

VALORISATION OF BY-PRODUCTS FROM FOOD INDUSTRY, MEANS OF EFFECTIVELY PROTECTING THE ENVIRONMENT

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Abstract

This paper aims to show scientifically the existing correlation between recovery of by-products and waste obtained from processing raw materials from food industry and other food producing sectors (tourism industry, catering, households) and environmental protection.

There are presented scientifically altering substances and degradation that may result from unprocessed sub-products and waste from food processing (putrescein, cadaverine, agmatine, phenilamina, tyramine, histamine, phenol, skatol, mercaptan, ammonia, hydrogen sulfide and others), most of them being toxic, with a smell stench, rejects that can pollute the environment. It has been also highlighted the role of support of waste and by-products for outbreaks of infection, the host of pests, parasites, pathogens, viruses and bacteria that can cause food poisoning and there are identified types of recovery of by-products for food and technical purposes. For waste recovery there are specified the main recovery directions: obtaining technical biogas and alcohol, which are used as fuel. Romanian and EU legal framework governing these areas is considered appropriate, but its application is deficient. Solutions and conclusions are presented.

Keywords: food, by-product, waste, environment

1. INTRODUCTION

By-products from processing raw materials for food production are in quite large and considerable quantities and they are very varied in terms of chemical composition. This latter point is particularly important because depending on their chemical composition, if these products are not processed, through depreciation and impairment (Popescu N. [1]) can be particularly dangerous source of environmental pollution. Due to this issue, the superior recovery of by-products is a concern of the foreign scientists (Keith Waldron, [2], [3], Lawrence K. Wang et al, [4], Herbert W. Ockerman, etc. [5], etc.) and romanian scientist (ICPE Bucharest - Draft VESPIL, [6], PNCDI2 - Program 4 - Area 5, the "Clean techniques in the production and recovery of by-products of food industry" and "Advanced Research on the use of cereals and waste grain to obtain bio-ethanol and bio-methanol used as alternative resources "[7], Institute of Food Bioresources Bucharest-target" Clean technologies"[8], etc.) and the European Union (Framework Directive 2005 / 0281 (COD), Directive 1999/31/EC,

Directive 2001/77/EC, etc.), aimed to propose measures to avoid environment pollution.

The objective of this work is to highlight the correlation between recovery of by-products and waste from food industry and environmental protection and to provide directions and solutions for this recovery.

2. THE RECOVERY OF BY-PRODUCTS IN FOOD INDUSTRY

2.1. The main by-products in food industry

To demonstrate the scientific necessity of higher recovery of by-products as a direct factor of environment protection, we will analyze which are the main by-products in various fields of food processing. In the table below are grouped by sector of activity by-products from several production sectors (Cojocaru C, etc. [9], Stanescu V, etc. [10], Ciobanu D, etc., [11], Herbert W. Ockerman, [5]):

Table 1. By-products from food industry

Processing sector	By-product name
<u>Meat industry:</u> 1. Slaughterhouses 2. Factory for prepared products, for cans and other products (dishes, pre-packaged products etc.)	- blood, flesh and organs seized - waste grease from the cleaning of leather, from cleaning the carcasses, empty stomachs - raw guts - hair, hooves, nails, horns - waste of primary processing (cutting, cooking - smoking) - manufacturing scrap - products out of warranty period;
<u>Milk industry</u>	- whey, buttermilk - manufacturing scrap - products out of warranty period
<u>Fermentation industry (beer, wine, alcohol)</u>	- waste of cereals, grapes, grape-marc, corner malt, hops, molasses - beer and wine yeast - carbon dioxide
<u>Vegetable oil industry</u>	- sunflower husks - dregs (of crude oil) - grits - the deodorizing waste - scrap and products out of warranty
<u>Sugar industry</u>	- leaves, stems, parcels, grain beet - molasses; - scrap and products out of warranty;
<u>Vegetable cans industry</u>	- waste from primary processing (sorting, cleaning, washing etc.) and manufacturing (skin, seed house, stones etc.) - degraded oil from frying - manufacturing scrap - products out of warranty period
<u>Milling bakery and pasta products industry</u>	- waste grist (gap, cockle, white powder, sleet), bakery and pasta (scrap) - corn germ - scrap - products altered or out of warranty

