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Determining the Amount and Types of Wastes Generated in Vocational School Cooking Programs and Educational Kitchen Applications and Environmental Recommendations in Education: Example of Ortaca Vocational School

Aşçılık Meslek Yüksekokulu Eğitim Mutfağı Uygulamalarında Oluşan Atıkların Miktarı ve Çeşitlerinin Belirlenmesi ve Eğitimde Çevreci Öneriler, Ortaca Meslek Yüksekokulu Örneği

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Özet

Yiyecek içecek sektörü ile ilgili atık sınıflandırmaları ve atık yönetimi çalışmalarını literatürde görmek mümkündür. Restoranlarda, otel mutfaklarında veya toplu beslenme sistemleri üretim alanlarında atık sınıflandırmaları ve sayımları yapılmıştır. Ancak eğitim mutfakları ile ilgili atık yönetimi çalışmasına literatürde rastlanmamıştır. Eğitim mutfakları amaç ve içerik olarak diğer mutfaklardan farklılık gösterir. Eğitim mutfaklarında ürün çeşitliliği, üretim çeşitliliği, az miktarda çok çeşit üretim söz konusudur. Çünkü bir türe yönelik değil, tüm farklı üretim türlerinin ürünlerine yönelik çalışmalar yapılmaktadır. Osmanlı mutfağı, Türk mutfağı, yöresel mutfaklar, dünya mutfağı, pastane, ekmek ve daha bir çok farklı alanda uygulamaların yapıldığı dersler mevcuttur. Ayrıca üretimler sırasında hatalar, yanlış uygulamalar olması ile atıkların miktarında da artışlar mümkündür. Bu ve benzeri nedenlerle farklı olan eğitim mutfaklarında sadece yemek üretimi değil, üretimin israfsız nasıl yapılacağı, atıkların nasıl azaltılacağı bilgileri verilmelidir. Geleceğin mutfak çalışanlarına başlangıç aşamasında bu farkındalığı kazandırmak sektörel anlamda fayda sağlayacaktır. Bu amaçlarla Muğla Sıtkı Koçman Üniversitesi Ortaca Meslek Yüksekokulu Aşçılık Programı uygulama mutfağında iki hafta boyunca yapılan tüm uygulamalarda kullanılan araç ve gereçler ile atıkların sayımları yapılmış, sınıflandırılarak kayıt altına alınmıştır. Elde edilen verilere göre en çok atığın üretim atığı olurken ikinci sırada gün sonundaki yemek atıkları olduğu sonucuna ulaşılmıştır. Üretim ve yemek atıklarının geri dönüşümü, atıksız üretim uygulamaları eğitimleri konularında öneriler sunulmuştur.

Anahtar Kelimeler: eğitim mutfağı, atık yönetimi, yemek atıkları, mutfak atıkları, geridönüşüm, atıksız mutfak

Abstract

It is possible to find waste classification and waste management studies related to the food and beverage industry in the literature. Waste classifications and counts have been made in restaurants, hotel kitchens or production areas of mass nutrition systems. However, there is no waste management study related to educational kitchens in the literature. Educational kitchens differ from other kitchen applications interms of purpose and content. In educational kitchens, there is a variety of products, a variety ofproduction, and a small amount of production. Studies in these kitchens are carried out not for one type,but for the products of all different types of production. There are lessons in Ottoman cuisine, Turkish cuisine, regional cuisines, world cuisine, pastry, bread and many other fields. In addition, it is possible to increase the amount of waste due to mistakes and wrong applications during production. In educational kitchens, which are different for these and other reasons, information should be given not only on food production; but also on how to make production without waste andhow to reduce waste. Bringing this awareness to kitchen workers of the future at the beginning of their studies will be beneficial in the sectoral sense. For these purposes, the tools and equipment used in all applications and wastes produced in the application kitchen of Muğla Sıtkı Koçman University Ortaca Vocational School Cooking Program were counted, classified and recorded over a period of two weeks. According to the data obtained, it was concluded that the highest waste was production waste, while the second highest waste was food waste at the end of the day. Suggestions were made for the recycling of production and food waste; and for waste-free production practices training.

