



PLANT BY-PRODUCTS REGULATIONS

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ABSTRACT

The food industry produces large quantities of by-products that may contain high-value compounds. Special attention is on by-products of plant origin due to their potential as a source of bioactive compounds, dietary fibers, fatty acids, proteins, etc. Pepper by-products are potentially interesting in this matter, due to the pepper great variety and numerous species grown in different regions worldwide, and consequently the products thereof. Utilization of pepper by-products generated during industrial processing has potential for new product development. However, processing of by-products into new ingredient or product and/or their application in a new products improving their functional or culinary value, addressing certain challenges on one side, but also pose an opportunity to promote a circular economy and sustainability to the consumers on the other side.

It is important to have a good understanding of the plant by-products regulations alongside the whole food chain, both in terms of food safety, as well as in clear communication on product labels and informing consumers about the nature and benefits of this type of food.

The aim of this paper is to provide an overview of the legislation and conditions that need to be met before placing on the market of an innovative pepper by-products.

Keywords: by-products, food regulation, pepper, circular economy, sustainability

INTRODUCTION

The food and agricultural industry produce annually large quantities of waste around the world, causing a serious problem of disposal. Research of by-products has gained weight in the scientific community and industry in recent years (Socaci et al., 2017). The European Commission adopted the new circular economy action plan (CEAP) in March 2020, that targets the whole life cycle of products: from how products are designed, processed to sustainable consumption in order to prevent waste losses and kept resources. Consumer demands for healthier food products have increased in recent years, and the food industry is trying to respond to this challenge (Ben-Othman et al., 2020). By-products from the processing of raw vegetables usually contain significant amounts of bioactive and nutritional compounds such as proteins, dietary fiber, polysaccharides, fatty acids, aromatic compounds and phytochemicals (e.g. polyphenols) which can be extracted, purified, concentrated and used as functional ingredients in the food industry or other related sectors (De Camargo et al, 2018). They are often richer sources of bioactive compounds compared to their original raw material (Socaci et al., 2017). Like many fruits and plants, peppers are an excellent food source, it has an abundance of minerals, vitamins, amino acids, carotenoids, phenolic compounds or polyunsaturated fatty acids, antioxidants, carotenoids (Echave et al., 2020). The oil content in peppers seeds is above 20%. In recent years, numerous studies have been conducted to better highlight the healing benefits of red pepper seeds. They are recognized for their antimicrobial, anticarcinogenic and antioxidant effects (Chouaibi et al., 2019). Phenolic acids and flavonoids are the main phenolic phytochemicals found in peppers. Phenolic compounds have positive effect on health and are currently in focus of nutritionist and pharmacological research (Table 1). Pepper seed has a high percentage of dietary fiber and is a good source of protein and oil. Red pepper seed oils are rich in polyunsaturated fatty acids, especially linoleic acids (Cvetković et al., 2020). The aim of this paper is to provide information of the conditions that need to be met before the-peppers by-products are placed on the market, and an overview of the legislation that have to be consider and apply.

Table 1: Bioactive and nutritional components found in significant amounts in paprika seed oil and flour and their impact on human health

	Impact on human health	References
Linoleic acid	It is essential in the diet because it is incorporated into cell membranes and participates in the synthesis of compounds responsible for regulating blood pressure. They are also considered beneficial for health because of their ability to reduce total cholesterol and body fat.	Cvetković et al., 2020
Oleic acid	It affects the reduction of systolic blood pressure, reduction of serum LDL cholesterol, reduces the risk of developing type 2 diabetes, obesity.	Karacor and Cam, 2015
Vitamin E	Due to the antioxidant properties of vitamin E, it acts in fight against various diseases such as atherosclerosis, oxidation stress, cancer. This vitamin has been found to be effective against asthma, allergies and diabetes.	Rizvi et al, 2015
Phenolic compounds/ Phenolic acids	Phenolic compounds can act as antioxidants, anticarcinogens, cardiopreventives, as antimicrobials, antiviral agents. They have a number of beneficial effects on health, including cancer prevention, cardiovascular diseases, diabetes, neurogenerative diseases, can have an anti-inflammatory effect.	Shahidi et al., 2019 Bento-Silva et al., 2020
Carotenoids	Strong antioxidants, when introduced, protect the human body against harmful effects of free radicals, i.e. substances that destroy or damage cell membranes and thereby reduce the risk of several chronic diseases (cardiovascular diseases, diabetes and cancer). β -carotene is a precursor of vitamin A, an important component in the maintenance of skin health.	Socaci et al., 2017
Fibers	Increasing the amount of fibre-rich food improves serum lipoprotein levels, lowers blood pressure, improves blood glucose control in diabetics, helps with the weight loss. People who consume abundant amounts of dietary fibres, compared to those with minimal fibre intake, are at lower risk of developing stroke, hypertension, diabetes, obesity and certain gastrointestinal diseases.	Anderson et al., 2020
Protein	Plant proteins affect cholesterol lowering, and can potentially modulate gut microbiota.	Busnelli et al., 2018