Analyzing the data presented in the table forward it can be seen the variety and large number of products resulting from processing raw materials, available in the food industry. Quantitative they have an important share in

food production, ranging from product to product. For example, in slaughterhouses they represent about 50% of total body weight in bovine (yields vary around 50%), pigs 30% of the total weight of living weight, fish about 12% of total material processed, in sugar beet about 65% by weight, the peas about 20% of the total weight of processed weight, potatoes about 25% of the total, the tomato 30% of the total, between 20 and 35% from other vegetables (cabbage, cauliflower, eggplant, carrots, parsley, celery, parsnips etc.), sunflower husks about 25%, dregs about 1% of total crude oil produced, oil degraded as 15 liters per tonne of product fried, etc.. (Cojocaru C., et al, [9]).

We can appreciate that overall about 40% (Cojocaru C., et al, [9]) of all processed raw materials is resulting in by-products, so that the level of food waste in 2002 represented about 1.2 million tonnes (National Waste Management Strategy [12]), which should be a signal of first importance for their recovery.

It should also be considered very large quantities of products (including waste) resulting from processing raw materials of animal and vegetable origins in different sectors of the units in the hotel industry, catering (restaurants, confectioneries, pastries, fast food establishments, butcher's shops, etc.), canteen, unit sales of domestic trade as well as from households.

The great diversity of sources of potentially polluting by-products and their production sources cause from the start the need for efforts conjugation in order to achieve their recovery and thus eliminate the hazards of environmental pollution.

2.2. By-products, potential factors of environmental pollution

Analyzing the chemical composition and biological value of by-products obtained, it can easily find that they are composed of organic substances and minerals, mostly, with a very high and high potential of degradation and deterioration, some of them constitute very suitable mediums for development of altered

micro-organisms, pathogens germs or microorganisms that cause food poisoning (*Cl.botulinum*, *Escherichia coli*, *Salmonella*, *Staphylococcus aureus*, etc.), particularly hazardous to human health. It is the case of by-products of animal origin, such as blood or meat, which are by their nature culture medium for microorganisms, and the dairy industry by-products, which are extremely favorable for the development of microorganisms, but also other products of vegetal origin with high water content and high microbial load, which degrades and alters slightly, forming toxic substances with unpleasant odor, fetid. For example, in alterations of meat and its derivatives, in the first phase it occurs an aerobic decay which are produced amines without toxic potential but with an unpleasant smell like putresceina, cadaverine and agmatina and then anaerobic bacteria develop enzymes that are decarboxylating amino acids (especially those cyclic) and form toxic products: fenilamine, tyramine, histamine, etc. In the final phase is produced consistently ammonia (an indicator of freshness) and the process of deterioration is ending with the presence of decomposition products with stench, rejection, rotting, phenol, skatol, mercaptans and hydrogen sulfide (Popescu N, S. A., [1]).

By-products of vegetable origin are consisting of plant tissue containing carbohydrates, particularly polysaccharides (starch, cellulose, hemicellulose), which can ferment in the initial phase and then can alter decaying under the action of pathogens (fungi, molds, bacteria, viruses, etc.), forming toxic substances with unpleasant smell.

It has also to be mentioned that in general such an organic waste is environmentally friendly in terms of biological development and infestation by insect pests or rodents, which in turn are carriers of germs.

It is obvious the existence of a direct link between the presence of by-products and waste, their use and environmental protection (Berit Mattsson [13], Martin R. Okos [14], Janet M. Dalzell [15]).

Overall, in light of the direction of destination for by-products, if not properly treated and recovered, they can be sources of pollution of soil, water and air.

Legal framework in the field

In the European Community operates the **EC Regulation 178/2002** known as the "General food law", which is partially implemented in Romania as **Law 150/2004**, subsequently revised and amended, and establishes general principles and obligations to be fulfilled by food processing operators. On this basis it issued a series of such regulations:

- **RCE 852/2004** transposed in Romania by **GD 924/2005**;
- **RCE 853/2004** transposed in Romania by **GD 954/2005**;
- **RCE 854/2004** transposed in Romania by **GD 955/2005**;
- **R 882/2004** transposed in Romania by **GD 925/2005**;
- **D 2004/41**, **D Framework 2005/0281 (COD)** regarding waste; **D 1999/31/EC** regarding waste storage, **D 2001/77/EC** regarding energy production from renewable sources, etc.
- **O.U.G. no. 195/2005** regarding environmental protection, as amended by **Law 265/2006**.

