POSSIBILITIES OF RECOVERY OF WASTE FROM FOOD PROCESSING IN HOSPITALITY INDUSTRY

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Abstract: *Food waste has one of the highest shares of total waste generated in the hospitality industry. This paper presents some accessible methods to reduce the amount of waste resulting from food preparation in the hospitality sector as well as some methods to recover it. Optimising logistics and implementing efficient food storage and preparation measures in hospitality companies are among the most useful ways to reduce waste collection and disposal costs. Redistributing unsold meals to charities or animal welfare organisations is one way of recovering food waste in the hospitality sector. Another solution for recovering the waste generated during food preparation in the hospitality industry is to compost it and use it as fertilizer. Converting food waste from the hospitality sector into biomass and using it as biofuel is also one of the most viable solutions for its recovery and valorisation.*

Key words*: food waste, hospitality sector, waste recovery, waste valorisation*

INTRODUCTION

Food losses and waste are defined by the World Resources Institute as "the unintended result of an agricultural process, respectively, insufficient technical storage, packaging or marketing capacities". They are also considered as "food of a conforming quality, which can be safely consumed by humans, but which is still discarded" [18]. The definition given by the European Union considers food waste as "inedible pieces and parts of food that are removed from the food chain for revalorisation by composting, as fertiliser in agricultural crops, in bioenergy production or cogeneration or are destroyed by incineration, discarded in sewage or dumped at sea" [32]. The rate of food processing has been on an upward trend above the rate of human population growth, currently generating enough food to meet the food needs of 10 billion people (2050 world population projection) [12], but an estimated one-third of food is lost or wasted as it flows through supply chains (FAO, 2011) [7]. The rate of food processing has been on an upward trend above the rate of human population growth, currently generating enough food to meet the food needs of 10 billion people (2050 world population projection) [12]. Nevertheless, according to the FAO (2011), globally, a third of the amount of food processed annually is lost along the food chain, generating a major impact from an ecological, social and economic point of view. Thus, it is necessary to apply fundamental measures to stop the depletion of valuable assets, to reduce wastage and food losses at every stage of the food chain, including production, processing, storage, handling and transport to final consumers. These actions must be completed with the identification and implementation of solutions for the recovery and use of organic waste, to prevent the depletion of non-renewable stocks. These include the conversion of plant biomass into chemicals and fuels [3] and the conversion of animal by-products into commodities, fuel and electricity [26,27]. Another potential solution to reduce and reuse food waste is the implementation of the Circular Economy (CE) concept, which consists of a responsible and rational approach to natural

resources while reusing nutrient-rich by-products to produce food, feed or fertilisers [5, 10]. The goal of this paper is to identify and to present some solutions solutions for the recovery and reuse of waste from the hospitality industry.

MATERIALS AND METHODS

The methodology approached for the study included the collection of information available in the literature on food waste recovery and reuse, followed by their synthesis and comprehensive presentation. To this purpose, the data identified in the 34 studies have been analysed and synthesised.

RESULTS AND DISCUSSION

The quantity of waste resulting in canteens in different types of kitchen and countries of the world during in 1 month expressed in % is shown in Figure 1.

