Probiotic Potential of Noni and Mulberry Juice Fermented with Lactic Acid Bacteria

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Abstract

The present study assesses the feasibility of noni and mulberry as a raw substrate for the production of probiotic noni and mulberry juice by lactic acid bacteria (Lactobacillus plantarum SK-3 and Pediococcus acidilactici M-3). Changes in pH, titratable acidity (lactic acid), cell survival, and antioxidant properties were examined during fermentation. Both the strains grew well in noni juice and mulberry juice after 48 hour fermentation. P. acidilactici M-3 produced less lactic acid than L. plantarum SK-3. After 28 days of cold storage, both tested strains survived the low-pH conditions in fermented noni juice and mulberry juice. Both the juices fermented with L. plantarum SK-3 had a high antioxidant capacity. The noni and mulberry juice fermented with L. plantarum SK-3 showed the cholesterol-lowering ability better than the juices fermented with P. acidilactici M-3. Finally, L. plantarum SK-3 and P. acidilactici M-3 were found as optimal probiotics for fermentation with noni juice as well as mulberry juice. In this investigation, the results could be an indicator of the development of health-promoting food juices.

Conclusion: These fermented fruit juices are low-cost healthy beverages, provide better nutrition and good health to the population.

Keywords: Antioxidant, Fermentation, Lactic acid bacteria, Mulberry, Noni, Probiotic.

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INTRODUCTION

Noni (Morinda citrifolia L.) belongs to the family Rubiaceae. Noni juice is derived from the fruit of the Morinda citrifolia tree indigenous to Southeast Asia and Australasia but is cultivated in India, Polynesia, central and northern South America and the Caribbean (Ross, 2001). Different parts of noni (fruit, root, leaves, and bark) contain different biologically active compounds (Chan-Blanco et al. 2006), having many health benefits such as to stimulate the immune system, scavenge free radicals, inhibit LDL (low-density lipoprotein) oxidation, regulate blood cholesterol level, and provide anti-inflammatory benefits (Basu and Hazra, 2006; Calzuela et al. 2006; Su et al. 2005; Chong et al. 2004; Kamiya et al. 2004). Traditionally noni juice was prepared by natural fermentation of noni fruit in sealed containers for 1-2 months at ambient temperature (Wang et al. 2008), but oxygen, temperature, and microorganisms during fermentation can cause undesirable chemical reactions which reduces the health benefits of noni juice (Chan-Blanco et al. 2007).

Mulberry (Morus nigra L.) belongs to the genus Morus of the family Moraceae. It is also known as black mulberry and is widely distributed in Asia, Africa, Europe, North America, and South America. There are at least 24 species of Mulberry and is extensively used for sericulture in east, central and south Asia. In India and China, farmers cultivate mulberries for silkworm, but European farmers cultivate them for fruit (Pawlowska et al. 2008). Mulberries are grown considerably at higher altitudes in the Himalaya-Hindu Kush region (Darias-Martín et al. 2003) but are widespread in northern India where the tree and fruits are known by Persian-derived names toot (mulberry) and shahoot (superior mulberry), respectively (Imran et al. 2007). Black mulberry has high natural antioxidants and phenolic compounds in the form of bioflavonoids and non-anthocyanin, respectively, having bioactive functions and are responsible for their medicinal properties (Ercisli and Orhan, 2007).

People with special needs of vegetarians and people with allergic reactions to milk proteins have found a good substitute in the form of fruit and vegetable juice containing probiotics (Marhamatizadeh et al. 2012; Rößle et al. 2010). Fruit juices have a high amount of antioxidants, dietary fiber, vitamins, minerals, and other useful nutritional substances and thus improve the health of the host (Nagpal et al. 2012; Pereira et al. 2011). Beverages based on fruits and vegetables have been reported as a novel suitable carrier medium for probiotic.

According to Tripathi and Giri (2014), significant factors that could limit the viability of probiotic bacteria in juices are categorized as (1) intrinsic food parameters such as pH, titratable acidity, microbial preservatives like bacteriocins and hydrogen peroxide, (2) processing parameters like
incubation temperature, heat treatment, cooling rate, storage techniques, (3) microbiological factors such as type of probiotic strains, inter-compatibility of different strains with each other, proportion and rate of inoculum.