Waste problem in our country is governed by GD 924/2005, Annex No. 2 to the general rules: Chapter VI Food waste, paragraph 3.

The concern of the European Union, Romania being part of it, to implement an integrated quality-environment management system shows how important the environment is in order to obtain quality food products, respecting in the same time the strict environmental protection. This is the reason for the setting up in the same period of international standards ISO 14000 series for environmental management community system and of standards ISO 9000 series for quality management.

2.4. Forms of recovery of by-products of food industry

In any analysis of recovery of by-products, the first problem that arises is the chemical composition of by-products obtained, according to which may be establish forms of exploitation, their destinations and the means of preservation to be used before, during and after processing by-products.

A second very important aspect is the need for higher recovery of by-products, because so many of them contain valuable nutrients or components of great utility, poor for other economic sectors. Finally, the effectiveness of the work is given also by the amount of available by-products, which determines the productivity of production and hence the price obtained.

From the beginning it should be noted that production units with low production capacity or even those having average production capacity, can experience difficulties from the start regarding the effective use of by-products obtained as a result of low productivity potential of the proposed processing lines. Therefore in these situations is the question of establishing collection centers for certain by-products resulting from various processing units and determined how to collect, transport, storage and preserve throughout all these phases.

Valorization of by-products (Keith Waldron [2], [3], Berit Mattsson [13], Lawrence K. Wang, [4], Herbert W. Ockerman [5], Michael L Westendorf [16] C. Cojocaru, [9], Stanescu V, etc. [10], Ciobanu D, et al, [11], Banu C., et al, [17]) is performed on several areas where the decisive role is represented by the composition of by-products, the quantities of by-products and finished products demand in the market. Forms of recovery by the amount of their use are mainly the following:

- ◆ **To obtain pharmaceutical products** (derived from blood and endocrine glands, gut, dairy foods, vitaminizate products, alcohol, etc.)
- ◆ **To obtain food or the fortified food derived edible** (dairy product, meat, blood food, bread yeast, enzyme products, food oil, casein and other protein derivatives, etc.)

- ◆ **To obtain technical products** with different uses (albumin, glue and charcoal blood, bone glue and charcoal, gelatin, dyes, soaps and cosmetics, brushes, paint, crafts, glycerin, chemicals, autolysates yeast, fuel liquid, gaseous or patent, CO₂, etc.);
- ◆ **To obtain feed** (foots, bran, chaff, fodder blood meal, meat, bones, dried fodder, concentrates, silage, feed whey, molasses, etc.)
- ◆ **Destroyed by ignition**, justified by veterinary medical indications for by-products carrying potential germs.

Research shows that unless the forms of recovery in food edible products, in feed and in certain technical products (listed above), the main directions of use of such organic waste bound for the manufacture of methane gas (Păsculete E., 18, Popovici A. , 19) and alcohol (Banu C., 17), which can then be used as fuel.

2.5. Criteria to be met for the effective use of by-products and indirectly protect the environment

Valorization of by-products with maximum efficiency is based on compliance with minimum criteria such as:

- ◆ Compliance with legislation (veterinary standards for production of food of animal origin, Romanian and European rules on hygiene in food industry, approved production technologies, international standards, Romanian and business, implementation of HACCP system, environmental legislation);
- ◆ Establishing forms of collection, storage and preservation of by-products from storage, during manufacture and storage of finished products;
- ◆ Establishment of manufacturing technology;
- ◆ Preparing and training of staff;
- ◆ Obtaining the operation approval.

From the documentary work made and practical experience gained through consultancy activities, it can be said that there is a comprehensive legislative framework on the

operation of food establishments and environmental protection, but in fact, there are recorded many instances of non-compliance (ANSVA statistics, OPC and the media), which causes environmental pollution.

3. CONCLUSIONS:

- All food production units must provide, from the setup and to the launch of new type of products, legal forms of recovery of by-products obtained from manufacturing, which does not pollute the environment;
- There is necessary the cooperation of all decision makers, at all levels, who have skills or are involved in food production and environmental protection, to address the recovery of by-products from this sector and from households;
- Regarding the recovery of by-products resulted from production, manufacturers must put in the forefront eliminating these sources of pollution and then economic efficiency of these activities;
- Environmental agencies and specialists in this field should be more deeply involved in finding forms to eliminate sources of environmental pollution and not just control inspections and sanctions.

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