

Possibilities of Increasing Resource Efficiency by Optimal Management of Solid Biodegradable Waste from Food and Beverage Production Industry

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In recent years, major focus has been placed on management of biodegradable waste (BDW) throughout the world and in the European Union. Food and Beverage Production Industry is the largest economic sector in the world employing the greatest number of people, processing large quantities of raw materials and the amount of waste makes up to 50% of processed raw materials. The European Union (EU) food industry sector providing vast population with food holds 12.2% of the market and is the second largest industry sector.

Based on Eurostat data in EU member states approx. 2.5 billion tons of waste is generated annually. In 2012, 46.1 million of non-hazardous waste generated within the food, beverage and tobacco production industry and approx. 69% of them are BDW. The majority of this waste, for about 85 % is solid waste. Remaining BDW flows include animal excrements, industrial sewage sludge, the sludge and liquid waste comprised during the disposal of the waste, common sludge (Eurostat, 2016).

As food products become waste, the energy, water and other natural resources used for growing/raising, processing and supply of food products are lost together with and decay of waste from food results in emissions of methane, carbon dioxide, sulphur hydrogen, mercaptans and other compounds, which pollute water, soil and atmosphere. It has been estimated that 2.4 t of CO_{2-eq} are emitted to the environment due to each tonne of BDW generated in food and beverage industry. For the afore-mentioned reasons, major attention is drawn to BDW from analysed industry in scientific literature.

One of the main problems in the food and beverage production industry sector is that BDW generated in technological processes is still commonly considered and managed as waste despite its nutritional value and suitability for production of other products. Residues of plant and animal origin consist of non-compliant raw materials or products and animal parts not suitable for food production. The first step towards sustainable development of food industry sector should be changing of attitude to BDW. The afore-mentioned problems should be solved by BDW prevention and/or secondary use methods applying the principles of Cleaner Production and Resource Efficiency (Kliopova et al, 2013, Aguedo et al, 2012, Staniškis et al, 2009, Bhaskar et al, 2007). The conducted laboratory tests of the characteristics of BDW reasonably allow proposing that a major part of non-compliant raw materials and non-compliant products are suitable for recycling to other food products or food additives which, *inter alia*, generally constitute raw materials for the very food industry and the remaining part and other BDW flows are suitable for production of other non-food products maintaining the nutrient content and/or energy potential of such residues (Dhillon et al, 2013, Kaur et al, 2012, Dhillon et al, 2011, Aristoy & Toldrá, 2011, García-Llatas et al, 2011, Honikel, 2011, Djilas et al, 2009, Gullon et al, 2008, Mohdaly et al, 2010, Nawirska & Kwaśniewska, 2005, Stabnikova et al, 2005, etc.).

This paper presents (1) the results of the most recent scientific researches in the area of BDW prevention, and use of nutrient value and energy potential of BDW of food industry; (2) the suggested integrated BDW management system for food and beverage production companies, made on the principles of the Environmental Systems' Theory; (3) the criteria which should be taken into consideration, when choosing the way of using the potential of BDW; (4) the results of feasibility analysis implemented innovations the application of which allows minimizing BDW volume and using the nutrient value of BDW generating in technological processes:

- Case Study 1: optimization of malt storage in the beer production company (waste prevention) (Jurovickaja & Ragot, 2015);
- Case Study 2: use of low nutritional value residues of animal origin suitable for food generating in the slaughter-house of an enterprise producing meat products (Grigaliūnaitė & Kliopova, 2015):
 - for production of new added value products;
 - production of energy.