Table 2: EU Regulation which have been consider and applied by placing on the market plant by-products

	Regulation	Features of Regulation
Food safety regulation	Regulation (EC) 178/2002 laying down the general principles and requirements of food law	- provides the basis for the assurance of a high level of protection of human health and consumers' interest in relation to food, taking into account in particular the diversity in the supply of food including traditional products, - lays down the general principles governing food and feed in general, and food and feed safety in particular, at Community and national level. - shall apply to all stages of production, processing and distribution of food and feed
	Regulation EC 396/2005 on maximum residue levels of pesticides in or on food	- the need to ensure a high level of consumer protection and harmonised Community provisions relating to maximum levels of pesticide residues in or on food and feed of plant and animal origin
	Regulation (EC) 1881/2006 setting maximum levels for certain contaminants in foodstuffs	- lays down the maximum levels of contaminants in food
	Regulation (EC) 2073/2005 on microbiological criteria for foodstuffs	- lays down the microbiological criteria for certain micro-organisms and the implementing rules to be complied with by food business operators
Food quality regulation	Regulation (EC) 1169/2011 on the provision of food information to consumers	- provides the basis for the assurance of a high level of consumer protection in relation to food information - establishes the general principles, requirements and responsibilities governing food information, and in particular food labelling - shall apply to food business operators at all stages of the food chain, where their activities concern the provision of food information to consumers
	Regulation (EC) 1924/2006 on nutrition and health claims made on foods; Regulation (EU) No 432/2012 establishing a list of permitted health claims made on foods, other than those referring to the reduction of disease risk and to children's development and health	- health claim - means any claim that states, suggests or implies that a relationship exists between a food category, a food or one of its constituents and health; - nutrition claim - means any claim which states, suggests or implies that a food has particular beneficial nutritional properties due to: the energy (caloric value) it provides, provides at a reduced or increased rate, or does not provide; and/or the nutrients or other substances it contains, contains in reduced or increased proportions, or does not contain; - reduction of disease risk claim - means any health claim that states, suggests or implies that the consumption of a food category, a food or one of its constituents significantly reduces a risk factor in the development of a human disease

LEGISLATIVE ENVIRONMENT

Functional or bioactive compounds are not regulated at European level as such. However, any type of bioactive compound included in food may fall under one or more regulations. Aware of the importance of safety aspects, the food industry must adhere to different legal requirements worldwide. The European regulatory framework considers that functional foods must comply with general food law and all relevant food safety regulation (Vettorazzi, 2020) (Table 2). Health claims about food should be scientifically supported and correctly interpreted. Regulation EC 1924/2006 on nutrition and health claims made on foods aims to ensure that claims are reliable and do not mislead consumers. Furthermore, their purpose is to encourage innovation to produce healthier food products. Health claims offer functional food companies the opportunity to differentiate their products in markets, adding value to their products, thus strengthening the competitive position of their products (Moors, 2012). Based on the literature data on bioactive components and nutrients found in significant quantities in pepper seed products (oil, flour), in Table 3 are listed the approved health claims that can be applied to this type of products. Claims for carotenoids and polyphenolic components have not been found (Table 3).

