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The Possibility of Food Consumption Improvement by Reducing Food Wastage in the Households in Poland

Abstract. The primary challenge of global food system is to provide food for nearly 800 million starving people and the next generations of constantly growing population. One of the solutions to this challenge is to reduce food wastage, which is especially high in the households of developed countries. Considering this fact, the analysis of a questionnaire study among WULS students determines their knowledge and awareness of food waste issues, and most often wasted food products. The study also tests the attitudes of respondents towards food waste and its consequences. Results showed that baker's good, fruit and vegetables were the most often wasted food while these products are recommended to consume in largest amounts. Respondents wrongly indicated that food service is the food chain sector with the highest food waste in Poland. The reduction of respondent's disposable income was recognized as the most important effect of food waste. In conclusion, it can be stated that the higher knowledge and awareness of food wastage issues can contribute to reduction of the scale of the problem and improvement of food consumption.

Key words: food wastage, food product, consumption, household

Introduction

Food wastage is a global issue with solely negative consequences. The effects of food wastage can be summed in the following three categories: environmental, economic and social/humanitarian. The third category concerns the perception of food wastage as a barrier for achieving the state of food security in starving regions of the world. A total of 795 million are estimated to be suffering from chronic hunger, regularly not getting enough food to conduct an active life in 2014-2016 (FAO et al., 2015). Over 2 billion people suffer from micronutrient deficiencies, in particular iron, vitamin A, iodine, folate and zinc, among others (CDC, 2015).

Professional literature mainly examines food wastage within the context of starvation and malnutrition in the global scale. Yet, there is still little evidence regarding the determinants of consumers' food waste behaviour in the households (Stancu et al., 2016). In developed countries the food waste generated at the household level represents about half of the total food wastage, making consumers the biggest contributor to food waste. The largest food waste concerns primarily bread/baked goods, fruit and vegetables (WRAP, 2009; European Commission DG ENV – Directorate C, 2011; Gustavsson et al., 2011). It should be added that the term food wastage covers food losses and food waste. Food losses

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occur in agricultural production, post-harvest and processing stages, while the term food waste refers to the end of the food supply chain: distribution and retail, restaurants and consumption in the households (Gustavsson et al., 2011).

Food waste in the final stage of food chain – that is in consumption at households – is much higher in developed regions and industrialised Asian countries than in developing regions. On average each European and North American consumer generates about 95-115 kg of food waste annually, whereas in least developed regions – sub-Saharan Africa and South and Southeast Asia, this number amounts to 6-11 kg (Gustavsson et al., 2011).

Table 1. Feasible food waste reasons in the household

Domestic food handling stages and consumer character traits	Reasons for food waste
Shopping	<ul style="list-style-type: none"> ▪ Shopping beyond need, impulsive and/or while hungry ▪ Unplanned, inconsiderate shopping ▪ Inability to buy less, lack of smaller packaging available ▪ Stockpiling ▪ Shopping disappointment (unsavoury from producers fault, partly spoilt – especially when buying in bulk)
Food storage	<ul style="list-style-type: none"> ▪ Inappropriate conditions ▪ Inability to use food stores ▪ Kept too long/forgotten ▪ Wrong packaging
Meal preparation	<ul style="list-style-type: none"> ▪ Preparing too much food ▪ Wrong processing of ingredients (pretreatment/thermal) ▪ Wrong cooking processes ▪ Failed recipes ▪ Insufficient cooking skills ▪ Lack of time for preparation of planned meals ▪ Lack of skills to manage surplus of products and meals
Meal consumption	<ul style="list-style-type: none"> ▪ Too large servings ▪ Leftovers ▪ Take away food (to work/school) not eaten
Knowledge and awareness	<ul style="list-style-type: none"> ▪ Unawareness of scale of food waste in own household ▪ Unawareness of money lost for wasted food ▪ Unawareness of the need to manage food efficiently ▪ Ignorance of other consequences of food wastage ▪ Lack of understanding and differentiation of 'best before' and 'use by' labels
Character traits	<ul style="list-style-type: none"> ▪ Attitudes: lack of respect for food, cultural standards ▪ Preferences: disposal of edible components of food ▪ Socio-economic aspects: smaller households and of younger people generate more waste and dispose more packaging

Source: own study.

