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Mini Review

Isolated Fluid Treatments have an Effect on the Structural and Functional Characteristics of the Legume Proteome

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Abstract

Few researches, to our knowledge, have used cold plasma to enhance the soybean protein's functional qualities and extraction yield. This investigation was evaluated using two distinct sample geometries (whole and ground beans), two distinct plasma chemistry modes (ozone and nitrogen oxides [NOx = NO + NO2]), and a unique pressure swing reactor. I was. Plasma treatment in the NOx mode had a significant impact on ground soybeans. The best results were obtained from pressed soybeans treated with plasma in the NOx mode, with a protein extraction yield that rose from 31.64% in the control to 37.90% following plasma treatment. The plasma-treated soybean's capacity to bind water (205.50%) and absorb oil (267.67%) increased to 190.88% and 246.23% of the control, respectively. In comparison to the control, emulsification activity and stability marginally increased. Surface hydrophobicity and secondary structure are changed. In comparison to plasma-treated whole beans and untreated bean fields, remote plasma treatment of ground soybeans enhanced the yield of soy protein extraction and changed the structural and physicochemical characteristics of soy protein.

Keywords: Air discharge, Ozone, Nitrogen oxides, Soybean

INTRODUCTION

Soybean (Glycine max L.) is a popular plant product used in human and animal nutrition due to its high protein (approximately 40%) and oil (18-22%) content. Soy protein is used in various forms in animal and human foods, including wheat flour, protein concentrates and isolates, the three subunits of soybean β-conglycinin have very flexible conformations in the quaternary structure **(Abe A et al., 2012)**. However, the compact quaternary structure of glycinin is generally stabilized by electrostatic and hydrophobic interactions and disulfide bonds, resulting in less molecular flexibility and relatively poor emulsifying properties. Therefore, the wide applicability of soy protein in food formulations allows physical and chemical modifications to improve functional properties such as emulsion and dynamic surface properties **(Abinaya ML et al., 2019)**.

Soy protein has been the dominant vegetable proteins in the market for several years.Isolates from soybean meal (soy flakes or wheat flour) were prepared by alkaline extraction of soy protein. However, most dietary protein remains unextractable by this method **(Afolayan G, 2019)**. Many physical modifications such as extrusion, sonication, microwave and high pressure treatment have been applied to soy flour to improve protein extraction yield. The use of soy protein as an alternative protein source requires further research to develop new environmentally friendly techniques that can improve functional protein properties while increasing protein extraction yields **(Anderson SN et al., 2019)**.

Cold plasma (CP) processing is a new technology in non-heated food processing. As the gas is partially ionized by the discharge, the CP consists of electrons, ions, neutrons and free radicals that are not in thermal equilibrium. Therefore, it is suitable for analysis of heat-sensitive substances. CP exhibits bactericidal, fungicidal and virucidal activity due to the abundant production of reactive species, especially at atmospheric pressure. CP-treated water, a mixture of plasma-derived reactive oxygen and nitrogen species, has been actively used to improve the applicability of CP in certain food and agriculture sectors. Depending on the plasma properties, CP-treated water shows significant differences in the density of reactive oxygen and reactive nitrogen species, pH, redox potential, and electrical conductivity, which can significantly affect seed germination and plant growth. In particular, in order to use CP for industrial development of protein materials, it is essential to have research results that consider the following various factors. B. Sample geometry and CP conditions. However, to our knowledge, few experiments have attempted to use CP to improve protein extraction yield and functional properties in soybean **(Austin RS et al., 2011)**.

The objectives of this study were to (1) evaluate the effect of CP treatment conditions on soy protein extraction yield and (2) examine the effects of CP treatment conditions on the functional properties of soy protein **(Avni R et al., 2017)**.

RESULTS AND DISCUSSION

Ozone and NO2 concentrations in the pressure-swing reactor

Absolute number densities of ozone (O3) and nitrogen oxides (NO2) in a pressure swing reactor (PS) are shown in O3 and NOx modes, respectively. For each species, the black scatterplot shows the characteristics of round beans, and the red scatterplot shows the characteristics of crushed beans. In particular, NO and NO2 were undetectable in the PS reactor in O3 mode, whereas O3 was not observed in nitrogen oxides (NOx) mode. NO was mainly produced in the NOx mode plasma reactor, but was not detected in the PS reactor **(Baumann K, 2020)**. This means that NO was completely oxidized to NO2 during the transport and pressurization process. Time variations of O3 and NO2 in the PS reactor were consistent with the gas pressure data. During a pressurization time of about 300 s, the O3 and NO + NO2 concentrations in each PS reactor equal those in the plasma reactor, reached. cm–3, or the PS process in the system, likely enabled rapid and uniform reaction of high concentrations of O3 and NO2 with the sample **(Bukowski R, 2018)**.