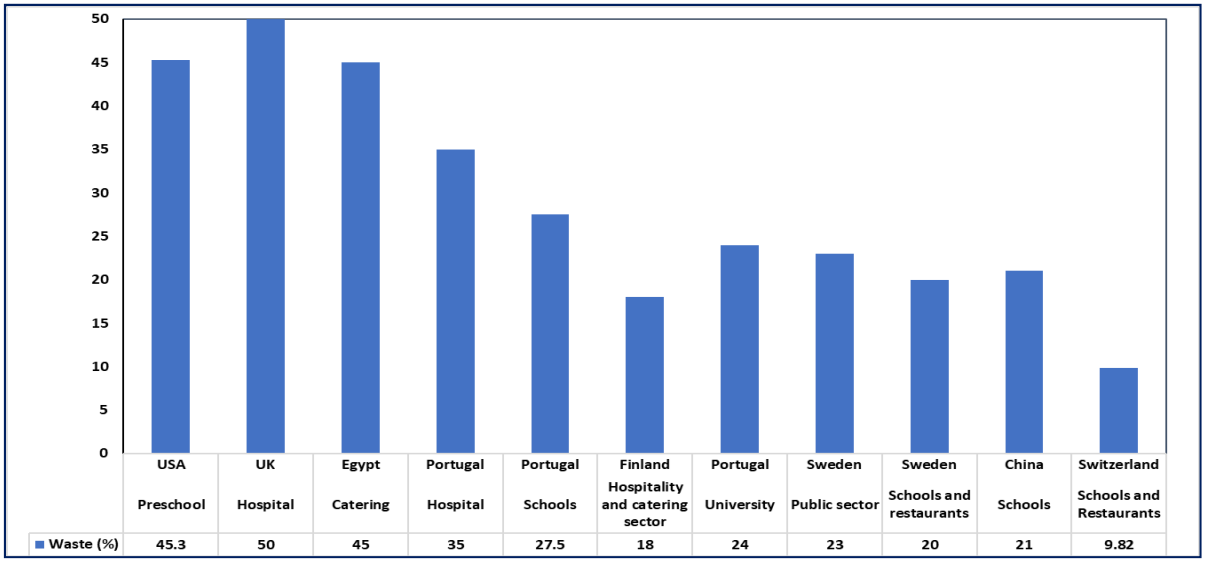

Figure 1. The quantity of waste resulting in canteens in different types of kitchen and countries [20]

The most quantities food waste produced in 1 month was registered in UK (50%) followed by USA (45.3%) and Egypt (45%). At the opposite pole is Switzerland with only 9.82% food waste resulted in 1 month, meaning 5 times lower than in UK and 4.6 times lower than in USA and Egypt respectively. The biggest percentage of food resulted from hospitals and preschool and the lowest schools, on average 2.5 times less than in hospitals.

The Scandinavian countries surveyed (Finland and Sweden) and China also stand out with quantities of waste generated in a month on average 2.5 times lower than the first ranked countries.

Strategies to reduce food waste

1. Optimising logistics

Ensuring optimal and efficient food logistics is a basic supply chain requirement to reduce waste generation. Delivering products on time and in the right quantity at the lowest possible cost and without food waste is a real challenge for food producers, as most foods have a very short shelf life and therefore a very short shelf life. Meeting this challenge requires accurate planning, i.e. efficient deployment and management of food logistics from farm to fork [9,11].

Modern technologies used in food logistics to reduce waste are shown in Table 1.

Table 1.

Modern technologies used in food logistics to reduce waste

Technology	Description	References
Automation	Automation represents a form of automatic mechanised technology. Using of automation in food bussines ensure the costs saving, leds to increased production and operating speed and last but not least ensures less waste and environmental protection. Regarding the warehouse logistics, a basic automation provides an efficient movements of products.	[6,15]
System Integration	Systems integration is the interconnection of different subsystems into a single system to provide global functionality. The advantages of system integration include costs saving a better efficiency, and offers superior quality products to consumers. A efficient intelligent logistics system ensures the reduction of food waste.	[16,17]
The Cloud	Cloud logistic has an important role in sustainable industries, due the fact that improves process resilience and facilitates reduction, reuse and recovery of waste. Using the cloud also allows to reduce energy consumption and therefore to reduce the associated costs.	[17,19]
Blockchain	The main benefits of using blockchain in food logistics include greater efficiency in the transport of goods, transparency, monitoring of shipments, reduced incidence of goods being lost or stolen and increased speed of invoicing and payments.	[1,30,31]
Artificial Intelligence	Artificial Intelligence is considered a descriptive, predictive and prescriptive technology capable of identifying new correlations that enable improved process design and control. In food logistics, artificial intelligence is mainly used for information exchange to ensure a seamless flow in supply and transportation.	[11,33]

2. Efficient food storage and preparation measures in hospitality companies

The storage is defined as a process of maximum importance for all food products and especially in the case of perishable and frozen foods as meat, and fish [14].

Thus, good storage practices plays a very important role in decreasing losses and in the optimal preservation of ingredients and materials until their use in the technological process (FAO, 2018) [8]. On the other hand, reduction of losses during storage, is considered a sustainable solution in ensuring business performance in the hospitality industry. (Kumar and Kalita, 2017).

The optimal storage procedures and practices in food stores of hospitality sector include:

- Food storage in dry rooms, on pallets and at appropriate heights;
- Ensuring sufficient space between product packages;
- Storage of heavy or large products on the lower shelves of warehouses;
- Ensuring the preservation of the integrity of the cans' packaging and storing them so that reading the data printed on them is not difficult and processing them according to the FIFO system (First In-First Out);
- Temperature monitoring in refrigerators and freezers by mounting electronic measuring devices on their doors;
- Products with properties that could affect the safety of other products, such as eggs, are stored separately;
- Storage of detergents, disinfectants, upholstery and other cleaning and packaging materials in rooms separate from those where food is stored [25]

Regarding the preparation, the waste generated during the food preparation process in the hospitality sector depends on the types of food. Thus, most waste results from

cooking preparations from fresh and raw ingredients [22]. It was reported that, the vegetable-based dishes generate a greater amount of waste than pasta-based dishes.

