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Editorial

Dairy Fermentation

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Fermented dairy products have been traditionally produced and fermentation has evolved as an effective technique to preserve milk from various milking animals. The present Special Issue (SI) is focused on the latest research on dairy fermentation and fermented dairy products. This SI consists of 13 papers; 3 review articles and 10 research articles, studying aspects of dairy products such as cheese, fermented milks, probiotic yoghurts, ice cream and fermented milk from camels. The contribution of all research groups, including those from Italy, Egypt, United Arab Emirates, Greece, Cyprus, Turkey, India, South Africa, Saudi Arabia, Iran and Mexico, that have published their work in this SI is acknowledged.

Mefleh et al. [1] reviewed the traditional fermented products in southern Mediterranean countries, focusing on dairy products, and discussed innovative strategies to formulate improved versions. A great variety of fermented milk products are produced in the Middle East and North Africa regions and are made by fermenting raw milk at room temperature by using spontaneous fermentation, back-slopping fermentation, or with the addition of specific starters. The main features of traditionally fermented dairy products, including cheese, produced in Algeria, Egypt, Libya, Morocco, Tunisia, Lebanon, Syria, and Palestine are presented. Moreover, innovative strategies for enhancing the quality and safety of the traditional fermented dairy products produced in these countries are discussed. Ultrafiltration, the addition of adjunct cultures, production of reduced-salt/sodium cheese, protein-enriched cheese, as well as the application of non-thermal treatments and edible coatings and films for enhancing the preservation and safety of various products, are covered in this review article.

Bintsis and Papademas [2] reviewed the evolution of fermented milks from artisanal to industrial products, their specific regional differences, their special characteristics, and the microbiological aspects of fermented dairy products. The main factors that affect the characteristics of fermented milk products are discussed and the specific microbiotas of 76 traditional fermented milk products are presented. The functional and therapeutic properties that have been attributed to certain components, and thus fermented dairy products, have gained wide global recognition, as they meet consumers' expectations for health-promoting and functional foods. The application of molecular methods to identify and characterize the microbial ecology of these products has revealed the role of indigenous microflora in the fermentation process, as well as in the development of the sensory, technological, and health-promoting properties of fermented dairy products, and the role of the microbiota for a number of fermented milks is reviewed.

A third review paper on the microbial communities in home-made and commercial Kefir is included in the SI. Kefir is one of the most studied fermented milks and its functional properties are studied by Yilmaz et al. [3]. The aim of this review was to explain the microbial composition of commercial and home-made kefir and its possible effects on type 2 diabetes mellitus, a common diet-related disease. The microbial composition of kefir products is presented, as well as their hypoglycemic properties. The hypoglycemic properties of kefir have been validated with certain studies on animal models and human clinical trials. It has been shown that the consumption of kefir reduces blood glucose, improves insulin

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Citation: Bintsis, T. Dairy Fermentation. *Fermentation* **2023**, *9*, 252. https://doi.org/10.3390/fermentation9030252

Received: 21 February 2023
Accepted: 1 March 2023
Published: 4 March 2023

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signaling, controls oxidative stress, and decreases the progression of diabetic nephropathy. However, there are still some research gaps. The predominance of certain species and strains of lactic acid bacteria (LAB) and yeasts with potential health benefits and ability to control many gut disorders has been revealed by metagenomics. The authors concluded that commercial kefir must be regulated for food safety and standardization purposes.