Food components can be modified in a controlled way by altering some structural characteristics of fruit and vegetable matrices with the advancement in technology (Luckow and Delahunty, 2004). The interest in the development of fruit juices based functional beverages with probiotics are increasing among people of all age groups as they have good taste profile and considered as healthy and refreshing food products (Tuorila and Gardello, 2002). In recent years, fruit and vegetable juices are considered an excellent basal medium for LAB fermentation. Advantage of these juices is accounted because of their low allergenicity and high health benefits (Sheehan et al. 2007).

The present study demonstrates the fermentation of noni and mulberry fruit with probiotic lactic acid bacteria to select an appropriate starter culture for developing noni and mulberry juice. Physicochemical changes, microbiological analysis, and antioxidant assay were carried out during fermentation.

MATERIALS AND METHODS

Preparation of Noni and Mulberry Substrate
Fresh noni (M. citrifolia) fruit and mulberry fruit were procured from the fruit market, Delhi and Kurukshetra University, Haryana, respectively. After arrival at the laboratory, noni and mulberry fruits were appropriately washed. Noni fruit was peeled. The seeds from the noni fruit were separated from manual splitting. The noni and mulberry juice (without supplementary water or nutrient) was prepared by the juicer. The juices were sterilized by autoclaving at 121°C for 15 min.

Probiotic Lactic Acid Bacteria
L. plantarum SK-3 (MK246167) and P. acidilactici M-3 (MK461878) were isolated from Sauerkraut and Maida dough, respectively. Probiotic attributes were studied on these two isolates.

Fermentation of Probiotic Noni Juice and Mulberry Juice
Both isolates were sub-cultured in MRS broth at 35°C till the colony count reaches up to 108 CFU/mL. 100 mL noni juice and mulberry juice were inoculated with L. plantarum SK-3 and P. acidilactici M-3 separately in triplicates. The fermentation process was executed at 35°C for 72 h. Control was run along with the samples.

Physicochemical Analysis

pH
The pH of fermented noni juice and mulberry juice was measured at 0, 7, 14, 21 and 30 days by using a digital pH meter (HI 8314, HANNA Instruments, Italy), calibrated with pH 4 and 7 buffers.

Total Soluble Solids (TSS)
TSS content of the juice was estimated using a portable refractometer (ARBO–95, Brix 0–95%).

Titratable Acidity (in terms of lactic acid)
Titratable acidity was measured by titrimetric method (AOAC, 1984) and expressed as % lactic acid. Fermented noni and mulberry juice were titrated to pH 8.0 with 0.1 N NaOH. 2–3 drops of 1% phenolphthalein were used as an indicator.

\[
\text{Titratable acidity} = \frac{\text{Titer} \times \text{Normality of alkali} \times \text{Volume made up} \times \text{Equivalent weight of lactic acid} \times 100}{\text{Volume of sample taken} \times \text{Volume of alkali taken}}
\]

Ascorbic Acid
Ascorbic acid content was evaluated by visual titration method given by AOAC (1984). 1 mL of the sample was diluted with 10 mL of 3% metaphosphoric acid. After centrifugation, titration was done with the standard dye solution (sodium salt of 2, 6-dichlorophenolindophenol) to a pink color end point.

\[
\text{Ascorbic acid(mg/100mL)} = \frac{\text{Titer} \times \text{Dye factor} \times \text{Volume made up} \times \text{Factor of sample extract} \times \text{Weight of sample taken}}{\text{Alcohol of sample extract} \times \text{Volume of sample taken}}
\]

Antioxidative Properties of Probiotic Juices
The fermented noni juice and mulberry juice were centrifuged at 8000 × g for 5 min at room temperature. The supernatant of each juice was extracted and analyzed for antioxidative properties viz. total antioxidant property, reducing power, and anti-scavenging property. Samples were taken at 0, 7, 14, 21, and 30 days for analysis.

