

Food Processing Technologies on Food Alkaloids and Food Allergens: Bioactive and Toxicological Aspects

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Abstract

In this proceeding, innovative food processing effects on some food alkaloids and food allergenic have been dealed. Alkaloids show widely diversified matrix and origins as well as pharmacological and/or nutra-ceutical action which often indicate a marked physiological action. Some proteins or protein fragments are resistant to digestion and those that are not broken down in the digestive process are tagged by the Immunoglobulin E (IgE); so these called as allergenics. These tags trick the immune system into thinking that the protein is harmful. Current researches stated that High Pressure Processing (HPP) have been optimised the unwanted concentrations regarding mentioned compounds in some foods. Further studies are needed for eliminating on unwanted alkaloid compounds and some advanced allergenic proteins in various food matrices.

Key words: Food Alkaloids, Food Allergens, HHP, High Pressure

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Introduction

Alkaloids are a class of naturally occurring chemical compounds that mostly contain biologically important amine structures and include some related compounds in plants and animal foods. Alkaloids show greatly diverse matrix and origins as well as pharmacological and/or nutraceutical action that often demonstrate a marked physiological action. The only thing that unites all these natural compounds under the term 'alkaloids' (alkali-like) is the nitrogen atom that is present in all of them. They are known to be adrenergics, antibiotics, poisons, stimulants, diuretics, astringents, antiinflammatory, antihypertensives, antimydratics, analgesics, antigitout, expectorant, emetic, antispasmodic and many others. Food alkaloids can be take part in chemistry, food industrial applications, food supplement and medical drug forti fier. Chemical alkaloid taxonomy in plants and animal foods, originating from protein and aminoacids like this xanthine alkaloids, phenolic based alkaloids, originating from plant cell cultures, pseudoalkaloids, ergot alkaloids and tropane alkaloids in plants and cereals, glycoalkaloids in potatoes, their properties, nutraceutical and pharmaceutical effects. (Tokusoglu, 2019.)

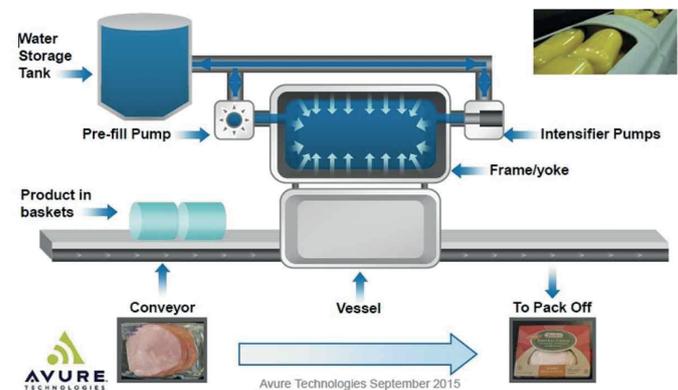
Food allergy is a reaction of the body's immune system to a particular food or beverage; it is a very specific reaction involving the immune system of the body. In this context, distinguishing food allergy from other food sensitivities is the most significant. There are generally several types of allergens in each food, and it is known that allergens are generally proteins. Some consumers are genetically predisposed and their immune system is not able to differentiate the food protein from the virus or bacteria, thereby attacks occur. Severe allergic reactions to foods are usually rapid, emerging within an hour or sometimes even seconds of consumption, also in some situations, they may be post-poned and appear up to 4 h after consuming. (Tokusoglu, 2019.)

Specific foods are responsible for the majority of food allergies, even though any food can stimulate an immune response in allergic individuals. It is known that peanuts are the leading cause of severe allergic reactions, followed by shellfish, fish, tree nuts, and eggs. Peanuts, tree nuts including almonds, brazil nuts, cashews, hazel- nuts (filberts), macadamia nuts, pecans, pine nuts (pignolias), pistachio nuts, walnuts, sesame seeds, milk, eggs, fish including shellfish and crustaceans, soy, gluten, fava beans, garlic and onion, mustard are some of the most known allergic foods. (Tokusoglu, 2019; Tokusoglu and Bozoglu, 2015)

High Hydrostatic Processing (HHP) processing improved the reducing of glycoalkaloids and some methyloxanthine caffeine and allergenic structure of some foods. Recently, limited studies have been performed on HHP effects. (Tokusoglu, 2019.)

