An Introductory Review on Increasing the Survival of Probiotic Bacteria in Dairy Products Using Essential Oil

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Introduction

Foodborne diseases recognized as one of the major public health problems worldwide, especially in developing countries and on the other hand, increasing incidence of foodborne disease along with its social and economic consequences have led to conducting extensive research in order to produce safer food and develop new antimicrobial agents; among them, extensive use of probiotics and bacteriocins as biological additives is of considerable importance [1]. Concerns about the safety of some chemical preservatives and negative consumer reactions to chemical and artificial preservatives rose, and more options include 'natural' and 'green' alternatives for the maintenance or extended of product shelf life have been considered. Particular interest has focused on the potential of applications of plant EOs [2,3]. Leistner and Gorris (1995) [4] suggested that to secure microbial stability and consumer safety while maintaining sensory, nutritious and economical properties of foods, multiple preservatives material in small amounts were superior to preservation by a large amount of a single preservative. The synergistic effect between EOs and other antimicrobial substances such as GRAS metabolites produced by lactic acid bacteria has been proven. It has been noted that the activities of the EOs and their constituents are enhanced by the presence of nisin [5]. Herbal EOs are aromatic oil liquids, extracted from various parts of plants, are used as flavoring agents in foods thus the importance of use of medicinal plants in food products can be multiple times [6].

Cuminum Cyminum

Cuminum cyminum L. has been allocated the topic of some recent studies in addition to its well documented traditional usage for treatment of toothache, dyspepsia, diarrhoea, epilepsy and jaundice and indicated drastic inhibitory effects on Escherichia coli, Listeria monocytogenes and S. aureus [7]. C. cyminum with the vernacular name of “Zireh e sabs” (in Farsi, Iran), is a plant belonging to the Apiaceae family applied in Iranian folk medicine since more than 200 years ago [8]. Besides its use in traditional medicine in the treatment of some ailments, C. cyminum is widely used as a spice (flavoring agent) in different kind’s food. The spice contains EO that imparts a characteristic aroma to it [9].
Major constituents in C. cyminum EO are cuminal, cuminic alcohol, gamma terpinene and beta-pinene [9].

**Mentha Longifolia**

Mentha longifolia L. belongs to the Lamiaceae plant family. This genus includes 25 species that grow wild in the humid zones of central and southern Europe, the south-west of Asia and northern Africa. The stems of the plant are erect, and the leaves are simply attached to the stem. The plant also bears white small blossoms with a light-purple tinge. Different parts of this plant are used in commercial spices as flavouring. Widely used in herbal medicine and believed to be particularly beneficial in building the immune system and fighting secondary infections. The plant is used for the treatment of coughs, colds and influenza. Externally, wild mint is used to treat wounds and swollen glands [10] and also this plant bears medicinal characteristics and has proven to be of benefit for digestive system disorders, vomiting and loss of appetite, ulcerative colitis and liver malfunctions. It also bears antimicrobial and antioxidant activity. Other reported inhibitory effects have been reported towards micro-organisms causing foodborne diseases, for example, S. aureus, E. coli, Bacillus subsp., Salmonella subsp. and Aspergillus subsp [11-13].

**Allium Ascalonicum**

Allium ascalonicum Linn. (Liliaceae) is an annual herbaceous plant, smaller than Allium cepa, belonging to the family Liliaceae. The shallot is commonly grown in West Africa, more than Allium cepa, being more suited to the climate. Various species of Allium are of considerable importance in African cooking and in salads. The pounded leaves of shallot are rolled in balls and sold in North-ern Nigerian markets and in Sudan [14].

In Northern Nigeria, some traditional herbalists pound the Allium ascalonicum dry skin, and dry leaf into a powder, and mix it with honey and carrot juice for the treatment of cancer. For the treatment of jaun-dice, Allium ascalonicum, Ziziphus mucronata (root), Khayaag randiflora (roots) and Moridia whitei (root) deoctions are taken orally. It has also been combined with Carica papaya (old leaves), Eliaies guineensis (roots), Citrullus vulgaris (roots), Aniophylyea species (seeds), Capsicum frutescens (unripe fruits) and Securi-daca longipendunculata (root) taken with pap made from Zea mays, for the treatment of malaria [15].

**Pimpinella anisum**

Pimpinella anisum L. Umbelliferae is an annual herb and a grassy plant with white flowers and small green to yellow seeds, which grows in Turkey, Iran, India, Egypt, and many other warm regions of the world [16,17]. P. anisum has several therapeutic effects on several conditions such as digestive, gynaecologic, neurologic, and respiratory disorders [18]. The aqueous extract of this plant has been reported to delay the onset of picrotxin-induced seizures in mice [19].

**Teucrium Polium**

Teucrium polium L. locally named Kalpooreh has been known as an important traditional medicinal plant in Khuzestan, South West of Iran. T. polium L. is the member of Lamiaceae family, a grass plant, durable, with 10 to 30 cm in height and callous with exterior that ordinarily have dispersal in rocky and sandy area of Europe zones, North of Africa and Southwest of Asia like Iran. Medical of reputation of this plant was noticed in traditional medicine by Socrates and Jalinous [17]. Researchers showed that this plant have antidiabetic, anti-inflammatory, antispasmodic, analgesic and antioxidant effects [20,21].