Antioxidant Activity
The ABTS antioxidant activity was determined using the method of Miller and Rice-Evans (1997). The antioxidant activity was measured by adding 1 mL of each peroxidase (Sigma-Aldrich), Hydrogen peroxide (Merck), 100 M ABTS [2,2-azino-bis (3-ethylbenzene-thiazoline-6-sulphonic acid)] (Sigma-Aldrich) and distilled water. After proper mixing, the reaction mixture was incubated in the dark at 25°C for 1 h. 1 mL of each noni juice supernatant and mulberry juice supernatant were added separately. Finally, the absorbance was measured at 734 nm. The antioxidant activity was calculated by the formula mentioned below:

Total antioxidant activity (%) = \[\frac{1-(A_{734 \text{ nm sample}}/A_{734 \text{ nm control})} \times 100}{1}\]

Reducing Power
The reducing power of probiotic noni juice and mulberry juice were determined following the method of Duh and Yen (1997). It was determined by adding 1 mL of noni and mulberry juice supernatant, 0.5 mL of 0.5 M phosphate buffer (Merck, pH 6.6) and 2.5 mL of potassium hexacyanoferrate solution (Merck, 1% w/v). The reaction mixture was heated at 50°C for 20 min. After the mixture was cooled to room temperature, the reaction was terminated by adding 0.5 mL of 10% trichloroacetic acid (Merck). After centrifugation at 3000 × g for 10 min, 1 mL of supernatant was mixed with 1 mL of distilled water and 0.1 mL of 0.1% ferric chloride (Merck). The reaction mixture was incubated for 10 min at room temperature. The absorbance was measured at 700 nm using a spectrophotometer.
Free Radical Scavenging Activity (FRSA)
FRSA was performed according to the method of Shimada et al. (1992). It was measured by adding 1 mL of each noni juice supernatant and mulberry juice supernatant with 5 mL of 0.1 mM DPPH-methanolic solution (Sigma-Aldrich). The mixture was kept in the dark for 1 h, and absorbance was measured at 517 nm by using a spectrophotometer. FRSA was calculated by the following formula:

\[
\text{Scavenging activity} = \left(1 - \frac{A_{517\text{ nm sample}}}{A_{517\text{ nm blank}}}ight) \times 100
\]

Microbiological Analysis
The viability of probiotic cultures in fermented noni juice and mulberry juice was determined by standard plate count method (CFU/mL) given by David (2005) on MRS agar medium after serial dilution ranging from 10⁻¹ to 10⁻⁹. The agar plates were incubated at 35°C for 24 h. The samples were taken at 0, 7, 14, 21, and 30 days.

Health-promoting Effect of Probiotic Juice
In Vitro Cholesterol-lowering Property
In vitro cholesterol-lowering property was performed by following the method of Liong and Shah (2005). 0.3% oxgall was added to MRS broth and autoclaved at 121°C for 15 minutes. Water-soluble cholesterol (after filter sterilization) was added to autoclaved MRS broth (Himedia). 10% of probiotic noni juice and mulberry juice were added to it and incubated at 35°C for 24 h. Centrifugation was performed at 10000 rpm for 10 min at 4°C. 1 mL of supernatant was taken into a sterilized test tube and added with 1 mL and 2 mL of KOH (33% w/v) and absolute ethanol, respectively. The mixture was incubated at 35°C for 15 min after vortexing for 1 min. The reaction mixture was cooled to room temperature. Then, it was mixed with 2 mL of distilled water and 3 mL of hexane. Vortexing was done for 1 min. 1 mL of hexane layer was separated and evaporated under nitrogen gas. The residue was dissolved in 2 mL of o-phthalaldehyde solution. 0.5 mL of conc. Sulphuric acid was added after proper mixing and vortexed for 1 min. The mixture was incubated for 10 min at room temperature, and absorbance was measured at 550 nm. Cholesterol-lowering capacity was measured by the following formula:

\[
\text{Cholesterol reduction} = \left(1 - \frac{\text{absorbance of culture supernatant}_{550}}{\text{absorbance of control}_{550}}\right) \times 100
\]

Statistical Analysis
All the experimental results were recorded as mean ± SD (standard deviation). For every observation, three determinations were used. The data were statistically analyzed. The significant differences between means were calculated by a one-way analysis of variance (ANOVA) using Duncan’s multiple range test at \(p < 0.05\).

