Relationships of Food Packaging Waste Processing and Costs with Environmental Protection in Iasi County

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The estimated food waste in Romania is around 1/3 of that generated. When we are discussing the food packaging waste generation, the data are really foggy. The aim of the present study was to compare the food packaging waste generation in two areas of Iasi county (one urban, one rural), in a close relationship with the costs of their collection and processing, as well as their direct impact on environment. There is a clear average difference of 89 % between the food generation waste amounts in urban and rural case-study areas. The same time, there exists also a huge difference of 75% between the food packaging generation waste amounts in same urban and rural areas. The food packaging waste generation represents 22.17% as average when compared to total waste generation in urban area. On the other hand, for the rural area, the food packaging waste generation represents 72.18% as average when compared to total waste generation. Moreover, we tried to estimate the costs for removing the waste from the two case-study areas. In the rural area, the costs are almost 99% lower than in urban one, since the collecting of garbage is done rarely during the year. In this case, the impact on environment seems to be harder in rural area. On contrary, there is a lot of packaging waste (including food packaging waste) spread all over the urban area, despite the involvement of local authorities in active removal. The lack of responsibility and of basic education might be the explanations for such a strange situation.

Keywords: environment, food waste, food packaging waste, urban, rural, costs

There is a global huge loosing or wasting of human food, around one-third of that produced. These wastes involve all types of food and achieve all links of the food chain. The preventive wastage is already searching for active packaging, which might play a pivotal role in food loses and costs reduction, future innovation being imperative to streamline the processes and stages of food chain [1].

The European strategy and management on food waste or food packaging waste includes prevention as the top priority. The actual Waste Framework Directive is stating that the reduction of waste generation is equivalent to the lack of its' producing. The general practice of loose distribution through self-dispensing systems is reducing the packaging waste appearance [2].

The consumer demand might be covered through an increase in production in all active sectors, including food ones. The increased production is further inducing a hard environmental deterioration. This environmental deterioration became last years a target for researchers and practitioners all over the world, in an attempt to balance the huge negative consequences. First results are represented by the development and application on a large scale of new governmental regulations and policies, thus increasing the efficiency and improving environmental performance. The manufacturing and services industries are among those mainly targeted. Especially, hazardous packaging materials used all over the packaging manufacturing branches have a tremendous impact on the environment through induced pollution size. The implementation of new management concepts on pollution caused by food packaging waste generation can significantly reduce the negative and disastrous impact on the environment quality. One of these new concepts is represented by the Green Supply Chain Management (GSCM), easy to apply by almost all industry. Recent researches suggest that the obstacles toward large implementation of GSCM principles are including poor or inadequate training, low monitoring, lack of application pressures as well as poor customer awareness [3].

Many activities involved by food industry are impacting on population health (the consumers) and environment, meaning the production, processing and transportation. Really sustainable systems in food industry production are necessary since hard strains are produced on Earth's natural resources as direct and adverse effects. There are several processes inducing environmental threatens, related to food industry, but one of the most common is represented by food and packaging food wastage. The greatest amount of impact on environment is associoated to meat and meat products and to dairy ones. There exists a bidirectional relationship between human eating patterns and the environment [4].

For Romania, there is no or minor sorting of packaging waste (including food packaging waste) at source. Reducing waste generation is not stimulated by incentives of any kind. The involvement of local authorities in environmental education of population is lacking almost totally. That's why the Romania's targets imposed by

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European Union Directives concerning the packaging waste recovery/recycling are far away to be reached in the next future years [5].

There are no concrete data concerning the food waste and food packaging generation in Romania. There is no clear management for wastage and a deep lack of population education to target the selective sorting of food wasting and food packaging wasting, related to all other types of waste generated. If the population is actively mobilized there will be really quick and high accurate responses, especially in larger areas with medium-high income [6].