Table 3: Authorized health claims for components found in pepper seed products

Nutrient, substance, food or food category	Claim	Conditions of use of the claim
α -linolenic acid and linoleic acid	Essential fatty acids are needed for normal growth and development of children	Information to the consumer that the beneficial effect is obtained with a daily intake of 2 g of α -linolenic acid (ALA) and a daily intake of 10 g of linoleic acid (LA).
Alpha-linolenic acid (ALA)	ALA contributes to the maintenance of normal blood cholesterol levels	The claim may be used only for food which is at least a source of ALA as referred to in the claim SOURCE OF OMEGA-3 FATTY ACIDS as listed in the Annex to Regulation (EC) No 1924/2006. Information shall be given to the consumer that the beneficial effect is obtained with a daily intake of 2 g of ALA.
Linoleic acid	Linoleic acid contributes to the maintenance of normal blood cholesterol levels	The claim may be used only for a food which provides at least 1.5 g of linoleic acid (LA) per 100 g and per 100 kcal. Information shall be given to the consumer that the beneficial effect is obtained with a daily intake of 10 g of LA.
Foods with a low or reduced content of saturated fatty acids	Reducing consumption of saturated fat contributes to the maintenance of normal blood cholesterol levels	The claim may be used only for food which is at least low in saturated fatty acids, as referred to in the claim LOW SATURATED FAT or reduced in saturated fatty acids as referred to in the claim REDUCED [NAME OF NUTRIENT] as listed in the Annex to Regulation (EC) No 1924/2006.
Foods with a low or reduced content of sodium	Reducing consumption of sodium contributes to the maintenance of normal blood pressure	The claim may be used only for food which is at least low in sodium/salt as referred to in the claim LOW SODIUM/SALT or reduced in sodium/salt as referred to in the claim REDUCED [NAME OF NUTRIENT] as listed in the Annex to Regulation (EC) No 1924/2006.
Monounsaturated and/or polyunsaturated fatty acids	Replacing saturated fats with unsaturated fats in the diet contributes to the maintenance of normal blood cholesterol levels [MUFA and PUFA are unsaturated fats]	The claim may be used only for food which is high in unsaturated fatty acids, as referred to in the claim HIGH UNSATURATED FAT as listed in the Annex to Regulation (EC) No 1924/2006.
Oleic acid	Replacing saturated fats in the diet with unsaturated fats contributes to the maintenance of normal blood cholesterol levels. Oleic acid is an unsaturated fat.	The claim may be used only for food which is high in unsaturated fatty acids, as referred to in the claim HIGH UNSATURATED FAT as listed in the Annex to Regulation (EC) No 1924/2006.
Vitamin E	Vitamin E contributes to the protection of cells from oxidative stress	The claim may be used only for food which is at least a source of vitamin E as referred to in the claim SOURCE OF [NAME OF VITAMIN/S] AND/OR [NAME OF MINERAL/S] as listed in the Annex to Regulation (EC) No 1924/2006.
Protein	Protein contributes to a growth in muscle mass	The claim may be used only for food which is at least a source of protein as referred to in the claim SOURCE OF PROTEIN as listed in the Annex to Regulation (EC) No 1924/2006
Protein	Protein contributes to the maintenance of muscle mass	The claim may be used only for food which is at least a source of protein as referred to in the claim SOURCE OF PROTEIN as listed in the Annex to Regulation (EC) No 1924/2006.
Protein	Protein contributes to the maintenance of normal bones	The claim may be used only for food which is at least a source of protein as referred to in the claim SOURCE OF PROTEIN as listed in the Annex to Regulation (EC) No 1924/2006.
Non-digestible carbohydrates	Consumption of foods/drinks containing <name of all used non-digestible carbohydrates> instead of sugars induces a lower blood glucose rise after their consumption compared to sugar-containing foods/drinks.	In order to bear the claim, sugars should be replaced in foods or drinks by non-digestible carbohydrates, which are carbohydrates neither digested nor absorbed in the small intestine, so that foods or drinks contain reduced amounts of sugars by at least the amount referred to in the claim REDUCED [NAME OF NUTRIENT] as listed in the Annex to Regulation (EC) No 1924/2006.
Non-fermentable carbohydrates	Consumption of foods/drinks containing <name of all used non-fermentable carbohydrates> instead of fermentable carbohydrates contributes to the maintenance of tooth mineralisation.	In order to bear the claim, fermentable carbohydrates (1**) should be replaced in foods or drinks by non-fermentable carbohydrates (2***) in such amounts that consumption of such foods or drinks does not lower plaque pH below 5,7 during and up to 30 minutes after consumption. (1**) Fermentable carbohydrates are defined as carbohydrates or carbohydrate mixtures as consumed in foods or beverages that lower plaque pH below 5,7, as determined in vivo or in situ by plaque pH telemetry tests, by bacterial fermentation during and up to 30 minutes after consumption. (2***) Non-fermentable carbohydrates are defined as carbohydrates or carbohydrate mixtures as consumed in foods or beverages that do not lower plaque pH, as determined in vivo or in situ by plaque pH telemetry tests, below a conservative value of 5,7 by bacterial fermentation during and up to 30 minutes after consumption.

Source: Regulation (EU) No 432/2012

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