According to European Commission report, EU member states annually waste 89 million tonnes of food, whereupon this estimate does not include food losses in food production and management in agriculture (European Commission DG ENV - Directorate

C, 2011). This equals to an average value of 179 kg per capita, with its largest shares attributed to the households – 76 kg per capita (42%), manufacturing – 70 kg (39%), food service/catering – 25 kg (14%) and retail/wholesale – 8 kg per capita (5%). The estimation made in the frame of European research project FUSIONS (Stenmarck et al., 2016) showed that total food waste in the EU-28 amounted to 88 million tonnes in 2012 (both edible and inedible parts associated with food). This equates to 173 kg per person and constitutes 20% of the total food production. FUSIONS calculation indicated that the share of food waste in the households is higher than it was stated in EC report and equals 53%. Moreover 60% of total food waste in the households is edible.

Costs of food waste accumulates in the whole food supply chain, however it is important to note, that one tonne of food wasted on the consumption stage is more expensive, for the economy as a whole, than one tonne wasted during agricultural production. Cost per tonne of edible food waste in primary production in the EU-28 was estimated at 399 Euro, in food processing – 1490, in wholesale and retail – 2768, in food service – 3148, and in the households – 3529 euro (Stenmarck et al., 2016). British study showed that the average value of food wasted by a household per year, amounts to 250 – 400 GBP (WRAP, 2009). This number is almost twice as high in US – 936 USD (Buzby & Hyman, 2012). In addition to that, household food waste contributes to further costs linked with its collecting, transporting, sorting and utilization (Priefer et al., 2013).

Household food waste generation on such a large scale is determined by a variety of factors which can be identified on all stages of domestic food handling, and also include character traits of consumers (Table 1).

Aim and methods

The purpose of this paper was to identify and recognize different aspects of food waste, including awareness of its consequences, types of food wasted and basic knowledge of the issue of selected group of consumers. The data were acquired using CAWI method (Computer Assisted Web Interview) and original Google Docs (<https://docs.google.com>) questionnaire as a research tool. The study was carried out between January and April 2015 and during this time 132 questionnaires were collected from the students aged 18-29 years of 18 fields of study at Warsaw University of Life Sciences (WULS – SGGW).

Among all respondents 82% were women. The same share lived in cities. Twenty five - 26% respondents lived each in 2, 3 and 4 person households, 9% lived in 1 person households and 13% in 5 and more person households. Monthly household income was classified in 6 groups. Exactly 58% of respondents chose the first three income ranges, while 42% declared the three latter. Almost all (95%) stated that their households waste food. From those, 57% acknowledged that they waste food at least once a week.

Awareness of food waste

The level of waste varies between respective links of food supply chain. According to 42% of respondents, most food waste should be attributed to catering services. One-third of the tested population indicated retail/wholesale and transport, and only 16% selected households as their answer (Table 2).

Table 2. Food supply chain links with highest food wastage in Poland in the opinion of respondents, %

Food chain link	% respondents
Agriculture	1,7
Food processing	6,7
Retail (shops, markets), wholesale, and transport	33,6
Food service	42,0
Households	16,0

Source: own study.

Those results entirely contrast with the outcomes of FUSIONS project (Stenmarck et al., 2016) and estimates of European Commission (European Commission DG ENV - Directorate C, 2011). According to EC estimation, food waste in Poland occurs primarily in the food processing sector (73% of total waste) and households (23% of waste).