Hydrostatic Pressure Processing (HHP) Effects on Alkaloids and Allergens

High-pressure (HP) processing treatments are novel-processing techniques that have the potential to alleviate the need for thermal processing of foods. High-pressure (400–700 MPa) processing is combined with temperatures around room temperature (5–40°C). It is stated that treatments offer an alternative to high-temperature pasteurization, or chemical preservation and fresh-like properties of foods are preserved. This is stated as cold pasteurisation for extending the shelf life and guarantee the food safety of the product by inactivating microorganisms, (Tokusoglu, 2019.)



Regarding Food Alkaloids and HHP

It has been carried out methylxanthine alkaloids including caffeine, theobromine and theophylline in most consumed non-alcoholic beverages such as tea, coffee, cocoa majorly and chocolate and herbal teas as less. Alkaloids are usually derivatives of aminoacids, many have a bitter taste and are found as secondary metabolites in plants (including potatoes glycoalkaloids as solanine, solanidine and their derivatives and tomato glycoalkaloids as tomatine). (Tokusoglu, 2019.)

In the study of Tsikrika et.al.(2019), potatoes of different cultivars were packaged in polyethylene/polyamide pouches and then vacuum sealed. HPP treatment was performed at 600 MPa (6000 bar) for 3 min. at 10.6 °C (max. temperature reached) on commercial-scale high pressure press (Hiperbaric 55HT, Doral, FL, USA) housed at HPP Tolling (St. Margarets, Co. Dublin, Ireland). Tsikrika et.al.(2019) found that Steroidal alkaloids (glycoalkaloids) was nitrogenous secondary metabolites in potatoes and other members of the Solanaceae family. The main glycoalkaloids in

potatoes was α -chaconine and α -solanine, constituting from approximately $1 \pm 0.2 \mu\text{g/g}$ – $16.5 \pm 1.5 \mu\text{g/g}$ and $1.5 \pm 0.1 \mu\text{g/g}$ – $18 \pm 1.7 \mu\text{g/g}$, respectively. However, HPP did not have a statistically significant effect on the glycoalkaloid content of the studied potato samples, i.e. within the same cultivar. (Tsikrika et.al.,2019)

Regarding Allergens and HHP

Meat (Beef) Allergens By HHP

Meat is an important food due to its high nutritional value and functional properties. However, meat allergy is considered to be a scarce pathological problem, and the current reports have demonstrated that meat allergy can be a serious problem, particularly in children. It is reported that bovine serum albumin (BSA) and bovine gamma globulin (BGG) are the major beef allergens. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

The HP processing is considered to be a useful food-processing technique and such a treatment affects the protein structures resulting in alterations in the food characteristics. Recently the high pressure effects on the antigenicity of beef extracts BSA (beef allergen) and ovomucoid (chicken egg white allergen) were reported; it was concluded that the structural changes in the allergens induced by pressure may lead to the reduction or eliminating of antigenicity. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

It is stated that the effects of a HP treatment (100–600 MPa/5–7 °C/5 min) on the IgE-specific binding activity and structural changes to bovine gamma globulin (BGG), a beef allergen, were investigated and then the allergenicity of pressure-treated BGG was evaluated. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

Hazelnut Allergens By HHP

Hazelnut is an edible nut with health benefits. It is reported that hazelnut is as a causative agent of allergic reactions. It is shown that allergies to hazelnuts, tend to be of a more severe nature, causing life-threatening and sometimes fatal reactions. Indeed, symptoms upon hazelnut ingestion are often confined to the mouth and throat, but are severe systemically. Type I food allergy is defined as an IgE-mediated response to a protein (or proteins) in a food source. It was indicated that post-translational modifications (PTMs) like phosphorylation and glycosylation can play a relevant role in allergenicity related to edible nuts including hazelnuts. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

It was concluded that a severe reduction *in vitro* in allergenicity to hazelnut after AC processing was observed in the allergic clinic patients studied. The specific-IgE binding of some of the described immunoreactive hazelnut protein bands: Cora 1 ~18 KDa, Cora 8 ~9 KDa, Cora 9 ~35–40 KDa and Cora 11 ~47–48 KDa decreases (López et al., 2012). It was also stated that a relevant glycosylation was assigned and visualized via structural analysis of proteins (3D modeling) for the first time in the protein-allergen Cora 11 showing a new role that could open a door for allergenicity-unravellings. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