The estimated food waste in Romania is more than 2.5 mil tones (that is, around 1/3 of that generated). When we are discussing the food packaging waste generation, the data are really foggy. The aim of the present study was to compare the food packaging waste generation in two areas of Iasi county (one urban, one rural), in a close relationship with the costs of their collection and processing, as well as their direct impact on environment.

Experimental part

The experimental plan was developed in two areas of Iasi county: one in Iasi city (urban, area A) and one in Iasi county (rural, C. village, area B).

The experimental basis was developed from a previous one [6,7]. The selected areas covered almost an equal number of households, around 60 for each one. The only one criterion for Iasi city area was represented by the acceptance of the owners to selectively analyze their garbage bins (25% of total) each Tuesday for 12 weeks. For the B area (the rural one) the total waste generation was analyzed also each Tuesday, using the accumulated garbage from random spill area, also for 12 weeks. The total analyzed quantity of waste generation was 5.8 tons, 2/3 being from Iasi city area. The analysis method and team were all the time the same.

As analysis indicators were used: food waste generation (kg/household, week); food packaging waste generation (kg/household, week); ratio of food waste generation and food packaging waste generation; ratio of food packaging waste generation and total thrown waste generation. These indicators were completed with an analysis of the average composition of the total waste generated in the two areas. Moreover, we tried to accurately estimate the costs implied by the removal of the generated waste in the analyzed areas.

For our experimental part we used the common Excel software in conjunction with Student T-test and Mann Whitney Rank Sum test, to verify if there exist statistical differences. The p values <0.05, corresponding to a 95% confidence level significance, were considered to reflect statistically significance.

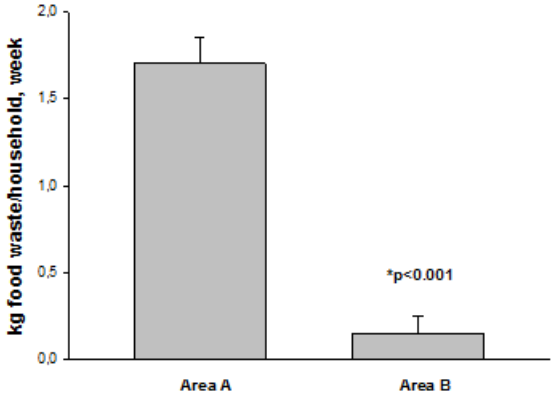

Fig. 1. Average amount (kg) of food waste generation in urban (A) and rural (B) areas per household and week. *Values of p<0.05 were considered statistically significant

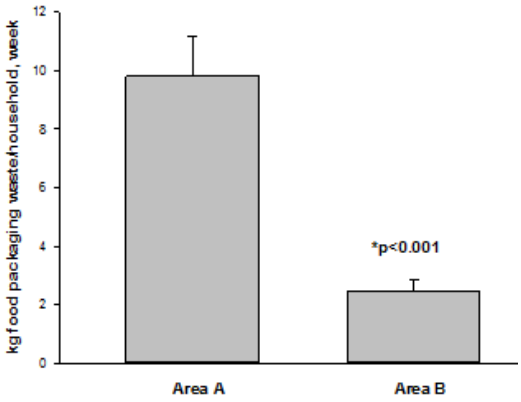

Fig. 2. Quantities (kg) of food packaging waste generation as average in urban (A) and rural (B) areas per household and week. *Values of p<0.05 were considered statistically significant.

Results and discussions

Results of food waste generation (average kg/household, week) for the 12 weeks of experiment in urban and rural areas are shown in figure 1.

As seen in figure 1, there exists an average difference of 89 % between the food generation waste amounts in A and B case-study areas. This difference might not be real, since in rural area (B) the resulted food garbage might be used almost entirely in the households for feeding livestock and poultry, as well as the dogs and cats.

The average food packaging waste generation quantities from both areas are presented in figure 2.

