Application of Plasma Activated Water as Green Strategy for Modification of Starches

Gebremedhin Gebremariam Gebremical[1], Silvia Tappi[1, 2], Romolo Laurita[3], Filippo Capelli[3], Federico Drudi[1], Santina Romani[1, 2], Marco Dalla Rosa[1, 2], Pietro Rocculi[1, 2]

[1]Department of Agricultural and Food Sciences, University of Bologna, Cesena, Italy

[2]Interdepartmental Centre for Agri-Food Industrial Research, University of Bologna, Cesena, Italy

[3]Department of Industrial Engineering (DIN), University of Bologna, Bologna, Italy

Abstract

Starch is a biopolymer composed mainly by amylose and amylopectin chains, used as food ingredients in many foods as stabilizer, emulsifier, thickener, binding and gelling agent. However native starch presents several drawbacks such as poor solubility, gel syneresis and instability to heat, acid and shear forces, weak structure and low shear resistance. Consequently, to meet industrial demands, starch modification is currently used by food ingredients manufacturers. Chemical modification is mostly applied; however, it poses various environmental issues and therefore, alternative green strategies are being investigated. Plasma activated water (PAW) is generated by exposure of water to cold plasma, leading to an acidic environment, changes of the redox potential, electrical conductivity and formation of reactive oxygen and nitrogen species. PAW has been shown to promote changes in various biomolecules structures. The present study was conducted to assess the effect of PAW, generated with a corona discharge at 15kV, 5 kHz for 1 min on potato, normal maize and waxy maize functional and chemical properties after a 20 min washing treatment. Results show that after PAW treatment, probably due to depolymerisation, crosslinking or etching effects, a decrease in elasticity, viscosity, pasting properties and gelatinization temperatures was observed in waxy maize, however contrary results were observed in potato and normal maize, probably because of the different composition in terms of amylopectin/amylose ratio and functional groups. PAW was confirmed as alternative green technology to modify the properties of starch, however the process needs to be optimized based on the properties of the raw material.