It was also reported that a smaller amount of waste results from preparations related to the breakfast buffet, compared to those generated during the preparation of the dishes of a lunch buffet. This can be explained by the fact that breakfast serves foods such as cereals and jams that have a longer shelf life [28] and therefore do not generate waste even if they are not consumed in the first event are served.

The best method to reduce waste in the hospitality industry is to identify and include in the menus those types of dishes that generate less waste during their cooking to the extent that they are economically feasible [28].

3. Redistributing unsold meals

European Comunities legislation defined food redistribution as "*a process by which surplus food is recovered, collected and provided to people, in particular to those in need*" (EC, 2017) [4].

Food donation is considered a method to establish a "win-win" agreement between the field of waste management and those of food security, and in spite of all this is still seen as a less attractive alternative than of the direction to he waste treatment systems [23]. Donations of food resulted from the hospitality industry are legally possible, but many times faces difficulties from the prism of infrastructural gapes of food service establishments [2]. There are some food service outlets which use to leave food close to places where are people in need can consume them. In case that provide charitable assistance, they give free meals or drinks to specific persons. Over all, there are two major ways to redistribute unsold meals: donating to food banks or donating to homeless people[23]. Another way to capitalize unsold or uneaten food in the hospitality industry and to reduce food waste is to donate it to animal shelters or non-profit organizations that deal with animal welfare.

4. Converting food waste from the hospitality sector into biomass

One of the most important ways of recovering food waste from the hospitality industry is by converting it into biogas or biomethane because of its energy benefits.

This is made possible by anaerobic digestion of organic matter, which during the process is broken down and energy is released as biogas. This method is considered an efficient alternative to waste incineration, which has major disadvantages such as energy loss and environmental pollution. Biogas consists of methane (50-70%), carbon dioxide (25-50%) and small amounts of hydrogen, hydrogen sulphide, ammonia, etc. Applications of biogas from waste include: production of heat and electricity, natural gas (at least 97%) for grid/vehicles (c) digested as fertiliser in agriculture [29,34].

Another use of food waste is to recover molecules with high biological value, with applications in many fields such as agriculture, health, pharmaceuticals, etc. [21]. Animal wastes, such as those from fish and seafood processing, are rich in chitin, proteins, gelatine, glycosaminoglycans, carotenoids, minerals, enzymes, antioxidants and other bioactive molecules. Some of these biomolecules can also be used in food processing, such as chitosan, which is used as an anti-browning agent and also as a food preservative [21].

Protein hydrolysates extracted from fish waste can be used in the manufacture of dietary protein supplements, but also as stabilisers in the beverage industry, milk replacers or as flavourings. Marine shells are rich in calcium carbonate and are processed into value-added products such as calcium phosphate and calcium citrate, with applications in the biomedical and food industries [13].

Carotenoids, such as astaxanthin and β-carotene, are used as dyes in the food industry and are usually extracted from shrimp cells [24].

CONCLUSIONS

The study presents a synthesis of the methods of recovery and valorization of food waste resulting from the hospitality industry. The biggest percentage of food resulted from hospitals and preschool and the lowest schools in United Kingdom and United States of America. The lowest quatities of food waste were regeistered in Switzerland, Egipt, China and Scandinavian countries. An optimal and efficient food logistics is one of the basic methods to reduce waste generation, consisting of delivering products on time, at the lowest possible cost and without food waste. The most efficient logistics methods applied to manage and reduce the amount of waste generated in the hospitality industry include: automation, system integration, cloud, blockchain and artificial intelligence of food chain. Reduction of losses during storage, is another sustainable solution of the food waste management in the hospitality industry. The amount of food preparation waste in the hospitality sector depends on the type of ingredients, most of which is generated when processing fresh and raw components. The best method to reduce waste in the hospitality industry is to designing menus so that they are composed of types of dishes that generate less waste during cooking. Donating unsold food to non-profit organizations that deal with social cases or animal shelters is also a method of capitalizing and reducing food waste. The conversion of food waste into biomass, respectively the extraction of nutrients from them and their use in food processing, medicine or fertilizers for agriculture represent valuable methods of valorizing food waste. Converting food waste into biogas or biomethane is considered an efficient alternative to waste incineration, due to reduced energy consumption and environmental pollution. The recovery of molecules with high biological value from food waste also has numerous applications in agriculture, healthcare and the pharmaceutical industry.

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