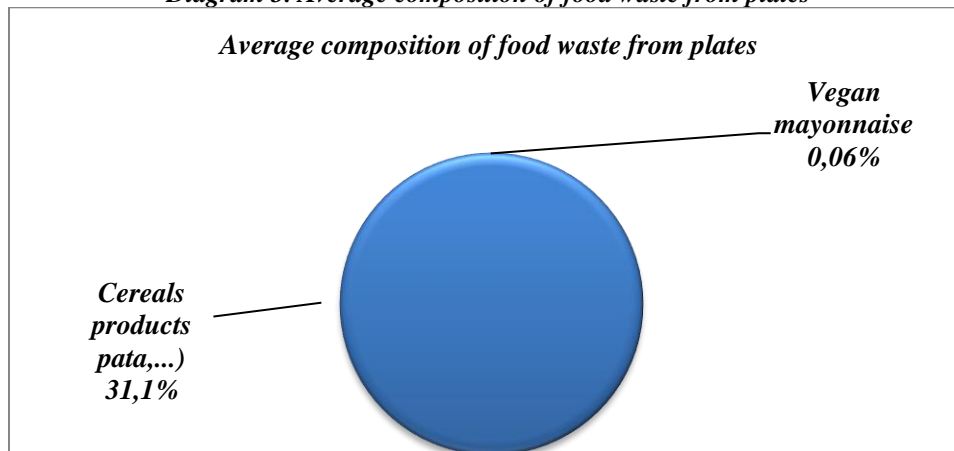
Source: Betz, A., et al). Food waste in the Swiss food service industry- Magnitude and potential for reduction. Waste Management 35, 218-226.

So, as diagram 3 shows, the largest share of food waste is cereal products with about 31.1%, vegan mayonnaise 0.06%. The amount of food waste from the plate after consumption varies with the type of food. As diagram three represents the largest amount of waste is reduced to starchy cereal products. Over 2/3 of the food waste in this research is made up of carbohydrates. Other conducted research where meat meals are served in facilities, the results were obtained on the basis of starch components. Similar results were obtained by Silvennolnen et al. Von Massow and McAdams state in their research that the largest amount of waste is carbohydrates, followed by vegetables. About 20% of plates contain salad and vegetables after consumption. These studies coincide with the studies conducted by Cordingley and Stephenson, and Silvennolnen et al. where they state that in their results they came to a figure of 20 to 27% of waste consisting of vegetables and salad. while Betz, et al. they state that 27% of the waste is vegetables. Table 8 shows the calculated correlations between categories.

Table 1. Correlations between waste categories

Nom	Waste category	I	II	III	IV	V	VI	VII	VIII
1.	Stew	-	-	-	-	-	-	-	-
2.	Salad	-0,003	-	-	-	-			
3.	Cereals products	-0,9	-0,03	-	-	-	-	-	-
4.	Bread	0,43	-0,15	-0,20	-	-	-	-	-
5.	Potato	-0,07	-0,26	-0,14	-0,47	-	-	-	-
6.	Rice	0,01	0,16	-0,14	0,09	-0,05	-	-	-
7.	Vegetables	-0,27	-0,15	-0,27	-0,01	-0,35	-0,05	-	-
8.	Products from bean	-0,25	-0,24	-0,10	-0,14	0,20	0,57	0,08	-
9.	Vegan mayonnaise	-0,16	-0,19	-0,11	-0,20	-0,71	-0,09	0,06	-0,05

Source: Betz, A. et al. (2014). Food waste in the Swiss food service industry- Magnitude and potential for reduction. Waste Management 35, 218-226.

Calculating the correlation between the stew and bread categories, the result r=0.43 was obtained, which means that it is a positive correlation. It was concluded that if there is waste from stew on the plate, there will also be waste from bread. Waste from processed products and vegetables and stews will not be on the same plate as the stew, which is visible based on the calculation of their correlations (more details in table 9). There is little probability that there is the same waste from stews with vegan mayonnaise on the same plate. If there is waste from salad on the plate, there will be no waste from potatoes, cereal products, while there is little probability that there will be bread, rice and vegan mayonnaise with it. It can be said that the only positive correlation with the salad category is the rice category because it is r=0.16. i.e. she says that there will be no rice on the plate with the salad.