Regarding possible actions that reduce food waste, the majority of respondents were of opinion that those should be implemented by consumers themselves (89%), then in catering services (79%) and in retail/wholesale (75%) (Fig. 1). Those results are consistent with responses presented in Table 1 (at least in terms of the actual stages not their percentage order). In the survey of Federation of Polish Food Banks [FPBŻ 2012] on random sample of Polish adults, the majority (57%) also indicated that households should be responsible for food waste. Next results were slightly different: retail (35%), food producers (34%), government/self-government (29%), NGO's (21%) and food service (15%). Remaining options were indicated by 4-7% of respondents.

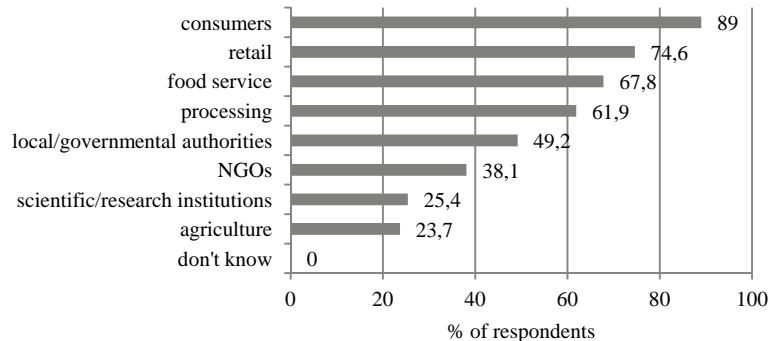


Fig. 1. Food supply chain links and its macro environment where, according to the survey respondents, actions reducing food waste should be undertaken, % of respondents

Source: own study.

The sphere of consumption, as a place where food waste reducing actions should be taken, was also the most popular survey choice in Canada – 74% (Parizeau et al., 2015) and Denmark – 59% (DA&FC, 2009). However, the multitude of determinants of food waste occurrence throughout the whole supply chain demands multidimensional solutions, implemented in parallel on micro, mezzo and macro levels. For instance: private investment in agriculture and crop management, good practices for businesses and consumers on micro level and financial

mechanisms, public investment, activities in the frame of Corporate Social Responsibility (CSR), indexation of food surplus and by-products on mezzo level, should be enabled, supported and reinforced by actions on the macro level (HLPE, 2014). Those solutions require a national scope and inclusion of food waste issues on relevant policy levels.

Wasted products and food handling stages critical in terms of food waste in the household

For a more complete portrait of food wastage, respondents were asked about all products types wasted in the month preceding the survey and top three most wasted products in their households. The percentage of declarations concerning last month's waste was higher than the percentage of total food wasted. This observation may suggest that the scale of total food waste is underestimated.

In both of those objectionable rankings first place was taken by bread/baked goods (around 60% of responses), second – vegetables (respectively 58 and 48%) and third – fruit (respectively 44 and 35%) (Fig. 2). Every third respondent indicated that last month he wasted already prepared meals (38%) and cold cuts or other meat products (34%). The same products, but in alternate order, were specified to be wasted most in general. Within the context of proposed consumption pattern change to a more sustainable one, it is worth noting that 10-30% of respondents declared wastage of milk, fermented milk-based beverages, cheese and meat. With reference to food of animal origin, the environmental consequences of food waste are especially severe and proliferated. This is due to the fact that life cycle stages of animal origin food include conversion of plant resources to animal ones, breeding time and more complex and material-consuming processing technologies, than their plant origin counterparts.

The obtained results are consistent with outcomes of Federation of Polish Food Banks studies, carried out on random samples of consumers (FPBŻ, 2012; 2013; 2014; 2015; 2016). Baked goods, vegetables, cold cuts, fruit and yogurts are in the forefront of those ranking. It is worth noting that both in 2013 and 2016, cold cuts were wasted most frequently. The cause of this declaration can be sought in incorrect storage of cold cuts in the final stages of food supply chain – that is: retail and households, as well as in low quality of parts of those products. Inspections of quality of food offered in the retail market show a large percentage of irregularities of meat products labelling, sensory characteristics and physical and chemical parameters triggered by errors occurring in production processes (for example: non-compliance with recipes, sub-standard base resources etc.) or by counterfeiting products (IJHAR-S, 2012; 2016).

