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Pomace in fruit industry and their contemporary potential application

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ABSTRACT

Food economy plays a major role in world development. A food chain, from an economic point of view, means a long series of interdependent management processes, which have the main goal to providing food to people. It consists of many elements like food production, harvesting, processing, storage, and trade. Fruit processing in Poland is a significant part of the Polish economy. During fruit processing for consumption, by-products are also produced, the largest portion of which is pomace. As pomace is a part of fruit, it has big health beefits and application potential. Pomace could be successfully converted into edible products. At the moment fruit pomace is used as in food stock for animals, or thrown away, which can cause environmental pollution and minimises potential. Fruit pomace is a big potential source of energy biomass for the production of biogas and bioethanol. This paper reviews the literature on the possibility of using selected fruit pomace in industry.

***Keywords*:** pomace; production residues; biofuels; economy in the fruit industry

1. INTRODUCTION

Poland is a significant fruit producer on a global scale. In the European Union, we are one of the biggest producers of apple, chokeberry, raspberry, currant and blueberry.

The most important fruit processing division is the production of juice concentrate (mainly from apple), nectar and drink. During fruit processing, the juice industry leaves between 25% and 35% mass of the raw material the by-product called fruit pomace [14]. The pomace is characterized by a high content of health protective compounds like: vitamins, minerals, crude fibre or polyphenols. Therefore, it is a valuable source of the compounds in a daily human diet. Unfortunately, some part of pomace in the fruit industry still goes to landfill, and causes environmental pollution. This paper shows different kinds of fruit pomace applications in food and energy industry.

2. POMACE – APPLICATION IN THE FOOD INDUSTRY

Fruit pomace is a by-product of pressing raw fruits for juice. The high moisture of pomace means that, in the area of potential storage of the by-product, there is a high risk of development of undesired micro-organisms. But by immediately drying the product after juice pressing (by maintaining the production chain) the potential risk can be reduced, whilst extending the shelf life of the pomace. The long shelf life is important in seasonal production for fruits processors. Dried pomace, as a by-product, is a very cheap intermediate product, which reduces the costs of food production in order to make them. Recycling the pomace also decreases the amounts of waste, which translates into direct cost savings in factory.

Produced during expeller pressing fruit waste have more health-protective ingredients than ready products (drink, juice, nectar), which are often diluted, clarification or fixation. Despite the fact that fruit pomace dries out in high temperature does not incur the degradation of its health-protective ingredients [8].

Consumers more often follow (besides price and taste of food) the health-promoting properties. Increasing such properties by adding dried fruit pomace and increasing the diversity of availability is desirable for consumers. For example, fresh apple pomace is composed of about 70% water, 16% carbohydrates, 7% cellulose, 5% protein [19], and many valuable polyphenols with antioxidant properties [6].

At the moment, the main way of making use of apple pomace is as a feed ingredient, after drying or pickling [19]. Apple pomace is a rich source of fibre, which is a very important component of our diets. Dietary fibre functions as an energy-intake controller, reducing the risk of developing obesity, and can prevent many diseases, which further increases the flexible application of apple pomace. Apple pomace contains 80% of fibre (/dm) and is a better source of the ingredient than wheat or oat bran [9]. Also contained in apple pomace, pectin is an important component of the human diet [23]. It can be used as supplement for increasing the moisture in: cake, muffins, buns, or bread, and can improve the properties of storage and health [25].

Apple pomace is also a rich source of antioxidants, and particular polyphenols, which are able to scavenge free radicals, and can participate in unwanted side reactions resulting in cell damage [1]. Unfortunately, apple processing has been shown to result in marked losses of 90% polyphenols. Only 5% of apple polyphenols are present in the juices people drink [15].

Pic. 1. Dried apple pomace: whole and ground (source: own image)

In the meat industry, the addition of the extract from apple pomace reduces the amount of synthetic antioxidants needing to be added, and increases the health-promoting properties of the finished product [10,11]. In light of the high content of hexose (glucose, fructose), fruit pomace is a good raw material for the fermentation industry. Many alcoholic drinks, such as beer, wine, cider could be produced based on fruit pomace including apple pomace [22]. Using *Acetobacter* bacteria can initiate the production of vinegar, which is also made by mixing the extract from apple pomace with molasses [5].

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3. BIOFUEL PRODUCTION FROM POMACE

The increase in energy price translates to an increase in production costs in the agro-food industry, therefore it is necessary to reduce energy losses through the application of energy efficient technology, or using cheaper energy carriers. In the food industry, sustainable energy can be produced from a variety of biomasses including waste, which can be great raw material for biogass and liquid biofuels production [2].

Apple pomace can be used as a valuable raw material in ethanoic fermentation. Potential amounts of obtainable bioethanol depend mainly on the concertation of fermentable saccharide present in biomass. Therefore, researchers try to increase the amount of useable fermentation sugars by using yeast *Trichoderma sp.* and *Aspergillus sp.* The yeast produces celluloses, which can hydrolysis the lignocellulosic material in apple pomace and forces a higher rate of ethanol production. The conversion of glucose and fructose to ethanol by the yeast is carried out in anaerobic conditions [26].

Biomass obtained from agricultural waste and unused materials consists partly of pentose (xylose, arabinose), but most yeast does not have enzymes allowing to hydrolysis and use as carbon source from pentose. But further research could solve the problem by modifying the yeast [20]. One of the methods is the application of the microorganisms able to use pentose within fermentation (e.g. *Pichia stipitis*, *Hansenula polymorpha*), or to increase fermentation efficiency and tolerance for high alcohol concentration [18,20]. A second way is improving the *Saccharomyces cerevisiae* yeast, which has high alcohol toleration, but could not carry out fermentation on arabinose and xylose [24]. Thus, obtained bioethanol could be used as replacement of liquid fossil fuel and bioethanol I generation [27].

It is estimated that from three tons of grapes used for wine production one ton of pomace is created, which is a big amount. In Poland, 100 million tons of wine is produced annually. Five metric tons of the grape pomace produced annually is from one acre grape

plantation, which is excellent raw material for biogas production. The amount of methane in the biogas depends on the type of wine production technology, because the white grape pomace does not contain alcohol, but red grape pomace does [12]. Fermentation of grape pomace is stable and is characterised by high biogas and methane yield. Biogas from grape pomace is from 70% [13], through 75-79% [12], over 82% of which is methane [4]. Apple pomace gives a high yield of biogas and bioethanol production [7]. It was also demonstrated that olive and apple pomace are good cosubstrate in fermentation of cow slime (excrement) [16]. Production residues from the food industry are characterised by low concentration of heavy metals and are good raw material for biogas production [3].

4. CONCLUSIONS

The utilization of agro-industrial residues is important for the reduction of environmental pollution. Most of the food industry by-product is disposed of in open areas. Therefore, it is necessary to look for processes that allow the controlled elimination of this residue and find new commercial applications. Fruit pomace is considered as a potential food ingredient due to dietary fibre content, and many other health-promoting ingredients. Because pomace is rich in sugar-containing materials, it could be a raw material for biogas and bioethanol production, which will reduce the environmental pollution. But still more research is necessary.

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