By comparing the categories of cereal products with the categories of bread and vegetables, their mutual relationship is also visible, because their correlations are r=0.20 (cereal products and bread), then r=-0.27 (cereal products and vegetables). so they won't end up together on the plate as waste. By calculation, the correlation of cereal products with potatoes and rice showed the same degree of connection between the categories r=-0.14, and such connection indicates that there is a low probability that these foods are on the same plate with cereal products as waste. The correlation in the case of the category of bread with potatoes was r=0.47, and with such a positive correlation it can be concluded that potatoes can be found on the plate as waste along with bread. While bread and vegan mayonnaise will not be found on the same plate because the mutual correlation is r=-0.20, and bread waste and stew products will not be found on the plate because their correlation is r=-0.14.

The biggest negative correlation is between potatoes and vegan mayonnaise because their correlation is r=-0.71. There is also a negative correlation between potatoes and vegetables r=-0.35 and in that case those foods are found as waste on the plate. The highest positive correlation is between the category of rice and stew products, their correlation is r=0.57. The obtained result shows that along with the rice on the plate, there will also be waste from processed products (stews). During the research, large differences were noted between the measured minimum and maximum values within certain categories. Because of these results, it was necessary to calculate the standard deviation. In the table below, the measured minimum and maximum values, then their average, standard deviation, and the number of plates per category on which food waste was actually found, are significantly observed.

Table 2. Measured data on 123 plates about the average value, minimum and maximum value, standard deviation, and how many plates contained each category of waste

Nom	Category	Maximum category (grams)	Minimal category (grams)	Average	Standard deviation	Nom. of waste plate
1.	Stew	242	12	8,57	29,22	19
2.	Salad	109	3	5,07	15,88	23
3.	Cereals products	287	8	17,58	48,90	34
4.	Bread	79	11	3,84	12,53	16
5.	Potato	79	8	0,93	7,55	3
6.	Rice	320	14	9,09	36,03	19
7.	Vegetable	175	3	5,23	22,44	13
8.	Cakes	131	5	1,55	11,99	7

9.	Stew products	160	5	4,63	17,86	16
10	Vegan mayonnaise	4	4	0,3	0,36	1

Source: Betz A., et al. (2014). Food waste in the Swiss food service industry- Magnitude and potential for reduction. Waste Management 35, 218-226.

As stated in table number 9, it was clearly observed that the biggest difference in the correlation between the maximum measured and the minimum measured amount of waste with 19 plates is in the rice category, and that difference amounts to a full 306 gr. In the case of vegan mayonnaise, the difference does not even exist because waste from this category was recorded on only one plate out of a total of 500 investigated. Therefore, based on the research, it is clearly visible that the largest standard deviation is found in the category of cereal products and it even amounts to sd=48.90.

The biggest deviations from the average were recorded in this category. The reason for such a result is the large number of different meals made from these mentioned foods, and it even amounts to sd= 48.90. Therefore, the largest deviations from the stated average were recorded in this category. The reason for such a result is the excessive amount of meals made from all these foods in catering facilities.

3. CONCLUSION

The amount of food waste in catering establishments depends on several factors, namely the quantities ordered, the way food is stored, the handling of food during meal preparation, and the restaurant's guests themselves. In response to the set goal of my seminar work, it can be concluded that the researched catering facility produced small amounts of food waste. In a sample of 500 measured plates, 123 of them contained waste, which accounted for 12% of food waste from the total amount of food served. Given that only vegan food is served in the catering establishment, it was to be expected that most of the waste would be cereals and vegetables. This assumption came true because in this research starch components make up 2/3 of food waste, while vegetables and salad were the second most represented group of waste in the facility and they make up 20% of the total waste. According to the defined categories, the most waste was found in the category of cereal products. That category also has the highest average waste per plate and the highest standard deviation. The highest negative correlation is between the categories of potatoes and vegan mayonnaise, and the highest positive correlation was recorded between the categories of rice and stewed products. As a recommendation for further waste reduction in the investigated facility, it is recommended to reduce the amount of meals and reduce the choice of dishes.

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