In the survey of inhabitants of Warsaw and Olsztyn, the largest percentage of respondent also indicated baked goods (64%) as most wasted, followed by milk and milk-products (56%), fruit, vegetables and potatoes (Rejman & Wrońska, 2014). In a study of Swedish consumers (Williams et al., 2012) most instances of food wasted concerned prepared meals, vegetables, fruit and dairy products. Respondents from Germany and Italy most commonly discarded vegetables, fruit and baked goods (Jörissen et al., 2015). In Netherlands, surveys specified significant wastage of milk and milk-products, baked goods, vegetables, fruit, sauces and fats (Ministry of Economic Affairs, 2014). Finnish study showed that vegetables (including potatoes), prepared meals and dairy products are wasted substantially (Koivupuro, 2011).

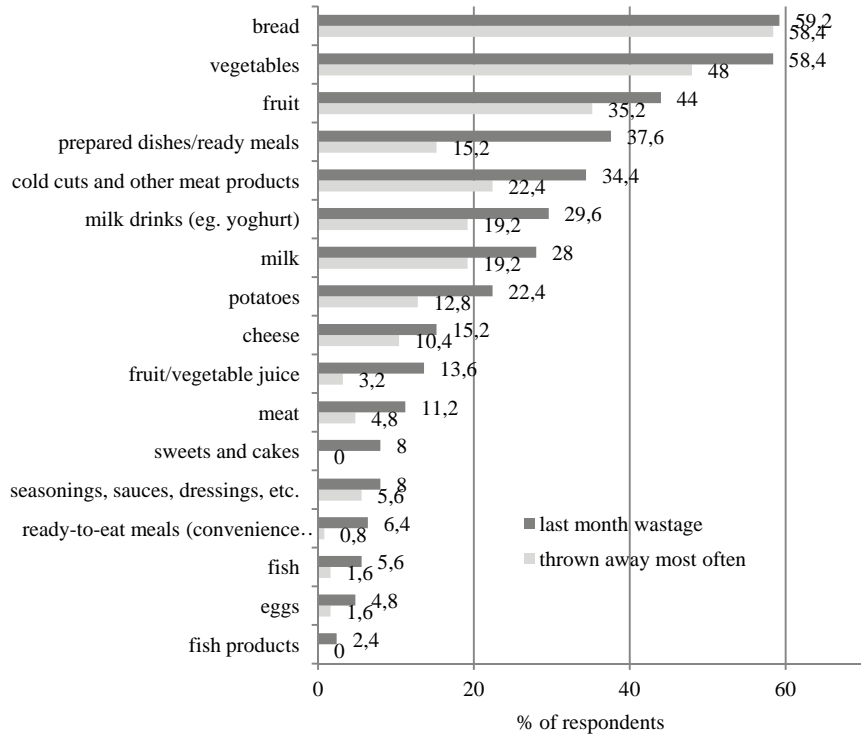


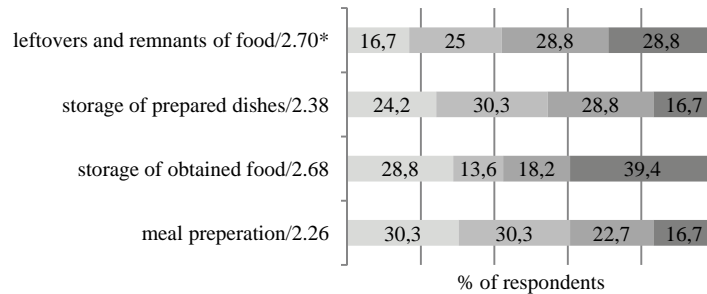
Fig. 2. Food products wasted/discarded last month (preceding the survey) and wasted most often presented in % of respondents

Source: own study.

