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New formulations to increase stability and nutritional and healthy quality of frozen desserts

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Project objective

The aim of the PhD project is the development of new formulations for milk-based frozen dessert products with higher quality, physical stability, nutritional and health benefits. The use of ingredients to stabilize the aqueous fraction in the frozen state and of probiotic agents will be studied along with new technologies to develop ingredients with improved functionality, milk- and egg-free formulations and reduced sucrose content. The project will be developed by using as a reference the classical cream of the typical Italian dessert, tiramisu made of mascarpone, a creamy and fatty cheese.

State of the art

The frozen dessert sector (e.g., cakes, semi-freddo-based creams and / or milk-based fillings) is a niche market in continuous growth with a high level of diversification (e.g., preparations, serving or consumption temperatures, recipes, channels sales) and service for ease of preparation and consumption. The production process includes the freezing or deep-freezing phase which for consumption is followed by a defrosting phase to obtain a soft and creamy product. In frozen foods, the stability depends on the immobilization of the water in ice crystals induced by the application of temperatures below the freezing point and the maintenance of the low temperature conditions during storage. To limit the impact of issues related to freezing and thawing stability, it is necessary to intervene on the formulation with: i) use of solutes or stabilizers with "water binding capacity" to limit the quantity of water that freezes (e.g. oligosaccharides, fibers) (Goff and Sahagian, 1996; Chaves et al., 2018; Tsai et al., 2020) ; ii) use of new technologies that improve the water holding/binding capacity of ingredients or formulated mixtures (e.g. high dynamic pressure for proteins, ball milling for starchy ingredients) (Lanciotti et al., 2004; Ahmad et al., 2020); Sim et al., 2021). Moreover, reformulation strategies with alternative protein sources (e.g., soy, peas) with functionality similar to those of milk and eggs, sugar reduction, new ingredients based on polysaccharides or proteins that mimic the sensory properties of fat, may allow the creation of products with higher nutritional quality and/or for consumers with specific dietary needs. The fortification with the addition of probiotics also allows the development of other innovative products with a greater health impact (Vijaya Kumar, Vijayendra and Reddy, 2015; Pimentel et al., 2021).

Objectives and milestones

Objectives of this project is the development of new formulations for milk-based frozen dessert products with higher quality, physical stability, nutritional and health benefits by: 1. the use of ingredients to stabilize the aqueous fraction in the frozen state and of probiotic agents; 2. Application of new technologies to develop ingredients with improved functionality; 3. Development of milk- and egg-free formulations and reduced sucrose content. The project will be developed by using as a reference the classical cream of the typical Italian dessert, tiramisu made of mascarpone, a creamy and fatty cheese. The following activities will be carried out with the timing reported in the Gantt diagram (Table 1):

A1: Study of the effect of solutes (hydrocolloids, fructo-oligosaccharides, trehalose, maltodextrins) as single ingredient or as mix on freezing and melting behavior of the mascarpone-based cream.

A2: Application of Innovative technologies on ingredients and/or the mascarpone-based cream and effect on the quality and stability of the processed product upon freezing and melting

A3: Industrial scaling-up of A1 and A2 in the company

A4: Development of a dairy and egg-free cream made of vegetable proteins and oils; the reduction of sucrose will be also investigated.

A5: Development of a mascarpone-based cream enriched with probiotics and estimation of the shelf-life of selected formulations from A1, A2, A4.

A6: Industrial scaling-up within the company

A7: bibliographic research, writing papers and final thesis

		First year											Second year										Third year															
	Month	1	2	3	4	5	6	7	8	1	9 10	11	112	2 1	3 1	4 1	5 1	6 1	17 1	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Bibliographic research																																					
A1	Ingredient's role																																					
	Hydrocolloids'role																																					
	Optimal formulation selection																																					
A2	Innovative technologies																	Т	Τ																			Γ
	Optimal formulation selection								Γ				Г	Τ				Т																				Γ
A3	Industrial scaling-up P1 and P2												Γ																									
A4	Diary- and egg-free and low sucrose creams formulations												Γ																									
A5	Probiotic-enriched formulations																																					
	Shelflife extimation (P1, P2, P4)								Γ	Γ			Г	Т		Т		Т																				Г
A6	Industrial scaling-up P4, P5 and P6																																					
	Publications and thesis preparation																																					

Selected references

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