Two papers that study cheese, the most diverse fermented dairy product, are included in the SI. Samelis and Kakouri [4] investigated the LAB microbiota of artisanal Galotyri cheese, the most popular traditional Greek Protected Designation of Origin (PDO) soft acid-curd cheese. Microbial numbers and types were compared, and 102 LAB isolates were identified. A diverse viable LAB biota comprising *Lacticaseibacillus paracasei*, *Leuconostoc mesenteroides*, *Lentilactobacillus diolivorans*, *Lentilactobacillus kefiri*, *Lentilactobacillus hilgardii*), *Pediococcus inopinatus/parvulus*, a few spontaneous non-starter thermophilic streptococci and lactobacilli, and *Enterococcus faecium* and *Enterococcus faecalis* at higher subdominant levels were found in artisanal samples. The authors concluded that ripening reduced the starter LAB viability but increased the non-starter LAB species diversity in the present Galotyri PDO market cheeses. Bennato et al. [5] investigated the effect of grape pomace in the diet of ewes on the metagenomic profile, volatile compounds and biogenic amines contents of ewe's ripened Italian cheese. Grape pomace was added in their diet as it is a rich source of bioactive compounds, especially polyphenols and fiber, that can improve the immune status of the animals, in addition to their rumen metabolism and milk characteristics. The diet did not affect the relative abundance of the main phyla identified. Cheeses were made from raw milk and *Pseudomonas*, *Chryseobacterium* and *Acinetobacter* spp. were the dominant taxa; however, a lower percentage of *Pseudomonas* spp. was detected in the cheeses produced from ewes with a diet containing grape pomace. *Enterococcus* spp. became the dominant bacteria species in ripened cheeses; during the ripening, the diet with grape pomace influenced the growth of other LAB, such as *Lactococcus*, *Lactobacillus*, *Streptococcus* and *Leuconostoc*.. The diet affected the development of carboxylic acids and ketones, but not of aldehydes. Low levels of esters were identified in all of the samples. In addition, four biogenic amines were determined in the cheeses samples and their levels differed between the two groups and during different ripening times. Overall, significant positive correlations between some families of bacteria and the formation of volatile organic compounds and biogenic amines were found. Bennato et al. [5] concluded that animal feed that contains grape pomace can affect the complex microbiota of ewes' milk cheese.

Maleke and Adebo [6] studied the nutritional composition and health-promoting properties of Amasi, also called Maswi or Sethemi, a fermented milk product, produced from cow's milk in Zimbabwe, South Africa, Lesotho, and other South African countries. The composition of Amasi, including amino acids, minerals, and fatty acids, as well as its health-promoting properties, were investigated using total phenolic content, total flavonoid content, and antioxidant activity assays (3-ethyl-benzothiazone-6-sulphonic acid and 2,2-diphenyl-1-picrylhydrazyl). The results showed that the fermentation conditions (time and temperature) significantly affected the ash contents. Fermentation was also observed to increase the contents of most of the essential and non-essential amino acids. A high concentration of glutamic acid was observed in optimized naturally fermented Amasi at 32 °C. A similar trend in the composition of minerals was also observed, with potassium being the most abundant. The total phenolic content, total flavonoid content, and the antioxidant activities were significantly improved by fermentation, while a significant reduction in free fatty acids was recorded. The authors concluded that the fermentation conditions had a significant beneficial effect on the nutritional and health-promoting qualities of both spontaneous and starter culture-fermented Amasi.

Since most of the studies on the probiotic properties of fermented milks are focused on the probiotic strains of LAB, Lama and Tamang [7] studied the yeast population and its probiotic properties in Dahi and Chhurpi, two home-made fermented dairy products from India. A total of 3438 yeasts were isolated from 40 samples of Dahi (1779 isolates) and 40 samples of Chhurpi (1659 isolates), purchased from the market of four districts of

Sikkim in India. The yeasts were screened for probiotic properties on the basis of survival in low pH conditions, resistance to bile salts and the percentage of hydrophobicity and 20 yeast strains were selected for in vitro and genetic screening of their probiotic properties. Based on the results of the in vitro and genetic screening of the probiotic yeast strains, *Saccharomyces cerevisiae* DAO-17 (from Dahi), *S. cerevisiae* CKL-10 (from Chhurpi), *Pichia kudriavzevii* CNT-3 (from Chhurpi) and *Kluyveromyces marxianus* DPA-41 (from Dahi) were selected as potential probiotic yeasts.