It is worth to notice that food waste surveys commissioned by FPBŻ (2012; 2013; 2014; 2015; 2016) displayed much lower scope of the problem in comparison to the own study results. In subsequent studies of years 2012-2016, only 30 to 39% of respondents admitted that they waste food. It was observed that food is wasted more by employed people and big cities inhabitants.

The completed survey enabled to assess the distribution of food waste during food management stages in the household. Most respondents (almost 40%) ranked storage of acquired food as the stage of highest wastage. Nearly 30% indicated meal/plate leftovers and remnants of food, and last 17% showed prepared meal storage and meal preparation processes (Fig. 3).

Calculation of weighted means of respondents declarations, allowed to recognise, that in the opinion of total tested population, the most significant stage of food waste is in leftovers and remnants of food (mean = 2.70). In a study referenced above, households in Warsaw also declared leftovers and remnants as the largest share of food waste (Rejman & Wrońska, 2014). Reasons for selecting this stage may include difficulties in evaluation of household members' food needs and preparation of meals for future, in order to limit the time needed in kitchen.

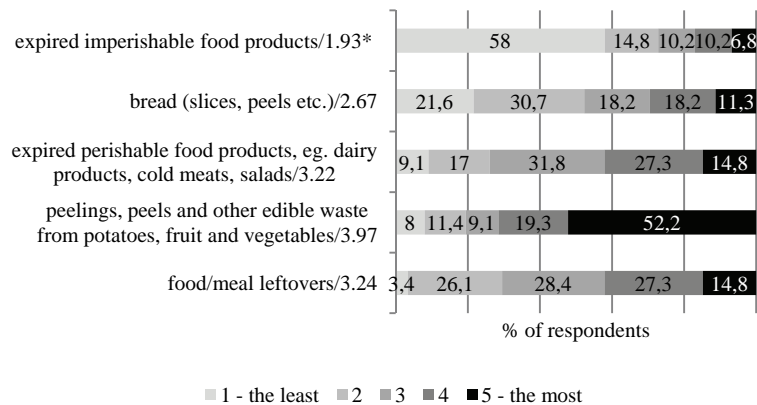


*weighted mean of declarations

Fig. 3. Assessment of food waste volume in respective stages of household food management, % of respondents and weighted means

Source: own study.

Food wastage in a household can also be evaluated by examining the content of household waste containers. More than half of respondents declared that majority of their waste bins contained peelings, peels, rinds, and other potentially edible elements of potatoes, fruit and vegetables (Fig. 4). Remaining categories of food waste in waste containers as the highest ones were selected by only 7-15% or respondents. As a result, the first category – peelings and other edible elements – obtained the highest weighted mean of 3.97 of a total population. Meals leftovers in waste bins were the second, with 15% of respondents declaring its highest share in the amount of wasted food and a mean of 3.24.



*weighted mean of declarations

Fig. 4. Visual assessment of particular food waste categories in waste containers, on 5 point ascending scale, where 1 – the least, 5 – the most, % of respondents and weighted means

Source: own study.