Results and Discussion
Physicochemical Analysis
Both the strains (L. plantarum SK-3 and P. acidilactici M-3) grew well on sterilized noni juice and mulberry juice without any nutrient supplementation. Tables 1 to 4 expressed the physicochemical analysis of noni and mulberry juice fermented with L. plantarum SK-3 and P. acidilactici M-3. During fermentation up to 72 h, the pH of noni juice showed a reduction from 4.7–3.6 in case of fermentation with P. acidilactici and 4.8–3.4 in case of fermentation with P. acidilactici M-3. The corresponding decrease in pH was observed in mulberry juice fermented with L. plantarum SK-3 and P. acidilactici M-3, i.e., 4.2–3.5 and 4.1–3.4, respectively.

| Time days (hour) | pH               | TSS (%) | Titratable acidity (%) | Ascorbic acid (mg/100mL) |
|------------------|------------------|---------|------------------------|--------------------------|
| 0                | 4.7 ± 0.05<sup>A</sup> | 5.57 ± 0.08<sup>A</sup> | 0.13 ± 0.04<sup>D</sup> | 46.65 ± 0.07<sup>A</sup> |
| 24               | 4.4 ± 0.05<sup>A</sup> | 5.35 ± 0.03<sup>A</sup> | 0.49 ± 0.05<sup>C</sup> | 45.43 ± 0.16<sup>A</sup> |
| 48               | 4.0 ± 0.11<sup>B</sup> | 5.10 ± 0.17<sup>A</sup> | 0.72 ± 0.02<sup>B</sup> | 44.27 ± 0.11<sup>B</sup> |
| 72               | 3.6 ± 0.04<sup>C</sup> | 4.88 ± 0.06<sup>B</sup> | 0.93 ± 0.06<sup>A</sup> | 43.18 ± 0.03<sup>C</sup> |
| Control          | 3.8 ± 0.08       | 3.80 ± 0.04       | 0.13 ± 0.08       | 13.76 ± 0.08       |

Each value represents the mean ± SD (n = 3). Data bearing different uppercase superscript letters in the same column are significantly different (\(p < 0.05\)).
According to Darias-Martin et al. (2003), pH values of *Morus nigra* fruit juice ranged between 3.10–3.36 (Spanish origin) and 3.60–3.80 (Turkish origin). Ercisli and Orhan (2007) observed a slightly higher pH range, i.e., 3.52–5.60. The changes in Brix in both the juices were evaluated over 72 h of fermentation and observed the decrease in both noni and mulberry juices. Highest titratable acidity was observed in case of mulberry juice. *L. plantarum* SK-3 produced about 0.93% and 0.85% lactic acid in case of noni juice and mulberry juice, respectively whereas *P. acidilactici* M-3 produced 0.96% and 0.92% titratable acidity in terms of lactic acid in case of noni juice and mulberry juice, respectively after 72 h of fermentation at 35°C. The production of acids resulted in a decrease in pH. The capability of a microorganism to survive and grow in fruit juices is more dependent on pH than on titratable acidity (Sadlier and Murphy, 2010). The ability of probiotic lactic acid bacteria to grow at such low pH may be due to the heterogeneous characteristics that allow them to survive in various ecological niches. These growth patterns are similar to those reported in the literature (Argyri et al. 2013; Fratianne et al. 2014). The gradual decrease in ascorbic acid content was observed during 30 days of storage at 4°C. *L. plantarum* SK-3 and *P. acidilactici* M-3 grew rapidly on noni juice and reached 5.35 ± 0.55 (log CFU/mL) and 5.40 ± 0.25 (log CFU/mL), respectively whereas mulberry juice showed significantly higher number of viable cells, i.e., 6.15 ± 0.38 (log CFU/mL) and 6.19 ± 0.94 (log CFU/mL) for *L. plantarum* SK-3 and *P. acidilactici* M-3, respectively after 30 days of storage (Table 5). Yahyai (2014) evaluated the viability of lactic acid bacteria in the production of functional drink based on a mixture of Malt extract and probiotic fermented red fruit juice by *Lactobacillus casei*. During 4 weeks of storing at 4°C, the number of probiotic bacteria is reduced due to sugar consumption and nutrients in Malt extract and Red fruit juice. The survival ability of the lactic acid bacteria in a probiotic food product is the essential factor during storage under refrigeration for producing health benefits to the host. A probiotic food product must contain 10⁶ CFU/mL viable cells to behave as a health-promoter product (Angelov et al. 2005).