Egg Protein Allergens By HHP

It is known that egg proteins are responsible for one of the most common forms of food allergy, especially in children, and one of the major allergens is ovalbumin (OVA). It was examined the potential of high pressure to enhance the enzymatic hydrolysis of OVA and modify its immunoreactivity, hence the protein was proteolyzed with pepsin under HP conditions (400 MPa). It was stated that some fragments identified in the hydrolysates including Leu124-Phe134, Ile178-Ala187, Leu242-Leu252, Gly251-Ile259, Lys322-Gly343, Phe358-Phe366, and Phe378-Pro385 carried previously identified IgE-binding epitopes due to some of the peptides found, such as Phe358-Phe366, probably contain only one binding site for IgE. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

Peanut Protein Allergens By HHP

It was examined the effects of HP/temperature treatment and pulsed electric field treatment on native peanut Ara h 2, 6 and apple Mal d 3 and Mal d 1b prepared by heterologous expression. It was stated that alterations in secondary structure and the aggregation state of treated proteins were characterized by circular dichroism spectroscopy and gel-filtration chromatography. It was concluded that HP/ temperature at 20°C did not change the structure of the Ara h 2, 6 or Mal d 3 and resulted in only minor changes in structure of Mal d 1b. Ara h 2, 6 was stable to HPP at 80°C, whereas changes in circular dichroism spectra were observed for both apple allergens. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

Milk Protein Allergens By HHP

It was stated that cow's milk protein allergy (CMPA) was the most prevalent allergy for infants or young children, with an incidence of about 2% to 7.5% in population-based studies in different countries. It was reported that β -lactoglobulin (β -

LG), α -lactalbumin (α -LA), and caseins are the main allergens in cow's milk; other proteins, such as bovine serum albumin (BSA) and even lactoferrin (present in trace amounts) are also potential allergens. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

It was reported that HP treatment (100–300 MPa) enhanced dairy whey protein hydrolysis and reduced the residual antigenicity of the hydrolysates, depending upon the choice of enzymes including trypsin, chymotrypsin, and pepsin. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

Apple and Celeriac Tissue Protein Allergens By HHP

It is known that apple is one of the most common allergenic foods in Europe and contains two predominant allergens, Mal d1 and Mal d3. Apple Mal d3 is a non-specific lipid transfer protein, a member of the prolamin structural family and is a problematic allergen in Southern European populations. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

It was shown that HP processing at 600 MPa at 20°C significantly reduced the polyclonal reactivity of Api g1. It was reported that *in vivo* studies involving food challenges in celeriac allergic patients have shown that the Api g1 as PR 10 allergen in celeriac was very much reduced in its allergenicity by thermal processing (110°C/15 min) (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

Rice Protein Allergens By HHP

Rice is a cereal grain belonging to the family of *Gramineae* and it is known that cereals such as wheat, barley, rye, oats, maize, and rice are reported to elicit allergic reactions. Rice is the main and most important food taken every day in Eastern Asia. The prevalence of IgE-mediated rice allergy is about 10% in atopic subjects in Japan, whereas the frequency of rice allergic reactions is much lower in Europe and in the US. It was stated that the 16-kDa rice allergen, RA17, belonging to the alpha-amylase/trypsin inhibitor family was isolated from rice seed and structurally characterized by identifying cystine-containing peptides and predicting the secondary structure and hydrophobic regions. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

It is known that rice allergy is more prominent in adults than in children, and the symptoms associated with rice allergy are atopic dermatitis, eczema, or asthma, and also anaphylactic reactions for severe cases. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

It was reported that polished rice grains were immersed in distilled water and pressurized at 100–400 MPa, so a considerable amount of proteins (0.2–0.5 mg per gram of grains) were released. The released proteins were identified as 16 kDa albumin, alpha-globulin, and 33 kDa globulin, which were known as major rice allergens after sodium dodecyl sulfate-polyacrylamide gel electrophoresis and immunoblot analyses. (Tokusoglu, 2019;Tokusoglu and Bozoglu, 2015)

As a result, it is shown that no positive data on HHP processing effects on food alkaloids but also there are various applications on food allergenic reducing by HHP. Further studies are needed for eliminating on unwanted alkaloid compounds and some advanced allergenic proteins in various food matrices.

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