Keywords: education kitchen, waste management, food waste, kitchen waste, recycling, waste-free kitchen

Environment and nutrition are fundamental concepts for the sustainability of human existence and life. A person's survival and a healthy and high-quality life are closely related to the nutrition. Nutrition is obligatory for all living beings. Nutrients required for nutrition are completely supplied from nature. They can be obtained by hunting and collecting from nature, as well as by making use of plant and animal production.

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In other words, in addition to what nature offers us by itself, what is obtained from nature with the use of our knowledge, skills, and technology is used as food.

The natural environment is an important factor for people to have a good quality of life. The natural environment is also a healthy environment. It is expected that the products obtained from agricultural production made in a healthy and natural environment will be healthy. Soil, water, and air, which are necessary for agricultural production, are considered to be natural resources. In addition to agricultural production, the raw materials required for industrial production can also be provided from natural resources (Okuyucu et al., 2006). With the industrial revolution, the use of natural resources has increased. In addition to the use of natural resources, there has also been pollution of nature with industrial production waste. Pollution and destruction have played a role in the greenhouse effect and caused an increase in the surface temperature of the world. Warming starting at the end of the nineteenth century and after the 1980s is very noticeable today; it continues to increase every year (Türkeş, 2006).

Both providing raw materials for nutrition and leaving waste after production to nature can cause environmental depletion and environmental pollution. With the increase in the human population, the increase in food production is inevitable. In order to produce enough food for the increasing population, first of all, plant and animal production must be increased. Performing production above capacity can cause irreversible damage to the environment. In addition, the waste after production will pollute the environment. This production and consumption waste have started to pollute the land where we live, the water we drink and use, and the air we breathe (Yücel & Ekmekçiler, 2008; Marmolejo et al., 2012). Food waste generated after production and consumption has become a global problem (Creedon, Cunningham, & Hogan, 2010; Graham-Rowe, Jessop, & Sparks, 2014).Accordingly, food waste harms the environment. However, the harms of waste are not limited to the environment. In addition, the problem of waste has an economic aspect. Not using all of the produced products or post-consumption waste affects the economy negatively. From this point of view, food waste has become one of the most discussed topics in the world (Marra, 2013). Since food is essential for human beings, it is possible to see food production and waste in places where there are humans. However, food waste is observed particularly in the sectors that focus on food production. Along with the food waste that may occur in the food and beverage sector, many different types of waste may occur in relation to the packaging and the tools used, all of which are called "solid waste". Solid waste is classified as paper, plastic, glass, metal and food (Owen, Widdowson, & Shields, 2013). More than two-thirds of waste is caused by food production and consumption (Shanklin & Pettay, 1993). Food and beverage production and consumption are important factors leading to environmental pollution.

Global warming and climate change, which are our current problems, endanger human life. Fighting this danger is inevitable. Since it is not possible to give up food productions or industrial productions that make life easier, environmentally friendly methods should be developed and precautions should be taken (Sağlam et al., 2008). Failure to take preventive measures may cause an increase in global warming, a change in climate, a negative impact on agricultural production, and a negative impact on living standards; industry and technology impact the economy, human health, and many other criteria. At this point, it is necessary to be more sensitive especially in the areas of food and beverage production. Waste management gains importance to provide sufficient production for the human population and to meet their needs without harming the environment. Caldeira et al. (2019) have studied food production, consumption, and waste by addressing different food groups throughout the food supply chain.

Studies on waste in areas with food production are available in the literature. For example, Şahin and Bekar studied food waste in hotel businesses in 2018. Yüksel and Arslan (1985) conducted research on bread consumption and disposal in places where mass feeding is provided. Yüksel (2015) determined the types of solid waste in the hospital kitchen, and Sönmez (2020) examined the level of food leftovers in mass nutrition systems. The subject content closest to this present study is available in the study of Kaur et al. (2021) in which the amount of food wasted in food service businesses in educational institutions was examined. Many studies similar to the present study are available in the literature. In their study, Çirişoğlu and Akoğlu (2021) determined that most of the waste in restaurants was in the service area, and that the most common reasons for the formation of waste were customers ordering too much or the food being not mouth-pleasing, and the size of the portions. Factors that cause food waste in restaurants have also been the focus of many researchers (Charlebois, Creedy & von Massow, 2015; Heikkilä et al., 2016). Hazarhun et al. (2020), in their study on food waste in hotels, concluded that the all-inclusive system increased food waste. A thesis study conducted in fine dining restaurants in Ankara reported that kitchen workers showed an environmentalist approach by applying separation and recycling because they were conscious about waste management (Kaya, 2022). It can be argued that concept restaurants are more sensitive to the subject than hotels with an all-inclusive system. However, in the kitchens where cookery training is given, one of the most popular professions today, waste is not considered. As it analyzes the nature of solid waste and food waste in training kitchens, this study fills this gap in the literature.

