



## Functional and stability profile changes of soy proteins cross linked with dextran through natural Maillard reaction

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**Introduction:** Proteins play a fundamental role in biological systems and are often sensitive against organic solvents, heat and other damaging factors. Proteins are the basic component of food formulations and enhancement the functional characteristics and stability of the proteins has always been the main goal of food industry engineers. One of the natural ways used for protein modifications is Maillard reaction. Maillard reaction as a result of covalent binding between the available amino groups of the proteins and carbonyl containing moiety of the polysaccharides, causes a loss in free amino group content of the mixture. Protein- polysaccharide hybrids, as a result of dry heating of two biopolymers mixture under controlled reaction conditions, cause the emergence of conjugates with novel functionalities. Much research has shown that conjugation can increase thermal stability and functional characteristics of food proteins and also reduce the allergenicity of suspected proteins. Although many studies have been conducted on the effects of conjugation on functional properties of proteins, the impacts of conjugation on proteins behavior after food processing have been less investigated. So, in this paper the influences of Maillard reaction on functional properties of soy proteins have been investigated. In addition, characteristics of conjugated proteins after pasteurization treatment was also studied.

**Materials and methods:** Construction of protein- polysaccharide conjugates was done in several steps. First, soy proteins and dextran were mixed with phosphate buffer (0.1 M, pH: 8.5) and 1 to 4 ratio of protein to polysaccharide. After mixing and incubating at ambient temperature for some hours, solutions were frozen at -80 °C and freeze dried. Then the lyophilized powder was incubated at different times, at 60°C, under the 79 percent relative humidity in presence of saturated KBr. For each treatment a non conjugated sample was prepared in the exact same condition. Conjugation of proteins to polysaccharides was monitored by SDS-PAGE electrophoresis, browning intensity measurement and UV absorbance analysis. SDS-PAGE was conducted according to Laemmli procedure using a discontinuous buffer system. A vertical gel electrophoresis unit was used with 3% acrylamide stacking gel and 10% acrylamide running gel. Evaluation of the color changes as an indicator of grafting intensity was investigated by monitoring absorption at a wavelength of 420 nm. To investigate the UV absorption of conjugated proteins, the samples were diluted with SDS (Sodium dodecyl sulfate) solution and the absorption was read by a UV-visible spectrophotometer at 294 nm. The impact of modification on characteristics of soy proteins was monitored by examining the functional properties changes of protein samples. In the last stage soy drinks were prepared from conjugated and non conjugated proteins then the prepared beverages were subjected to thermal processing conditions and the influences of Maillard conjugation on the stability of soy drinks was monitored over time.

**Results and Discussion:** SDS-PAGE electrophoresis profile showed that proteins-polysaccharide conjugates were formed. As a result of conjugation, the protein-dextran covalent binding occurs, leads to the formation of higher molecular weight components, resulting in its accumulation on the top of the separating gel. When *heating* time increased a wider and higher molecular weight bands appeared near the top of the running gel however they were not observed in the native soy pattern. Covalent linkage between amino group of proteins and carbonyl group of polysaccharides causes a color changes from light yellow to brown, browning intensity results showed that the even during early incubation time, a significant absorption was observed at 420 nm compared to the control samples. UV absorption results showed similar trend of changes in browning intensity measurement.

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Increasing UV absorption is due to the intermediate Maillard reaction products (MRP). Increasing UV absorption with increasing heating time indicates the fact that Maillard reaction products (MRP) formation are more favorable in the long incubation time. Data of UV absorption are a good evidence for SDS-PAGE and browning intensity results. Functional properties results indicated that grafted proteins had better functional properties. The storage stability of soy drinks prepared from conjugated proteins was significantly higher than the samples prepared from non conjugated proteins. Stability of beverages after thermal processing and during storage is one of the most important features of protein drinks and many efforts have been made to develop mentioned characteristics. Stability of soy drinks produced from the conjugated proteins was significantly higher than those prepared from non conjugated soy proteins. Functional characterization of proteins is dependent on several factors, the majority of soy drink composed of proteins that could be denaturated by heating applied during thermal processing, as the results showed conjugation with dextran caused an increase in denaturation temperature of soy proteins which enhance the resistance of proteins during thermal processing treatment. In addition, the solubility and emulsifying properties of soy proteins increased with conjugation which can be a good reason for improvement the relation between protein and surrounding water molecules and therefore increases the protein storage stability. It can be concluded that Maillard reaction could be applied as a means to prepare soy proteins-dextran conjugates with better functional properties and more stable during processing and storage.

**Keyword.** Stability, Heat processing, Maillard reaction, Soy proteins