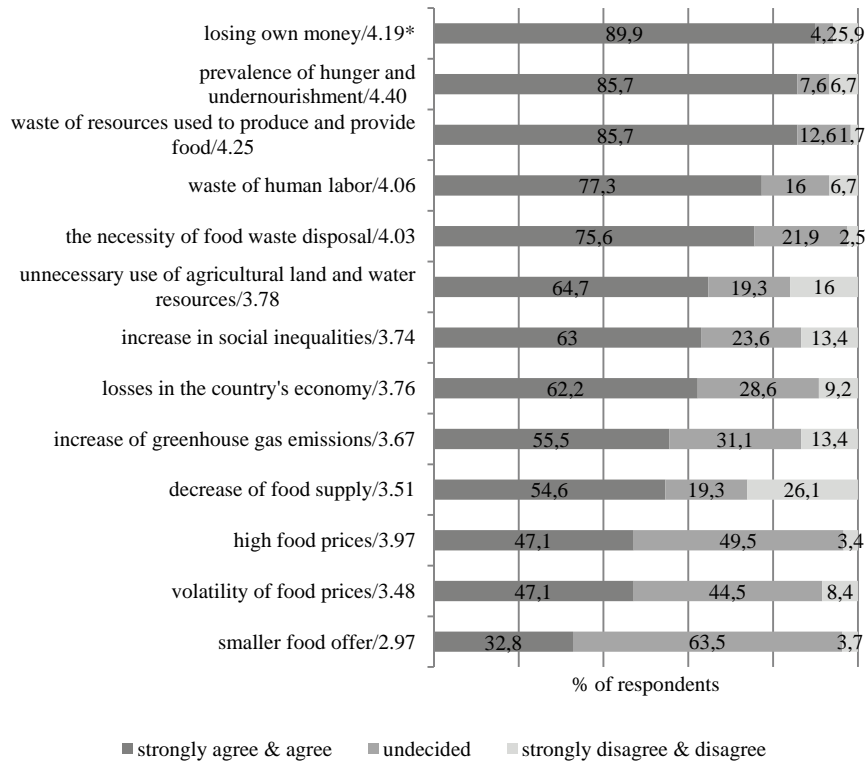
Taking into account this data, and previous indications (Fig. 3), it seems that British distinction between avoidable, possibly avoidable and unavoidable food waste is justifiable (WRAP, 2009). Food leftovers constitute the majority of food waste in many European countries, for example in Austria (Schneider, 2008), Finland (Silvennoinen et al., 2012) and Netherlands (van Westerhoven & Steenhuisen, 2010).

Expired non-perishable food products in waste containers was the least popular choice in the survey (with average rank of 1.93). This can signify a rational food management behaviour or knowledge about expiry date labelling systems. Vast majority of respondents (90%) correctly assigned 'best before' and 'use by' labels to categories of respectively lasting and perishable products. Lasting products such as flour, groats, canned vegetables, coffee etc. can usually still be consumed beyond their 'best before' date. After this date, the product quality may become less, however without any increased risk regarding food safety, if the conditions mentioned on the label have been regarded (Bartels et al., 2010). So this term does not mean that the product is unsafe automatically. Currently on the EU forum is a discussion on the issue of non-discrimination of 'best before' and 'use by' labels by consumers, as the cause of food waste – especially with regards to wasted food with past 'best before' date. The ongoing discussion also concerns on whether such food can be freely redistributed to most deprived persons through NGOs, eg. food banks.

Assessment of food waste consequences

The need to limit food waste on global, regional and national scale, results from solely negative consequences of this issue on the environment, global population and economies. That is why in the next part of the survey respondent attitudes towards 13 listed consequences of food waste were identified by using 5-points Likert scale. Consequences were ranked on the basis of weighted means with the following rank ranges and assessment categories: 1.0-1.5 unimportant, >1.5-2.5 rather unimportant, >2.5-3.5 medium importance, >3.5-4.5 rather important, and >4.5-5.0 very important.

Majority of respondents rank the consequences of food waste by a perspective of their own disposable budget (total 90% of agree and strongly agree responses) (Fig. 5).



*weighted mean, with assumption: 5 – strongly agree, 4 – agree, 3 – undecided, 2 – disagree, 1 – strongly disagree

Fig. 5. Consequences of food waste according to respondents in 5-point Likert scale (% of respondents), and weighted means listed after each consequence

Source: own study.