**Ferula sharifi**

The genus Ferula, belonging to the Apiaceae, comprises about 170 species. These are produced from central Asia westward to northern Africa. The Iranian flora comprises of 30 species of Ferula, of which some are endemic. The popular Persian name of the most species is “Koma” [22]. The chemistry of this genus has been studied by many investigators. To date, more than 70 species of Ferula have been investigated chemically [23,24]. The plants of this genus are well documented as a good source of biologically active compounds such as Sesquiterpenoids and sulfur containing compounds [23]. Several species of this genus have been used in traditional medicine for the treatment of various organ disorders. Among different Ferula species that have been used as natural remedies, F. assa-foetida used as anticonvulsant, carminative, antispasmodic, diuretic, aphrodisiac, antihelminic, tonic, and laxative, alternative, F. badrakema and F. gummosa both used as anticonvulsant, tonic, anti-hysteric, decongest, treatment of neurological disorders, and stomachache, and F. persica used as laxative, carminative, antihysteric, treatment of lumbago, diabetes, rheumatism, and backache are most famous [17,22].

**Lactobacillus**

Lactobacillus strains have been utilized as dairy starter and may act as both probiotic and bioprotective culture (one possible mode of action for probiotics is the production of antimicrobial compound) as well as fermenting agent in fermented products. Studies showed the inhibitory effect of these bacteria against the growth of various foodborne bacterial pathogens [25].

Probiotic species such as Lactobacillus casei and Lactobacillus acidophilus have been safely used for more than 70 years and are available in conventional foods and dietary supplements [26]. L. casei is a homofermentative micro-organism, It is acid tolerant and could thus survive during yoghurt production and storage [27].

**Due to the use of EOs combined with probiotics**

An application performance of botanical extracts EOs is in food preservation. However, to create a beneficial natural antimicrobial preservative, they must be evaluated alone and in combination with other preservation factors such as probiotic bacteria to determine whether there are synergistic effects and to devise effective compounds [28-30].

Probiotics are food supplements containing live microorganisms bringing beneficial effects to consumer host through balancing intestine micro flora [31]. The idea of probiotics was primarily introduced by Russian scientist Metchnikoff in 1907. According to his observations, consuming large amounts of lactic acid bacteria available in fermented milks. Along with the discovery of useful effects of probiotics, many efforts were focused on the production and process of fermentative products containing probiotic microorganisms. More than 90% of probiotic products include various species of *Lactobacilli* and *Bifidobacteria* [32]. Different concentrations of herbal EOs influence the activity of...
### EO and dairy product chemical composition probiotic microorganisms effect on growth probiotics pathogenic microorganisms effect on inhibition pathogenic source

| Cuminum cyminum L. (yoghurt) | Cumin aldehyde, alpha- Terpine, gamma Terpine, para-Sea- man and beta-pinene | Lactobacillus casei, Streptococcus salivarius and Lactobacillus delbrueckii | + | Salmonella typhimurium | + | Mahmoudi 2013 [37] |
| Mentha longifolia L. (Iranian white-brined cheese) | Pulegone, 1,8-cineole and menthofuran | Lactobacillus casei | + | Staphylococcus aureus and Listeria monocytogenes | + | Ehsani, et al. 2013 [38] |
| Mentha longifolia L. (feta cheese) | Pulegone, 1,8-Cineole, Menthofuran and cis-Isopulegone | Lactobacillus casei | + | +** | + | Mahmoudi, et al. 2013 [39] |
| Mentha longifolia L. (Bio-Ayran*) | Pulegone, 1,8-Cineole, Menthofuran, β-Pinene and cis-Isopulegone | Lactobacillus casei | + | — | — | Mahmoudi 2014 [40] |
| Allium ascalonicum (Iranian white-brined cheese) | Diallyl disulphide, Trisulfide, methyl 2-propenyl, Trisulfide, di-2-propenyl and Disulfide, methyl 1-propenyl | — | — | Escherichia coli | + | Ehsani and Mahmoudi 2014 [41] |
| Pimpinella anisum (Iranian white-brined cheese) | Benzene, 1-methoxy-4-(1-propenyl), Longifolene-(4) and Phenol, 2-methoxy-4-(1-propenyl) | — | — | Escherichia coli | + | Ehsani and Mahmoudi 2014 [41] |
| Teucrum polium (yoghurt) | Spathulenol, Beta-pinene, Beta-ymcine, Germacrene B, Bicyclogermacrene and Germacrene D | Lactobacillus casei | + | — | — | Mahmoudi, et al. 2014 [42] |
| Teucrum polium (yoghurt) | Spathulenol, Beta-pinene, Beta-ymcine, Germacrene B, Bicyclogermacrene and Germacrene D | Lactobacillus casei | + | Salmonella typhimurium | + | Mahmoudi, et al. 2015 [43] |
| Ferula sharii (MIC*** and MBC**** method) | β-Pinene, o-Pipene, Naphthalene, Isolongifol, Sabinene, trans-Pinocarveol and Myrtalen | Lactobacillus casei, Lactobacillus acidophilus, Lactobacilli plantarum and Lactobacillus rammus | + | — | — | Mahmoudi, et al. 2013 [44] |

* Ayran is a fermented milk beverage traditionally manufactured by mixing yoghurt with water and salt
** Not mentioned
*** Minimal Bactericidal Concentration (MBC)
**** Minimal Inhibition Concentration (MIC)

| Table 1: Review on chemical constituent and effects of EOs on probiotic & pathogenic bacteria in dairy product.

In the below Table 1 showed EOs effect on pathogenic microorganisms and probiotic bacteria in dairy product.

**Conclusion**

The results obtained in our studies showed significant inhibitory effects of EOs, probiotic bacteria, time and the overall interactions including EO concentrations with the presence of probiotic on the growth rate of pathogenic microorganisms.

The combined effect of EOs and probiotic bacteria can be improve the scope of EO function in the food industry, especially in processing dairy and fermented dairy products. Thus the use of synthetic or chemical preservatives can be reduced or replaced by using the natural ones. Finally, there are numerous advantages of probiotics and herbal EOs. The use of these bacteria or bacteriocins purified from them in combination with herbal extracts and EOs as biological preservatives may revolutionize the food industry.

**References**


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