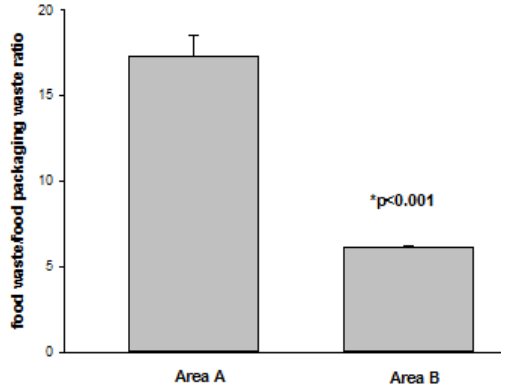

Fig. 3. Food waste generation/food packaging waste generation ratio in the two case-study urban (A) and rural (B) areas. *Values of p<0.05 were considered statistically significant

As seen, there exists also a huge difference of 75% between the food packaging generation waste amounts in A and B case-study areas. These differences might be related to the lower consume of packed and processed food in rural area. As a partial clear conclusion, in urban areas there are generated higher amounts of food waste and food packaging waste, at least in Romania and Iasi county.

Figure 3 presents the ratio of food waste generation and food packaging waste generation, comparatively, in the two researched areas.

The conclusion of this analysis is that the food waste generation represents 17.34% as average when compared to food packaging waste generation in urban (A) area. On the other hand, for the rural (B) area, the food waste generation represents 6.12% as average when compared to food packaging waste generation.

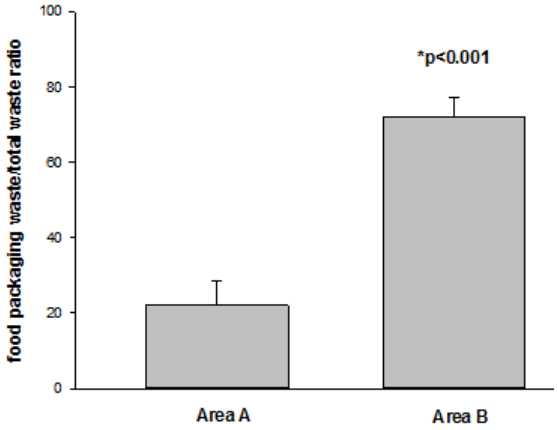

Fig. 4. Food packaging waste generation/total waste generation ratio in the two case-study urban (A) and rural (B) areas. *Values of $p<0.05$ were considered statistically significant

Figure 4 presents the ratio of food packaging waste generation and total waste generation, comparatively, in the two researched areas.

As seen in figure 4 the food packaging waste generation represents 22.17% as average when compared to total waste generation in urban (A) area. On the other hand, for the rural (B) area, the food packaging waste generation represents 72.18% as average when compared to total waste generation. This huge difference might be explained by the re-use of some components (paper, cardboard, metals, plastics, wood, organic, glass, green waste, textiles, etc.) of total waste generated in the rural households for many purposes.

Figure 5 and 6 presents an estimation of total (solid) waste composition generated in urban (A) and rural (B) areas of Iasi county.

We tried to estimate the costs to remove the waste from the two case-study areas. In the rural area, the costs are almost 99% lower than in urban one, since the collecting of garbage is done once or twice a year. In this case, the impact on environment seems to be harder in rural area. On the other hand, there is a lot of packaging waste (including food packaging waste) spread all over the urban area, despite the involvement of local authorities in active removal. The lack of responsibility and of basic education might be the explanations for such a strange situation.