Method

The aim of this research is to determine the amount and types of waste generated in training kitchens and to offer suggestions that will enrich the training with practices that do not pollute and harm the environment. Therefore, answers to the following questions were sought:

- What are the types of waste in training kitchens?
- What is the amount of waste in training kitchens?
- In which type of production does waste increase in training kitchens?
- Is it possible to reduce the amount of waste in training kitchens and make waste reduction methods available for public use?

The research was planned to be carried out in Muğla Sıtkı Koçman University, Ortaca Vocational School Cookery Program. The list of applied courses was drawn up and the curriculum, number of students and lesson plan were requested from the relevant course instructors. Measurements were planned in nine courses: kitchen products, cooking methods, local cuisines, cold cuisine, Muğla cuisine in the spring term, pastry products, world cuisines, cuisine types, and Ottoman cuisine in the fall term. Based on the information received from the instructors, weekly planning and task distribution were made. Data were collected in the middle of the semester when the applications started and continued intensively. For two weeks, the number of students in the practice kitchen, the number of dishes applied, the waste from the meals during the production, and the waste after consumption were recorded and classified and evaluated in all compulsory and elective practice courses of the first and second weeks. The data obtained were recorded using the Microsoft Office Excel program.

Results

In the first cooking methods lesson, the measurements of which were taken on February 23, 2022, 10 kinds of products were studied with 49 students. In the second cooking methods lesson, the measurements of which were taken on March 2, 2022, 13 kinds of products were produced with 43 items. The types and quantities of waste for both applications are given in Table 1.

Table 1. Types and quantities of waste in the cooking methods lesson.

Waste Type	Quantity Week 1	Quantity Week 2
Plastic waste	2.5 kg	2.9 kg
Paper waste	1.8 kg	2.4 kg
Glass waste	380 gr	212 gr
Food preparation waste	10 kg	12.6 kg
Food waste	7.5 kg	6.8 kg
Metal waste	5.859 kg	2.5 kg
Used oil	1.574 ml	1.188 ml
Porcelain waste	-	0.4 kg
Total waste	**24.343 kg**	**29 kg**

In the first regional cuisine lesson, the measurements of which were taken on February 24, 2022, six kinds of products were studied with 22 students. The second regional cuisine lesson, the measurements of which were taken on March 3, 2022, produced 23 items and 10 types of products. The amount and types of waste for both practices are given in Table 2.

Table 2. Types and quantities of waste in the regional cuisine lesson.

Waste Type	Quantity Week 1	Quantity Week 2
Plastic waste	810 gr	1.1 kg
Paper waste	1.5 kg	1.3 kg
Glass waste	-	-
Food preparation waste	1 kg	2.3 kg
Food waste	2.28 kg	5 kg
Metal waste	-	49 gr
Used oil	661 ml	428 ml
Porcelain waste	133 gr	-
Total waste	**6.384 kg**	**10.618 kg**

In the first kitchen products lesson, the measurements of which were taken on February 23, 2022, 12 kinds of products were studied with 15 students. The second kitchen products lesson, the measurements of which were taken on March 2, 2022, were produced with 17 items and eight types of products. The types and quantities of waste for both practices are given in Table 3.

Table 3. Types and quantities of waste in kitchen products lesson.

