28th Workshop on the Developments in the Italian Ph.D research on Food Science, Technology and Biotechnology
Catania, 18-20 September 2024

DEVELOPMENT AND OPTIMIZATION OF NEW PROCESSING AND PACKAGING TECHNOLOGIES FOR FRESH-CUT FRUIT

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State-of-the-Art

Fresh-cut fruit industry begins in the USA during the 50s. However, research on fresh-cut fruit products is relatively recent, gaining interest in particular after 1986 when FDA declared unsafe and banned the use of sulfites on fruit and vegetables. The challenge, after then, it has always been how to prevent browning, texture loss and microbial spoilage by the means of safer and greener technologies. New formulations tend to reduce chlorine and to use natural compounds. Examples are concentrated fruit extracts, essential oils, glutathione, resorcinol, nisin, kojic acid, cyclodextrins, melatonin (Iturralde-García et al., 2022). The application of preservatives is generally carried out through a dipping treatment (water solution) for 2-5 minutes.

An alternative to traditional dipping is the application of edible coatings; the product is immerged in a solution that solidifies adhering to the product surface resulting in thin layer of edible material. It can act as a barrier that limits water loss and regulates gas exchange. A coating can be based on proteins, carbohydrates or lipids; however, the recent research trend includes alginate, chitosan, starch, gums, cellulose, pullulan, aloe vera, pectin and caseinate based coatings (Maringgal et al., 2020).

Non-thermal processing can provide a valid solution for sanitizing the products without adding more preservatives. Plasma activated water (PAW), electrolyzed water (EW), ozone water are technologies able to have a sanitizing effect without leaving any residue (Mendoza et al., 2022).

Moreover, fruit is usually very susceptible to enzymatic browning, due to high content of polyphenol oxidase (PPO), and texture loss. PPO is a copper enzyme which catalyzes the oxidation of phenols to p-quinones which can further react both enzymatically or non-enzymatically resulting in brown pigments (melanins). The reaction needs oxygen as a cofactor and has a optimal working pH at 6.0-6.5 (Toivonen & Brummell, 2008). Therefore, the reaction can be controlled by the means of antioxidants, copper chelators, inhibitors, ph adjusters.

Polygalacturonase (PG) and pectinesterase (PE) are the main responsible for pectin degradation. PG hydrolyze the glycosidic bonds while PE catalyzes the de-esterification of pectin (Toivonen & Brummell, 2008), promoting its degradation. Adding calcium salts can delay this process by strengthening the pectin-rich middle lamella promoting cell-to-cell adhesion and wall structure.

PhD Thesis Objectives and Milestones

The present PhD thesis research project aims to identify, develop and optimize different technologies for the stabilization of fresh-cut fruits in order to slow down the occurrence of microbiological and physicochemical phenomena responsible for the loss of safety and quality of the products during shelf life. In addition, the project focuses on the elaboration of operating procedures to be developed and implemented in an industrial context by carrying out experimental tests at laboratory/pilot scale up to pre-industrial/industrial tests in the plant, also with the possible support of equipment manufacturers.

Gantt diagram for this PhD thesis project

Activity	Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A1)	***Dipping treatments***																								
	1) Fruit maturity (non-destructive)																								
	2) Innovative molecules																								
A2)	***Edible coatings***																								
	1) Chemical-free formulations																								
	2) Active molecules incapsulation																								
A3)	***Emerging sanitizing treatments***																								
	1) PAW, EW, ozone water																								
	2) High-pressure CO_2																								
A4)	***Scaling up***																								
	1) In-company trials																								
	2) Production line adaptation																								
A5)	***Thesis and Paper Preparation***																								

References

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