"Technological development of new tropical fruit products and beverages"

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State of the art

Beer is one of the oldest and most widely consumed alcoholic drink in the world. Many kinds of beer were born and established worldwide, each with its own distinctive feature, often linked to the production area. In recent years, the manufacture of craft beers included local fruits in order to provide territorial ties. Tropical fruit and beer production might represent novel commercial opportunity for food company based in the marginal areas in Sicily. The consumption of exotic fruit is rising worldwide, probably due to increasing public awareness of their nutritional and health properties (Gasiński et al., 2020). The conventional *Saccharomyces* and non-*Saccharomyces* strains isolated from non-brewing matrices, as fermented honey by-products, are attracting a lot of interest. In fact, the application of non-*Saccharomyces* yeasts, such as *Hanseniaspora* spp., *Candida*, *Brettanomyces/Dekkera* spp., *Debaryomyces* spp., *Rhodotorula* spp., *Cryptococcus* spp. and *Pichia* spp., in beer is increasing (Matraxia et al., 2021; Larroque et al., 2021; Colomer et al., 2019). Lactic acid fermented fruit juices show great commercialization potential in the non-dairy functional beverage sector due to their content of probiotic bacteria, antioxidant properties and several beneficial activities against diverse diseases (Muhialdin et al., 2021; Szutowska, 2020). So far, the fermented fruit juices commercialized are mainly made by alcoholic fermentation such as sour cherry, strawberry, pomegranate and quince wines, but some probiotic products are also available in form of fermented cranberry soda or as forest berry food supplements in liquid formulas (Gaglio et al., 2021; Isas et al., 2020).

PhD Thesis Objectives and Milestones

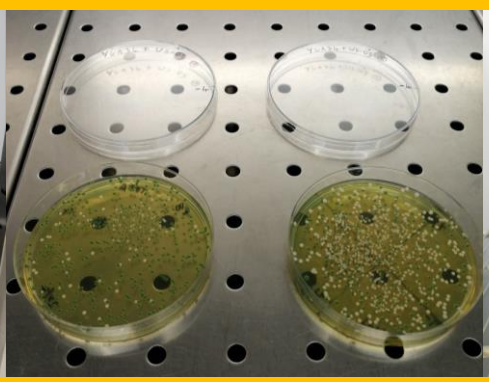
The objective of the research activity is to study and develop process and product technologies aimed at obtaining fermented beverages based on tropical fruit grown in Sicily, such as **beer** and **Lactic acid fermented fruit juices**. The production of beverages with fruit is more difficult than "normal" products, as fruit is a less "controllable" element, especially in terms of microbial contamination. For the research activity we will select yeast strains (mainly non-*Saccharomyces*) and Lactic acid bacteria LAB, already present in the microbial collection of the "SAAF Department" of the University of Palermo, and it will be studied the microbiota dynamics in different fermentation protocols. Each fruit-based formulation will be characterized by unique properties, which determine specific requirements in terms of processing techniques and maintenance of the quality of fruits during processing. This project aims to carry out an active role in the conjunction between research and industrial chain related to the production of fermented alcoholic beverages based on Sicilian tropical fruit.

Experimental plan

1) Selection of fruit species, development and validation of process parameters

2) Selection and application of yeast strains (mainly non-*Saccharomyces*) and LAB already present in the collection of the SAAF Department of the University of Palermo. Initiation of in vitro tests and microbrewing trials with a synthetic wort






3) Study of microbiota dynamics in different fermentation protocols and study of secondary metabolites

4) Evaluation of different nutrient addition, industrial scale up and monitoring

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	25	26	27	28	29	30
A1)	Selection of fruit species																														
A2)	Selection and application of yeast strains																														
A3)	Study of microbiota dynamics																														
A4)	Evaluation of new products																														

Fig. 1. Gantt diagram for this PhD thesis project

Selected References

Colomer M S, Funch B, & Forster J (2019). The raise of *Brettanomyces* yeast species for beer production. Current opinion in biotechnology, 56, 30-35.

Gaglio R, Pescuma M, Madrid-Albarrán Y, Franciosi E, Moschetti G, Francesca N, Mozzi F & Settanni L (2021). Selenium bio-enrichment of Mediterranean fruit juices through lactic acid fermentation. Int. J. Food Microbiol. Article in press.

Gasiński A, Kawa-Rygielska J, Szumny A, Czubaszek A, Gąsior J, Pietrzak W (2020). Volatile compounds content, physicochemical parameters, and antioxidant activity of beers with addition of mango fruit (*Mangifera indica*). Molecules, 25(13), 3033.

Isas A S, Celis M S M, Correa J R P, Fuentes E, Rodríguez L, Palomo I, Mozzi F, & Van Nieuwenhove C (2020). Functional fermented cherimoya (*Annona cherimola* Mill.) juice using autochthonous Lactic acid bacteria. Food Res Int, 138, 109729.

Larroque M N, Carrau F, Fariña L, Boido E, Dellacassa E, & Medina K (2021). Effect of *Saccharomyces* and non-*Saccharomyces* native yeasts on beer aroma compounds. Int. J. Food Microbiol., 337, 108953.

Matraxia, M, Alfonzo A, Prestianni R, Francesca N, Gaglio R, Todaro A, Alfeo V, Perretti G, Columba P, Settanni L & Moschetti G. (2021) Non-conventional yeasts from fermented honey by-products: Focus on *Hanseniaspora uvarum* strains for craft beer production. Food Microbiol, 99, 103806.

Muhialdin B J, Hussin A S M, Kadum H, Hamid A A, Jaafar A H, (2021). Metabolomic changes and biological activities during the lacto-fermentation of jackfruit juice using *Lactobacillus casei* ATCC334. LWT Food Sci. Technol. 141, 110940.

Szutowska J, 2020. Functional properties of Lactic acid bacteria in fermented fruit and vegetable juices: a systematic literature review. Eur Food Res Technol 246, 357–372.