Slightly less (86%) believed that food waste causes hunger/undernourishment and needless waste of resources used to produce and provide food. Next three consequences were also of economic nature: waste of human labour, necessity of food waste disposal and unnecessary use of agricultural land and water resources (77, 76 and 65%, respectively). Respondents were, therefore, aware of economic consequences of food waste. Even so, only 56% of respondents understood that economic wastage is directly correlated to environmental consequences in form of greenhouse gases emissions. Least respondents viewed the consequences of food waste in decrease of food supply and market offer of food, and in high and volatile food prices. Based on values of weighted means, one can also deduce that respondents valued no consequence to be very important, 10 to be important and 3 to be of medium importance. It is also interesting to note that weighted means scores had different importance order than percentage based scores. Most important consequence was the prevalence of hunger and undernourishment (with mean of 4.4), and disposable budget considerations fell to the third position (with mean of 4.19).

Survey results of categories of most undesirable food wastage consequences serve as confirmation of abovementioned ranking. According to over a half of respondents (52.1%), social/humanitarian consequences are most undesirable. Almost a quarter ranked economic and environmental consequences (23.5 and 22.7%, respectively). Respondents from Canada were of similar opinion – they viewed food waste as primarily a social issue (83%), followed by economic (72%) and environmental (68%) (Parizeau et al., 2015). This, in all probability, can be linked with favourable geo-environmental condition of Canada, and attentiveness towards environmental issues. On the other hand, British respondents considered food waste as primarily a negative environmental issue (70%) (WRAP, 2013).

Conclusions

Questionnaire survey conducted on a population of students from different fields of study at WULS demonstrates that $\frac{3}{4}$ wrongly regard food service and retail as the main food chain sectors where food waste is the largest. Only 16% recognised that the principal guilty party are consumers in households. Even so, the majority (almost 90%) was of opinion that consumers in households should undertake actions that limit food waste. Respondents stated that largest food waste in their households occurs during storage and in form of meal/plate leftovers and remnants of food. Second declaration was confirmed by observation of contents of waste bins. Respondents' households mainly waste: baked goods, vegetables, fruit, cold cuts and milk based beverages. Baked goods, fruit and vegetables are wasted most frequently according to many surveys and studies from different organisations, countries and regions. This signifies, that consumers waste most valuable food. Those products should be consumed in largest amounts, due to their dietary and pro-health properties. In the new Healthy Nutrition and Physical Activity Pyramid for the Polish population fruit and vegetables form its basis, as they should be consumed most frequently and in most quantity (IŻŻ, 2016). Baked goods are on the second stage of the pyramid, with whole grain products being recommended most. Those three categories of food are also featured as the foundation of food consumption patterns in dietary guidelines of majority of other countries. Meanwhile the consumption of fruit and vegetables is in general too low, especially with respect to daily intake recommendations. That is why WHO population dietary goals (WHO & FAO, 2003), which advises pro-healthy structure of dietary energy supply and amounts of intake of nutrients being recognised as risk factors of diet-related chronic diseases, list among them fruit and vegetables as a solely food product category. Recommended daily goal for fruit and vegetables is at least 400 g for adult.

Therefore, respondents waste those products, which are essential for prevention or for treatment of diet-related diseases, including overweight and obesity, type II diabetes and different types of tumours. In Great Britain, it is estimated that British consumers waste 22% of fibre, 18% of carbohydrates, 17% of proteins, and 16% of energy included in purchased and then wasted food (DEFRA, 2010).

Own study also indicated that almost all respondents are aware that food waste equates to financial losses. According to authors' estimation using data from EU (European Commission DG ENV – Directorate C, 2011) and GUS (Central Statistical Office of Poland) (GUS, 2016) Polish consumers in households annually lose on average 185 PLN on wasted food. In households of employees in non-manual labour positions, the cost of

wasted food equals to 223 PLN. This means that 4-person household loses about 740 – 890 PLN annually.

Results of study display that limiting food waste in households can impact the improvement of food consumption and nutritional value of the diet. For this reason, widespread propagating of food waste issues and using all means necessary to promote the reduction of food waste shall be very much advocated.

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