### Antioxidative Properties of Probiotic Noni and Mulberry Juice

In this study, the antioxidative activity of cell-free extract of lactic acid bacteria was determined using various antioxidant assays. Tables 6 and 7 showing the antioxidant activity of noni and mulberry juice using different starter cultures of...
Table 5: Viability of lactic acid bacteria in fermented noni juice and mulberry juice

| Time (days) | Viability of lactic acid bacteria (log CFU/mL) |
|-------------|---------------------------------------------|
|             | Fermented noni juice | Fermented mulberry juice |
|             | \( L.\) plantarum SK-3 | \( P.\) acidilactici M-3 | \( L.\) plantarum SK-3 | \( P.\) acidilactici M-3 |
| 0           | 9.86 ± 0.49          | 9.78 ± 1.01          | 9.68 ± 0.22          | 8.99 ± 0.38          |
| 7           | 8.45 ± 0.32          | 8.60 ± 0.53          | 8.93 ± 0.19          | 8.81 ± 0.53          |
| 14          | 7.57 ± 0.36          | 7.58 ± 0.41          | 8.35 ± 0.76          | 8.75 ± 0.18          |
| 21          | 6.14 ± 0.69          | 6.61 ± 0.18          | 7.29 ± 0.19          | 7.41 ± 0.51          |
| 30          | 5.35 ± 0.55          | 5.40 ± 0.25          | 6.15 ± 0.38          | 6.19 ± 0.94          |

Table 6: Antioxidant activity of fermented noni juice

| Time (days) | Total antioxidant activity | Reducing power | Free radical scavenging activity |
|-------------|---------------------------|----------------|----------------------------------|
|             | \( L.\) plantarum SK-3 | \( P.\) acidilactici M-3 | \( L.\) plantarum SK-3 | \( P.\) acidilactici M-3 |
| 0           | 74.76 ± 4.90           | 73.24 ± 6.60   | 0.45 ± 0.02       | 0.44 ± 0.01       |
| 7           | 73.16 ± 2.40           | 72.36 ± 1.42   | 0.44 ± 0.02       | 0.43 ± 0.03       |
| 14          | 72.07 ± 3.41           | 71.61 ± 2.10   | 0.43 ± 0.02       | 0.43 ± 0.01       |
| 21          | 71.76 ± 1.15           | 70.58 ± 3.10   | 0.41 ± 0.01       | 0.40 ± 0.02       |
| 30          | 70.10 ± 4.13           | 70.43 ± 2.16   | 0.38 ± 0.01       | 0.38 ± 0.02       |

Control: 65.70 ± 4.16

Each value represents the mean ± SD (n = 3). Data bearing uppercase superscript letters in the same column (different sampling time) are significantly different (p <0.05)

Table 7: Antioxidant activity of fermented mulberry juice

| Time (days) | Total antioxidant activity | Reducing power | Free radical scavenging activity |
|-------------|---------------------------|----------------|----------------------------------|
|             | \( L.\) plantarum SK-3 | \( P.\) acidilactici M-3 | \( L.\) plantarum SK-3 | \( P.\) acidilactici M-3 |
| 0           | 77.36 ± 1.35           | 75.33 ± 2.45   | 0.84 ± 0.09       | 0.85 ± 0.05       |
| 7           | 76.73 ± 1.45           | 73.66 ± 1.35   | 0.83 ± 0.04       | 0.84 ± 0.07       |
| 14          | 74.06 ± 1.72           | 72.63 ± 1.84   | 0.83 ± 0.05       | 0.83 ± 0.14       |
| 21          | 72.96 ± 2.30           | 71.00 ± 1.80   | 0.82 ± 0.15       | 0.82 ± 0.06       |
| 30          | 70.93 ± 1.30           | 69.20 ± 2.57   | 0.81 ± 0.11       | 0.82 ± 0.12       |