One of the modern tendencies concerning the food waste selective treatment is that of the generation of biogas using anaerobic digestion [8]. The hydrolysates of

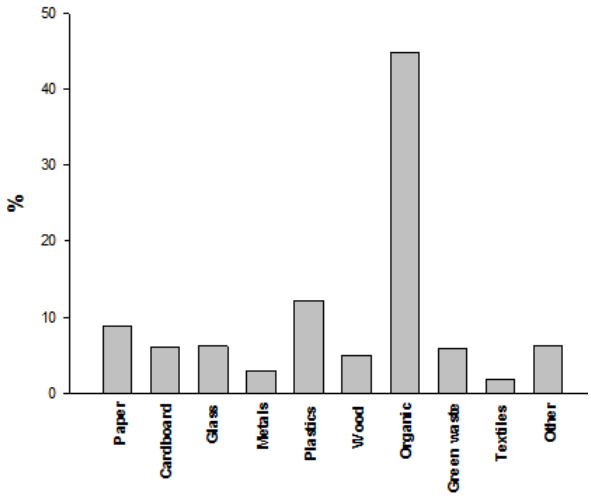

Fig. 5. Average composition of total waste generated in urban (A) area of Iasi county for 12 weeks experiment.

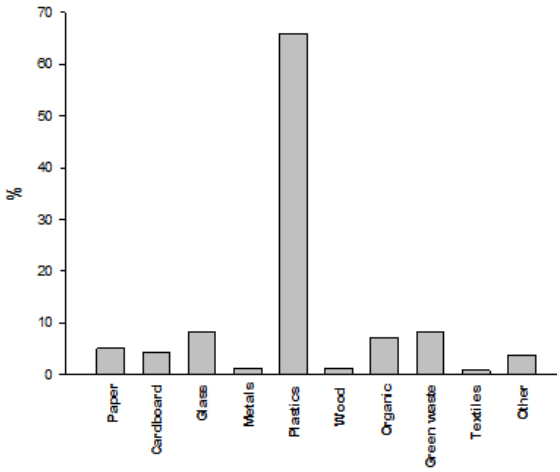

Fig. 6. Components of total waste generated (as average) in rural (B) area of Iasi county for 12 weeks experiment

collagen from leather waste might have agricultural applications [9]. The obtained collagen-synthetic polymer materials could represent a viable solution for biodegradability of plastic materials used in food packaging industry [10].

It is not well established if the waste bio-drying and thermal treatments represent the most effective removal processes from the point of view of environmental and financial analysis [11].

There are several and important interactions between the food, food additives and food packaging materials [12].

The packaging materials as reactive polyurethane adhesives might contaminate the packaged food in normal conditions by, isocyanates and carcinogenetic aromatic amines being found inside [13]. High quantities of mercury are released through the waste incineration (including the food packaging waste) [14].

There are some new data showing the reduction of waste (including food and food packaging waste) generation in the areas with a higher degree of wellbeing at working place and, consecutively, at home (personal observation, data not shown) [15].

New materials with antimicrobial properties were developed, starting from polyvinyl alcohol and benzoic acid [16].

The plastic manufacturing might benefit from the potential of plastics recycling processes. Many hazardous chemicals are contained by plastics as e.g. phthalates (DMP, DEP, DPP, DiBP, DBP, BBzP, DEHP, DCHP and DnOP). They are added in the later phases of production and might not be removed when recycling the household waste plastics [17].

The multilayer plastic films present a bunch of properties which are not possible for the monolayer ones. On the other side, the recyclability is a doubtful question and must be deeply researched. Thus, the more recent researches pointed out that the whey protein could successfully replace the petrochemical materials, non-recyclable, as a layer material, acting as a barrier against oxygen and moisture. Whey protein is degraded by specific enzymes, the coating film being easily removed from the plastic substrate layer [18].

Conclusions

There exists an average difference of 89 % between the food generation waste amounts in urban and rural case-study areas. This difference might not be real, since in rural area (B) the resulted food garbage might be used almost entirely in the households for feeding livestock and poultry, as well as the dogs and cats.

The same time, there exists also a huge difference of 75% between the food packaging generation waste amounts in urban and rural case-study areas. These differences might be related to the lower consume of packed and processed food in rural area. As a partial clear conclusion, in urban areas there are generated higher amounts of food waste and food packaging waste, at least in Romania and Iasi county.

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