Waste Type	Quantity Week 1	Quantity Week 2
Plastic waste	0.7 kg	1.1 kg
Paper waste	1.3 kg	0.9 kg
Glass waste	-	160 gr
Food preparation waste	5.743 kg	6.4 kg
Food waste	2.3 kg	3.4 kg
Metal waste	71 gr	910 gr
Used oil	84 ml	676 ml
Porcelain waste	90 gr	301gr
Total waste	**12.493 kg**	**13.847 kg**

In the first cold cuisine lesson, the measurements of which were taken on February 24, 2022, 12 kinds of products were studied with 18 students. In the second cold cuisine lesson, the measurements of which were taken on March 2, 2022, eight types of products were produced with 13 items. The types and quantities of waste for both practices are given in Table 4.

Table 4. Types and quantities of waste cold cuisine lesson.

Waste Type	Quantity Week 1	Quantity Week 2
Plastic waste	0.8 kg	800 gr
Paper waste	1.8 kg	1 kg
Glass waste	-	-
Food preparation waste	4.3 kg	5 kg
Food waste	1.6 kg	5.636 kg
Metal waste	87 gr	65 gr
Used oil	181 ml	736 ml
Porcelain waste	-	-
Total waste	**9.551 kg**	**13.822 kg**

In the first Ottoman cuisine lesson, the measurements of which were taken on March 16, 2022, nine kinds of products were studied with 21 students. The second Ottoman cuisine lesson, the measurements of which were taken on March 30, 2022, were produced with 17 items and six types of products. The types and quantities of waste for both practices are given in Table 5.

Table 5. Types and quantities of waste in ottoman cuisine lesson.

Waste Type	Quantity Week 1	Quantity Week 2
Plastic waste	1.2 kg	0.8 kg
Paper waste	0.9 kg	0.6 kg
Glass waste	-	-
Food preparation waste	1.2 kg	2 kg
Food waste	2.3 kg	4.610 kg
Metal waste	55 gr	36 gr
Used oil	163 gr	-
Porcelain waste	-	111 gr
Total waste	**6.313 gr**	**8.481 kg**

In the first cuisine types courses, the measurements of which were taken on March 15, 2022, nine kinds of products were studied with 15 students. The second cuisine types lesson, the measurements of which were taken on March 29, 2022, was produced with 17 items and four types of products. The types and quantities of waste for both practices are given in Table 6.

Table 6. Types and quantities of waste in cuisine types lesson.

Waste Type	Quantity Week 1	Quantity Week 2
Plastic waste	1 kg	0.4 kg
Paper waste	1 kg	0.9 kg
Glass waste	-	-
Food preparation waste	9.728 kg	3.4 kg
Food waste	1.502 kg	1.4 kg
Metal waste	104 gr	-
Used oil	120 ml	-
Porcelain waste	-	-
Total waste	**13.454 kg**	**6.1 kg**

Table 7. Types and quantities of waste in the world cuisines lesson.

Waste Type	Quantity Week 1	Quantity Week 2
Plastic waste	0.8 kg	0.8 kg
Paper waste	0.7 kg	1.2 kg
Glass waste	-	-
Food preparation waste	4.1 kg	2.4 kg
Food waste	2.8 kg	1.5 kg
Metal waste	46 gr	-
Used oil	158 ml	-
Porcelain waste	-	-
Total waste	**9.018 kg**	**5.9 kg**

In the first world cuisines lesson, the measurements of which were taken on March 15, 2022, eiğht kinds of products were studied with 15 students. In the second world cuisines course, the measurements of which were taken on March 29, 2022, 18 items and four types of products were produced. The types and quantities of waste for both practices are given in Table 7.

In the first pastry products lesson, the measurements of which were taken on March 11, 2022, six kinds of products were studied with 34 students. In the second pastry products lesson, the measurements of which were taken on March 25, 2022, 32 items and five types of products were produced. The types and quantities of waste for both practices are given in Table 8.

Table 8. Types and quantities of waste in the pastry products lesson.

Waste Type	Quantity Week 1	Quantity Week 2
Plastic waste	1.3 kg	2.200 kg
Paper waste	1 kg	1.950 kg
Glass waste	-	365 gr
Food preparation waste	2.7 kg	11.750 kg
Food waste	0.5 kg	219 gr
Metal waste	60 gr	16 gr
Used oil	-	-
Porcelain waste	-	-
Total waste	**6.1 kg**	**16.644 kg**

In the first Muğla cuisine lesson, the measurements of which were taken on March 11, 2022, seven kinds of products were studied with 19 students. The second Muğla cuisine lesson, the measurements of which were taken on March 25, 2022, utilized 21 items and two types of products. The types and quantities of waste for both practices are given in Table 9.