Control: 70.92 ± 2.28

Each value represents the mean ± SD (n = 3). Data bearing uppercase superscript letters in the same column (different sampling time) are significantly different (p <0.05)

L. plantarum SK-3 and P. acidilactici M-3. Fermented noni and mulberry juice exhibited high antioxidative activity in terms of total antioxidant activity, reducing power and DPPH radical scavenging activity irrespective of the starter culture used in them. Antioxidant activity of both noni and mulberry juice fermented with L. plantarum SK-3 and P. acidilactici M-3 reduced with the storage time. Noni juice fermented with L. plantarum SK-3 and P. acidilactici M-3 showed a reduction of 6.23% and 3.83%, respectively whereas mulberry juice fermented with L. plantarum SK-3 and P. acidilactici M-3 showed a decrease of approximately 8.3% and 8.1%, respectively over 30 days of storage time at 4°C. The reducing power of noni and mulberry juice fermented with L. plantarum SK-3 and P. acidilactici M-3 showed a decrease of approximately 8.3% and 8.1%, respectively over 30 days of storage time at 4°C. The reducing power of noni and mulberry juice fermented with L. plantarum SK-3 and P. acidilactici M-3 showed a decrease of 3.52–15% during storage at 4°C for 30 days. Radical scavenging activity of noni and mulberry juices were varied with that of control because of the starters used. P. acidilactici M-3 showed good DPPH scavenging activity in both the juices in comparison with L. plantarum SK-3. Fermented mulberry juice exhibited the better DPPH scavenging activity (71.1% and 72.74% in case of fermentation with L. plantarum SK-3 and P. acidilactici M-3, respectively) in comparison to fermented noni juice which exhibited 66.4% and 67.26% scavenging activity. Four weeks of storage at 4°C reduced the DPPH scavenging activity of both noni and mulberry juice.

Free radicals play an essential role in numerous chronic pathologies as they are involved in the process of lipid peroxidation. A compound with radical scavenging property serves as a potential antioxidant (Arabshahi-Delouee and Urooj, 2007; Khan et al., 2006). Many researchers observed the effect of fermentation on antioxidant properties of natural food juices. Tien et al. (2005) found no significant difference in antioxidant properties in sugar apple juice fermented with Lactobacillus paracasei, Lactobacillus casei, and Lactobacillus delbrueckii in comparison with unfermented fresh juice. Nazarro et al. (2008) adopted carrot as a substrate for fermentation with lactic acid bacteria. Chen et al. (2008) used Lactobacillus plantarum, Lactobacillus casei, and...
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Bifidobacterium longum as a starter culture in ginger juice and found B. longum to be the optimal starter for ginger juice.

Cholesterol-lowering Property
The lowering of serum cholesterol level could be an important health benefit of lactic acid bacteria, demonstrated in humans as well as in animal studies (Wang et al. 2014). In the present study, both noni and mulberry juices fermented with L. plantarum SK-3 and P. acidilactici M-3 showed to reduce the in vitro cholesterol level (Graph 1). Natural News (2012) observed the same results in cocktail fermented with Lactobacillus plantarum and noted the reduction of 13.6% after weeks of consumption. Choi et al. (2013) reported the significant level of reduction in the total cholesterol and low-density lipoprotein-c level after the consumption of kimchi by the young, healthy volunteers. No literature was found for in vitro reduction of cholesterol by fruit juices.

Conclusion
In the present study, noni and mulberry juice were fermented using two strains of LAB. The study assessed the physicochemical and微生物学 changes during fermentation and storage period. Fruit juices represent a suitable carrier for the delivery of probiotics. Incorporation of probiotics into fruit juices makes them healthier as fruits are naturally rich in essential macro- and microelements. Concerning the performance, L. plantarum SK-3 and P. acidilactici M-3 were observed to be suitable for fermentation of noni juice and mulberry juice and may have the ability for a possible industrial application in the production of lactic acid fermented noni and mulberry juice. Further work on optimizing the fermentation conditions and in vitro and in vivo functionality of the fermented noni and mulberry juice is highly recommended.

References
Angelov, A., Gotcheva, V., Hristozova, T., Gargova, S. (2005). Application of pure and mixed probiotic lactic acid bacteria and yeast cultures for oat fermentation. J Sci Food Agric, 85:2134-2141.