Frozen dairy products are the subject of four papers in the SI; probiotic bio-frozen yoghurt made with probiotic strains of *Bifidobacterium bifidum* BGN4 and *Lactobacillus casei* Lc-01 and Jerusalem artichoke tuber powder were studied by Shahein et al. [8]. Jerusalem artichoke tubers, due to their specific components, can enhance the properties of yoghurt. The aim of this study was to determine the effect of Jerusalem artichoke tuber powder, used in the mix as a fat and sugar replacement in frozen yoghurt production. The microbiological, physicochemical, textural, and sensory properties of frozen yoghurt were investigated. The incorporation of Jerusalem artichoke tuber powder into frozen yoghurt increased the melting resistance, overrun, and viscosity of the frozen yoghurt, as well as certain sensory attributes; the enriched frozen yoghurt could provide consumers with additional health benefits and could be introduced to consumers as functional frozen yoghurt. Ranjbar et al. [9] evaluated the effect of thermal processes on the phenotypic characteristics of *Escherichia coli* strains from Iranian home-made and commercial ice creams. Throughout the manufacturing process of dairy products, *E. coli* is shocked by various temperature processes, which forces the organism to make specific proteins as a result of the changes in the synthesis of enzymes that might give the strain special characteristics. The aim of this study was to investigate the effects of the heat shock factor on the results of the biochemical and molecular tests among *E. coli* strains from ice cream and non-pasteurized milk and to determine the phenotypic variation caused by the temperature conditions of the manufacturing process. Interestingly, isolates with characteristics similar to *E. coli* were discovered, but they were not identified as *E. coli* and caused some ambiguity. These isolates appeared to experience alterations in their enzyme characteristics and structural proteins due to their exposure to various temperature conditions, including pasteurization and frigidity. Sezer et al. [10] investigated whether the use of fermented milk with added dietary fiber in ice cream production positively affected the quality characteristics of the product during a shelf life of 90 days. Fermented milk was prepared with starter cultures (yoghurt and *Lacticaseibacillus rhamnosus*) and dietary fiber (wheat fiber and inulin). In addition to the viable cell count, some related quality characteristics, such as its sensory, physical, chemical, and thermal properties and energy content, were examined. *Streptococcus thermophilus* in the yoghurt ice creams and *L. rhamnosus* in the ice cream with wheat fiber had the highest viability for 90 days. The authors concluded that probiotic ice cream production with dietary fiber and a single *L. rhamnosus* culture may be preferred in terms of sensory properties, cell viability, and economic aspects. Ice cream produced from camel milk using black rice powder (BRP) and *Lactobacillus acidophilus* LA-5, a strain with probiotic properties, was studied by Elkot et al. [11]. Camel milk has become more popular among customers in recent years, as a result of its therapeutic effects. In many parts of the world, it is considered to be a primary component of human nutrition. The study aimed to develop a novel symbiotic ice cream from camel milk formulated with BRP and investigated the viability of probiotic bacteria during a storage period of 60 days. The produced ice cream was examined for its physicochemical, rheological, microbiological, and sensorial properties. The obtained results indicated that the incorporation of BRP into ice cream blends resulted in significant increases in the overrun, viscosity, and melting resistance of the ice cream samples, whereas the freezing point decreased as the proportion of BRP in the blend increased. The sensory evaluation results showed that the most acceptable treatments were those formulated with 25% and could be increased to 50% BRP with no significant differences. The incorporation of BRP improved the viability of *L. acidophilus* LA-5 in the ice cream samples over 60 days of storage. The symbiotic camel milk ice cream

formulated with BRP showed enhanced physicochemical and rheological properties and a protective effect on the viability of probiotic bacteria.

Aljuataily et al. [12] studied the effects of fermented camel milk and fermented camel milk that incorporated 10% Sukkari dates (a variety of date palm, *Phoenix dactylifera* L.) combined with intermittent fasting on weight loss, blood profile and antioxidant status in obese rats. Obesity causes metabolic syndrome disorders that are detrimental to one's health. This research group investigated leptin and adiponectin levels and carried out a histopathological examination of adipose tissue. The results showed that intermittent fasting with both fermented camel milk and fermented camel milk that incorporated 10% Sukkari dates decreased body weight and the obese rats given this treatment demonstrated the lowest blood glucose levels. The authors concluded that combining intermittent fasting and probiotic fermented camel milk effectively accelerated weight loss, attenuated metabolic markers, and reversed histopathological alterations in rats, thus strengthening their antioxidative status and preventing certain health disorders.

Bolivar-Jacobo et al. [13] studied the effect of the non-thermal technique known as high-intensity ultrasound (HIUS) on the growth pattern of probiotics. The aim of this research was to investigate the effect of culture medium, culture age, and ultrasound parameters (time and amplitude) on the kinetic growth parameters of *L. acidophilus* (LA-5). HIUS can be employed to increase probiotics' biomass and the one-factor-at-a-time approach was employed to investigate the influence of the growth medium, culture age and ultrasound parameters on the kinetic parameters of *L. acidophilus*. Since the growth pattern of probiotics can be modified by changing their nutritional factors and their physiological stage, the authors reported that HIUS can be employed to increase probiotics' biomass. Regarding the effect of the growth medium, skim milk showed the highest *L. acidophilus* concentrations. The authors concluded that the growth medium, culture age, and ultrasound parameters (time and amplitude) influence the kinetic parameters of *L. acidophilus*.

In short, the present SI covered the recent research on the characteristics of fermented dairy products, with a special focus on innovative probiotic and functional dairy products, which have been developed to fulfill consumers' demands for functional foods and have a clear impact on human health.

Conflicts of Interest: The author declares no conflict of interest.

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