Considering that the surface area of the ground beans is much larger than the surface area of the whole bean, the chemical species should adsorb more strongly to the ground beans. Here, the number densities of O 3 and NO 2 were lower in the ground beans than in the whole beans, clearly demonstrating increased adsorption of the reactive species to the ground beans. Moreover, the time-averaged number density of O3 in both types of soybean decreased during the second pressurization cycle. In NOx mode, the time-averaged number density of NO2 molecules remained nearly constant regardless of the number of cycles **(Benin S et al., 2003)**.

Functional properties

Physical treatments such as ultrasound, induced cavitation, and microstreaming break particles into smaller particles. This increases cell swelling and hydration, releasing proteins into the extraction solvent. However, to our knowledge, no studies have yet been published on improving soy protein extraction yield under CP conditions. The protein extractability from soybeans using CP was 31.64%, which was the protein extractability of the untreated sample (total) and increased using CP. Crush-NOx showed the highest protein extraction rate of 37.90%. Showed that polyphenol concentrations in tangerine peel increased after exposure to 900 W microwave nitrogen plasma for 10 minutes. We emphasized the important role of CP in promoting galactomannan extraction, including generation of reactive species in the extraction solution and modification of the seed surface. Microstructure. Therefore, the extraction efficiency of functional components depends on various factors such as: B. Sample conditions, extraction solvent, and type of radicals during CP processing.

It affects taste, texture and product yield. It is also important in the production of products such as donuts, pancakes, baked goods, desserts, confectionery, beverages, meat extenders and meat substitutes. OAC measured in CP-exposed soy protein was significantly higher than in unexposed controls. Similar to WBC, crush-NOx showed the highest OAC among all treatments. Most of the changes in OAC were attributed to protein modifications during CP treatment, revealing surface and structural modifications of protein and fiber matrices compared to starch molecules. This indicates the exposure of the non-polar groups of the protein and the increased surface hydrophobicity of the flour particles. This is similar to the results that CP increased leukocyte and OAC levels depending on CP treatment time and protein composition.

Proteins and lipids commonly interact in different food systems, giving proteins a very high emulsion-forming capacity. However, plant proteins are mainly globular proteins with low emulsifying power due to their large molecular size, which limits their flexibility for rapid adsorption at the oil-water interface. Protein by CP treatment The emulsifying activity and emulsifying stability of soy protein tended to increase slightly with higher CP, and pulverized NOx showed the highest values. This increase during CP treatment is due to the increase in surface hydrophobicity caused by the exposure of hydrophobic groups of protein molecules.

In this study, the plasma treatment was tailored to food crops and the plasma source was separated from the sample to maintain constant productivity of reactive species and plasma properties while the sample was remotely processed in the PS reactor. . A PS reactor equipped with a rotary pump (Uno6; Pfeiffer Vacuum, Asslar, Germany) was connected to the plasma reactor via a 1 m polytetrafluoroethylene tube and needle. In particular, the remote treatment differed by the dominant chemical O3 or NOx in the plasma reactor at the beginning of the first pressurization period of the PS reactor. In addition, the bean samples were differentiated according to whether they were whole or ground. In the following the experiments are referred to as O 3 or NO x treated whole beans and milled beans. First, he placed a 90 mm diameter Pyrex Petri dish containing 60 g of beans into the PS reactor. Then, with the needle valve fully closed, the pump was activated to reduce the gas pressure in the PS reactor from 760 torr to 0.08 torr. The PS reactor was gradually pressurized by closing the valve and partially opening the needle valve. During the pressurization phase, gas flow between the two reactors transferred high concentrations of reactive species from the plasma reactor to the PS reactor containing the sample. After treatment (pressurization), he evacuated the PS reactor again for 2.5 minutes with the needle valve closed. Gas pressure in the PS reactor was recorded with a manometer (626A; MKS Instruments, Andover, MA, USA and TPR280; Pfeiffer Vacuum).

CONCLUSION

Through remote plasma treatment, soybeans may serve as a valuable source of protein material. We found that NOx treatment of compacted soybeans improved protein extraction yields compared to CP-treated or untreated whole soybean kernels and also improved functional properties by inducing structural changes. Our results suggest that applying NOx treatment to ground soybeans is an efficient way to treat soybeans prior to their use in industrial applications.

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