AOAC. (1984). Official methods of analysis of the association of official analytical chemist.

Hortwits W (ed). Association of official analytical chemists, Washington, D. C. USA.

Arabshahi-Delouee, S., Urooj, A. (2007). Antioxidant properties of various solvent extracts of mulberry (Morus indica L.) leaves. Food Chem., 102(4):1233-1240.

Argyri, A.A., Nisiotou, A.A., Mallouchos, A., Panagou, E.Z., Tassou, C.C. (2013). Performance of two potential probiotic Lactobacillus strains from the olive microbiota as starters in the fermentation of heat shocked green olives. International Journal of Food Microbiology, 171:68-76.

Basu, B., Hazra, B. (2006). Evaluation of nitric oxide scavenging activity, in vitro and ex vivo, of selected medicinal plants traditionally used in inflammatory diseases. Phytother Res, 20:896-900.

Calzuola, I., Gianfranceschi, G.L., Marsili, V. (2006). Comparative activity of antioxidants from wheat sprouts, Morinda citrifolia, fermented papaya and white tea. Int J Food Sci Nutr, 57:168-177.

Chan-Blanco, Y., Vaillant, F., Pe’rez, A.M., Belleville, M., Zu’n’iga, C., Brat, P. (2007). The ripening and aging of noni fruits (Morinda citrifolia L.): Microbiological flora and antioxidant compounds. J Sci Food Agric, 87:1710-1716.

Chen, I.N., Ng, C.C., Wang, C.Y., Chang, T.L. (2008). Lactic fermentation and antioxidant activity of Zingiberaceae plants in Taiwan. Int J Food Sci Nutr, 22:1-10.

Choi, I.H., Noh, J.S., Han, J.S., Kim, H.J., Han, E-S., Song, Y.O. (2013). Kimchi, a fermented vegetable, improves serum lipid profiles in healthy young adults: Randomized clinical trial. J Med Food, 16(3):223-229.

Chong, T.M., Abdullah, M.A., Fadzillah, N.M., Lai, O.M., Lajis, N.H. (2004). Anthraquinones production, hydrogen peroxide level and antioxidant vitamins in Marinda elliptical cell suspension
cultures from intermediary and production medium strategies. Plant cell reports, 22:951-958.

Darias-Martin, J., Lobo-Rodrigo, G., Hernandez-Cordero, J., Diaz-Diaz, E., Diaz-Romero, C. (2003). Alcoholic beverages obtained from black mulberry. Food Technol. Biotechnol., 41(2):173-176.

David B Fankhauser. (2005). Pour plate technique for bacterial enumeration. Uni. Of Cincinnati Clermont College. Batavia OH, 45103:1-3.

Duh, P.D., Yen, G.C. (1997). Antioxidative activity of three herbal water extracts. Food Chem, 60:639-645.

Ercisli, S., Orhan, E. (2007). Some physicochemical characteristics of black mulberry (Morus nigra L.) genotypes from Northeast Anatolia region of Turkey. Sci Hortic, 116:41-46.

Ercisli, S., Tosun, M., Duralija, B., Voça, S., Sengul, M., Turan, M. (2010). Phytochemical Content of Some Black (Morus nigra L.) and Purple (Morus rubra L.) Mulberry Genotypes. Food Technology & Biotechnology, 48(1).

Fratianni, F., Pepe, S., Cardinale, F., Granese, T., Cozzolino, A., Coppola, R., Nazzaro, F. (2014). Eruca sativa might influence the growth, survival under simulated gastrointestinal conditions and some biological features of Lactobacillus acidophilus, Lactobacillus plantarum, and Lactobacillus rhamnosus strains. International Journal of Molecular Sciences, 15:17790-17805.

Imran, M., Talpur, F.N., Jan, M.S., Khan, A., Khan, I. (2007). Analysis of nutritional components of some wild edible plants. J Chem Soc Pak, 29(5):500-508.

Kamiya, K., Tanaka, Y., Endang, H., Umar, M., Satake, T. (2004). Chemical constituents of Morinda citrifolia fruits inhibit copper-induced low-density lipoprotein oxidation. J Agric Food Chem, 52:5843-5848.