Table 9. Types and quantities of waste in the mugla cuisine lesson.

Waste Type	Quantity Week 1	Quantity Week 2
Plastic waste	0.5 kg	700 gr
Paper waste	0.6 kg	650 gr
Glass waste	-	366 gr
Food preparation waste	0.9 kg	4.750 gr
Food waste	0.9 kg	142 gr
Metal waste	-	16 gr
Used oil	-	-
Porcelain waste	-	-
Total waste	**2.9 kg**	**6.624 kg**

Plastic waste produced in the applied courses consists of gloves, plastic wrap and packaging. Napkins, paper towels, hair nets and packaging are mostly seen as paper waste. Food waste includes shells, stems, bones, and fishbones, which are not used in cooking and are separated and scraped during production. Food waste is the part that remains on the plates after the cooking process is completed and taken

out for service. Since this is a training kitchen, there are more people involved than in other types of kitchens, and therefore this situation changes the amount of waste. For all cooking practice courses, data were collected for two weeks. As a result, the total quantity of waste generated in two weeks is given in Table 10.

Table 10. Types and total quantities of waste.

Waste Type	Quantity
Plastic waste	20.410 kg
Paper waste	21.500 kg
Glass waste	1.483 kg
Food preparation waste	90.271 kg
Food waste	50.389 kg
Metal waste	14.383 kg
Porcelain waste	1.845 kg
Total waste	**200.281 kg**

The total amount of oil waste in the two week was determined as 6.725 liters. In the same process, the amount of solid waste was 200.281 kg.

The measurements showed that different types and amounts of waste occured in different courses. It is possible to explain this situation with the general characteristics of the cuisine that are the subject of the lessons.

The cooking methods course is a compulsory course given to first year students and has a large class size because it is a basic course. It is possible to say that the amount of waste is higher due to the large number of students in the cooking methods course. Similar amounts of waste were produced in both weeks. It can be said that similar amounts are produced for each type of waste. The reason for the difference between the first and second weeks is the number of products produced. Since six products were produced in the first week and 10 products were produced in the second week, the amount of waste increased in the second week. It can be evaluated as ± 5 kg for the weekly change in the total amount together with the changes that may occur in the number of products. Since the local cuisine course is an elective course given to second year students, the student population is between 20 and 25. The amount of waste is evaluated according to the number of students and the number of products removed although there are differences between the first and second weeks. The kitchen products course is one of the elective courses given to second year students. Therefore, student enrollment is less than that of first year students. So the amount of product removed decreases proportionally. Since the number of product types differs in the first and second week, they proportionally differ in the amount of waste. The change in the weekly total waste amount can be said to be ± 1 kg. In the cold cuisine application, there was a difference in the waste due to the differences in the number of students and the variety of products produced. The weekly difference can be said to be ± 5 kg . The Ottoman cuisine course is an elective course given to first year students. Student enrollment is between 20 and 25. Although the number of students and the variety of products were higher in the first week, the amount of waste was higher in the second week. For the amount of waste obtained in this course, it can be deduced that the amount of waste changes according to the characteristics of the product studied. Cuisine courses as an elective course given for the second year have fewer students compared to other compulsory courses. Although there is a difference between the first and second week totals in this course, the absence of waste such as metal waste and porcelain waste in the second week is actually an indication that the waste is excessive due to a special situation in the course. Similarly, in world cuisines, the total amount of waste is shaped according to the type of product and the number of students in the first and second week studies. The pastry products course is a second-year and a compulsory course. Although the number of student is higher than in the other second-year courses, the amount of waste is less than the waste of other courses. This could be due to the fact that food is prepared using products with low waste. In the Muğla cuisine class, although more product types were studied in the first week, a lot of waste was produced in the second week. There is a lot of food preparation waste, an indication that it is a production made using products with a lot of waste.

