Ball milling: innovative and sustainable technology for the development of innovative and high-performing food ingredients

PITTIA P. (1), FAIETA M. (1), GONZALEZ ORTEGA R. (1,2), DI MATTIA C. (1), NERI L. (1)
1 University of Teramo, Teramo, Italy
2 Free University of Bolzano, Bolzano, Italy

Global compelling need for a more sustainable economic system fueled the food sector, to develop and promote the application of innovative and more environmentally friendly technologies.
Ball-milling, initially developed by the pharmaceutical sector, nowadays finds application in several fields mainly for micro-powders production. This technology is based on the effects of high energy mechanical forces (e.g. attrition, shear, and impact) induced by the collision of balls within a jar under high rotational speed. Researches showed that it may induce physical, structural modifications and state transitions in biopolimers and solutes in dry state, causing changes of their chemical and physical properties and technological performances. Limited are the studies on this technology in food processing and ingredients development and its full potential still remain unraveled.
This presentation will review the results of some applications of the ball-milling technology in modulating techno-functional properties of food molecules and the development of innovative encapsulated ingredients.
Ball-milling applied to small saccharides (trehalose), in presence of limonene (co-milling), allowed the development of amorphous powdered encapsulates. The high-intensity mechanical stresses cause stepwise transition from the crystal to an amorphous state of the saccharide, along with the formation of a micro-dispersion of limonene as to a high-performing, stable, glassy encapsulated powder with a high retention ability of the volatile compound. Similar encapsulation approaches have been applied also for valorization of olive oil processing by-products. Co-milling of maltodextrin alone or maltodextrin-trehalose mixtures (90/10; w/w) combined with an olive leaves extract resulted in an encapsulation efficiency higher than 90% after 1 h-treatment with an effect related to processing time and carrier composition.
Modulation of technological functionalities of native corn starch have been achived by short-time ball-milling treatments. At increasing treatment time, milled starch showed significant changes of the semicrystalline structure of the granules and physico-chemical properties resulting in a mechanic-induced gelatinization, increased cold water solubility, oil and water holding capacity. Moreover, aqueous milled-starch dispersions subjected to heat-treatments showed interesting pasting and rheological properties to be exploited for new formulated foods.
Nowadays, ball-milling represents a "green" technology to obtain, in dry-state, innovative and sustainable ingredients.