



Holy Spirit University of Kaslik

Doctoral College

Doctoral Studies Rules and Regulations/ Article 2

PhD Thesis Proposal (PTP)¹

General Information		
PhD Thesis Title	<i>Valorization of dairy and apples by-products by fermentation process</i>	
USEK Doctoral Program	<i>PhD in Agricultural and Food Sciences</i>	
Joint Guardianship/Cotutelle	<input type="checkbox"/> Yes	Partnership university's doctoral program:
	<input checked="" type="checkbox"/> No	
Research Center	NA	
Research Group	NA	
Research Axis	Sustainability	
PhD Supervisor	Name & Title: Dr. Youssef El Rayess Email: youssefrayess@usek.edu.lb	University Address: Holy Spirit University of Kaslik - USEK
Co-supervisor (if applicable)	Name & Title: Dr Lea Nehme Email: Leanehme@usek.edu.lb	University Address: Holy Spirit University of Kaslik - USEK
Location (s)	Location 1: USEK	Work shift calendar /per year (%):
	Location 2: (if applicable)	Work shift calendar /per year (%):
Potential funding and scholarship		

Applicant's Name and Profile		
Comps Exam Language (to be check-marked by the PhD Supervisor)	<input checked="" type="checkbox"/> Oral Assessment <input type="checkbox"/> Written Assessment <input type="checkbox"/> Arabic <input type="checkbox"/> French <input checked="" type="checkbox"/> English	

Subject's national or worldwide context, objectives & research lines
Food loss and waste reduction is an important way to decrease production costs and increase the efficiency of the food system, but also a way to contribute towards environmental sustainability. From an economic perspective, food loss and waste reductions can also have a positive impact upon suppliers' and consumers' well-being. Farmers, processors, transporters, retailers, and food service providers can increase their productivity by reducing food loss and waste.

¹ The PhD Thesis Proposal should not exceed three pages. It shall be approved by the School/Faculty.



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Fruit cultivation is considered a very important element in the Lebanese agricultural sector; it presents 28 % of the total productive agricultural area. Apples and grapes are the most prominent fruit product. However, the apples farmers are actually facing a huge crisis due to marketing and valorization problems of apples. Tons of apples are actually not sold and thrown in the environment generating considerable amounts of food loss and wastes. In another hand, the dairy industries also generate high amounts of whey which are not valorized and considered of food waste.

The main objective of this project is to valorize these two types of food wastes by fermentation process (Kombucha process) in order to create new beverages.

Kombucha is a traditional non-alcoholic beverage prepared by the fermentation of sweetened tea by a symbiotic consortium of bacteria and yeast (SCOBY). The production of kombucha is the result of several microbial actions and can be compared to the making of vinegar since two steps are necessary: yeast fermentation of sugars (fructose and glucose) into ethanol and conversion of alcohol into acetic acid by acetic acid bacteria mainly *Acetobacter aceti*. Moreover, acetic acid bacteria transform glucose into gluconic acid and nanocellulose and fructose into acetic acid. Lactic acid bacteria, when present, generate lactic acid.

Designing a novel functional beverage can be a promising area of research. To our best knowledge, very few studies have examined the fermentation of apple pomace and whey with the kombucha consortium. The research will be organized around 4 main objectives:

- Studying the effect of fermentation parameters on the physico-chemical characteristics and biological activities of the beverage
- Assessing the organoleptic properties of the beverage, in addition to the consumer's acceptability
- Assessing the market's response with regards to trying the newly developed beverage
- Determining the shelf-life of the beverage and the food safety practices needed during production.

Outcomes (OCs): What do we wish to achieve?

OC1:	Creating a new fermented beverage from apple and whey wastes
OC2:	Optimization of the fermentation parameters in order to obtain a tasty and healthy beverage
OC (n):	

References (R) (5 most recent peer-reviewed publications in the field)

R1:	Al-Mohammadi, A. R., Ismaiel, A. A., Ibrahim, R. A., Moustafa, A. H., Abou Zeid, A., & Enan, G. (2021). Chemical constitution and antimicrobial activity of kombucha fermented beverage. <i>Molecules</i> , 26(16), 5026
R2:	Tu, C., Tang, S., Azi, F., Hu, W., & Dong, M. (2019). Use of kombucha consortium to transform soy whey into a novel functional beverage. <i>Journal of Functional Foods</i> , 52, 81-89.
R3:	Barakat, N., Beaufort, S., Rizk, Z., Bouajila, J., Taillandier, P., & El Rayess, Y. (2022). Kombucha analogues around the world: A review. <i>Critical Reviews in Food Science and Nutrition</i> , 1-25.



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R4:	Sarkaya, P., Akan, E., & Kinik, O. (2021). Use of kombucha culture in the production of fermented dairy beverages. <i>LWT</i> , 137, 110326.
R5:	Zubaidah, E., Yurista, S., & Rahmadani, N. R. (2018, March). Characteristic of physical, chemical, and microbiological kombucha from various varieties of apples. In <i>IOP Conference Series: Earth and Environmental Science</i> (Vol. 131, No. 1, p. 012040). IOP Publishing.