**Thermo-mechanical corn starch modification: effect on physical and techno-functional properties**

M Faieta1, A Di Michele2, L Valbonetti1, R De Flaviis1, P Pittia1

*1Department of Bioscience and Technology for Food, Environment and Agriculture, University of Teramo*

*2Department of Physics and Geology, University of Perugia, Via Pascoli, 06123 Perugia, Italy*

Corn starch is one of the most valuable ingredients of the food industry widely used in formulated foods due to its availability at low price, storability and high starch content.

In the native state corn starch has limited use in the food industry due to its poor functional and physico-chemical properties, such as low cold water solubility, low viscosity and high gelatinization temperature that depend on its structure, the amylose to amylopectin ratio and granular particle diameter. Different physical, chemical, and biotechnological methods have been applied to modify its properties to improve, in turn, its technological functionalities.

Ball-milling is a physical innovative and environmentally friendly technology pioneered in the pharmaceutical sector and now adopted in several areas, including food, mainly for size reduction. However, during the process, friction, collision, [impingement](https://www.sciencedirect.com/topics/engineering/impingement), shear, or other mechanical actions could also lead to modify the structure and physical properties of biomolecules including the transition from crystalline to amorphous state of carbohydrates including starch.

This study aimed to investigate the effects of ball milling on the physical, chemical and techno-functional properties of corn starch. Native corn starch has been subjected to ball milling process for different time (3, 5, 8, 10, 15 and 30 min) at a rotational speed of 350 rpm.

Thermal analysis showed a stepwise decrease of enthalpy of gelatinization at increasing milling time indicating an increase of the starch gelatinisation degree, confirmed also by the amylose-iodine gelatinisation and X-ray diffraction methodologies suggesting the progressive loss of the crystalline fraction . Polarized light microscopy evidenced a loss of birefringence of the granules. SEM analysis showed significative changes in starch microstructure with a change of grains surface from smooth to rough and formation of aggregates due to high mechanical shock of the treatments. The formation of agglomerates was confirmed by particle size analysis that showed an overall increase of particles volume distribution.

Solubility of corn starch raised from 3.2% (native) up to 32% (30 min). Water and oil holding capacity resulted being positively correlated with the treatment time, by increasing for longer ball milling process. Rheological measurements of starch pastes highlighted lower G’ modulus of starch gels with the increasing of BM treatment time and a more elastic behaviour for NAT starch. Transparency was monitored to investigate starch pastes retrogradation and results showed a faster decrease in the ball milled samples.

1 Chao C., Huang S. and Yu J. (2020). Starch structure, functionality and application in foods. Springer, 2020.