The amount of plastic waste obtained after the data collection process was determined as 20.410 kg. The determinant of this waste amount was the glove used. Since the visible majority of the waste is gloves, it can be concluded that the amount of plastic waste increases in direct proportion to the number of students in the training kitchens. Due to the fact that production is made for education rather than for production in training kitchens, it is possible for a large number of students to make a products. Considering the amount of paper towels used by each student, the amount of paper waste increases in direct proportion to the number of students, and the result is similar to the result of plastic waste.

Conclusion

Nutrition is a necessity for human beings. However, environmental values are important in order to be able to be fed and to ensure the continuity of future generations. As a matter of fact, the raw materials required for nutrition are obtained from nature and the environment. Destruction or pollution of the environment has led to global warming and climate change. If humans continue to live uncontrollably, in other words, without taking any precautions, environmental problems may increase in a short period of time and may negatively affect food production and human life. Existence of humans entails nutrition, food production and beverage production. In other words, waste will be produced as long as humans exist. However, the greater the amount of waste, the more wastage and environmental pollution. It is important to measure and classify the waste in the kitchens of the enterprises where food is produced, as well as in the institutions where cooks are trained.

According to the measurements made and the findings obtained, the highest amount of waste in the training kitchens is 90.271 kg of production waste. In the second place is leftovers with 50.389 kg. This shows that both the waste generation during production is intense and the food left on the plate after the production constitutes a significant amount of waste. In addition, porcelain waste, which has the lowest amount, is caused by accidents in the kitchen rather than production and consumption.

In summary, the following can be said about the waste generated in the training kitchens:

- Unlike other kitchen production areas, all types of waste can be seen in educational kitchens because kitchen includes different departments or areas of food production.
- The amount of waste is affected by the number of students taking the course.
- The type of product studied in the course affects the amount of waste.
- The amount of waste is high in the productions areas where more products are used. For example, while less waste is generated in the production of *baklava* and *kadayif* as part of the pastry lesson, more waste is generated during the production of pastries prepared with various vegetables, such as herbs or potatoes.
- The presence and excess of plastic materials and paper materials in all lessons is related to the use of paper towels and gloves by following the hygiene rules during the studies. This amount increases even more because of the production with many more people than in a professional kitchen.
- The largest amount of waste comes while food is prepared. This is followed by food waste.
- The least amount of waste is seen in porcelain waste.
- The amount of waste is less in the local cuisines course than in others, which is an indication that practices to prevent waste in local productions are effective. Indeed, there are many local recipes in which stale bread, leftover cheese, and leftover vegetables are used. An example of this is making vegetable patty with the inside of zucchini while making zucchini *dolma* (stuffed zucchini).
- Since there are more required courses than elective courses, the amount of waste increases.
- In general, when different food is prepared using different products in almost all courses, the amount of waste varies by ±5 kg.

In the literature, leftover meals, unfinished meals, or breads are classified as avoidable waste, while waste such as eggshell, bones, and fishbones are classified as non-preventable waste (Lipinski et al., 2013; Bagherzadeh, 2014). Based on the findings obtained in the present study, to reduce or recycle the amount of waste classified as non-preventable waste in the literature, together with the preventable waste generated during production in the training kitchens, the following measures could be taken:

- Zero waste practices aimed at reducing the amount of waste during production should be adopted as a complementary practice within the scope of the course. The waste generated in this way can be used in different food preparation practices without giving harm to the environment. Thus, it will be possible for new chef candidates to be trained in detail in waste-free production in each department.
- Waste is one of the issues that affects people, families, and society today. Collection, reprocessing, and recycling of waste is one of the expectations of today (Gündüzalp & Güven, 2016). It is necessary to turn to methods that will reduce consumption and pollution in order not to leave a dirty or inadequate environment to the next generation (Aydın & Deniz, 2018). Courses related to recycling applications should be added to the curriculum so that waste is considered (eg. within the scope of an applied course on the composting of waste), and the rate of environmental pollution will be reduced and environment-friendly production will be possible.
- The food waste suitable for consumption by animals should be delivered to animal shelters.
- As Teigiserova et al. (2020) reported in their study, applications for recovery and recycling in the nutrient and energy cycle can produce positive results.
- Finally, food waste can be recycled together with food preparation waste.

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