Khan, T., Ahmad, M., Khan, R., Khan, H., Ejaz, A., Choudhary, M.I. (2006). Evaluation of phytomedicinal potentials of selected plants of Pakistan. Am. Lab., 38(9):20-22.

Lale, H., Ozczagir, A. (1996). Study on pomological, phenolic and fruit quality characteristics of mulberry (Morus sp.) species, Derim, 13:177-182 (in Turkish).

Liong, M.T. and Shah, N.P. (2005). Acid and bile tolerance and cholesterol removal ability of Lactobacilli strains. Journal of Dairy Science; 88: 55-56.

Luckow, T., Delahunty, C. (2004). Which juice is ‘healthier’? A consumer study of probiotic non-dairy juice drinks. Food Quality and Preference, 15:751-759.

Marhamatizadeh, M.H., Rezazadeh, S., Kazemeini, F., Kazemi, M.R. (2012). The study of probiotic juice product conditions supplemented by the culture of Lactobacillus acidophilus and Bifidobacterium bifidum. Middle-East J Sci Res, 11(3):287-297.

Miller, N.J. and Rice-Evans, C.A. (1997). The relative contributions of ascorbic acid and phenolic antioxidants to the total antioxidant activity of orange and apple fruit juices and blackcurrant drink. Food Chem, 60:331-337.

Nagpal, R., Ashwani, K. and Kumar, M. (2012). Fortification and fermentation of fruit juices with probiotic lactobacilli, Annals of Microbiology, 62(4):1573-1578.

Natural news. Lowering cholesterol with fermented foods. 2012. http://www.Nyrnaturalnews.com/diet-2/2012/11/lowering-cholesterol-with-fermented-foods.

Nazzaro, F., Frattini, F., Sada, A., Orlando, P. (2008). Symbiotic potential of carrot juice supplemented with Lactobacillus spp. and inulin or fructooligosaccharides. J Sci Food Agric, 88:2271-2276.

Norusis, M.J. 1993. SPSS Advanced Statistics User’s Guide. SPSS, Chicago.

Pawlowska, AM., Oleszek, W., Braca, A. (2008). Qualitativative analyses of flavonoids of Morus nigra L. and Morus alba L. (Moraceae) fruits. J. Agric. Food Chem., 56:3377-3380.

Pereira, A.L.F., Maciel, T.C., Rodrigues, S. (2011). Probiotic beverage from cashew apple juice fermented with Lactobacillus casei. Food Res Int, 44:1276-1283.

Rößle, C., Auty, M.A.E., Brunton, N., Gormley, R.T., Butler, F. (2010). Evaluation of fresh-cut apple slices enriched with probiotic bacteria. Innova Food Sci Emerg Technol, 11:203-209.

Ross, I.A. (2001). Medical Plants of the World. Chemical Constituents, Traditional and Modern Medical Uses. Humana Press, New Jersey.

Sadler, G.D., Murphy, P.A. (2010). pH and titratable acidity. In: Nielsen, S. (Ed): Food analysis. 4th edition. New York, Springer US; 219-238.

Sheehan, V.M., Ross, P., Fitzgerald, G.F. (2007). Assessing the acid tolerance and the technological robustness of probiotic cultures for fortification in fruit juices. Innovative Food Science and Emerging Technologies, 8:279-284.

Shimada, K., Fujikawa, K., Yahara, K., Nakamura, T. (1992). Antioxidative properties of xanthan on the autooxidation of soybean oil in cyclodextrin. J Agric Food Chem, 40:945-948.

Su, B.N., Pawlus, A.D., Jung, H.A., Keller, W.J., McLaughlin, J.L., Kinghorn, A.D. (2005). Chemical constituents of the fruits of Morinda citrifolia (Noni) and their antioxidant activity. J Nat Prod, 68:592-595.

Tien, Y.Y., Ng, C.C., Chang, C.C., Tseng, W.S., Kotwal, S., Shyu, Y.T. (2005). Studies in the lactic-fermentation of sugar apple (Annona squamosa L.) puree. J Food Drug Anal, 13:377-381.

Tripathi, M.K. and Giri, S.K. (2014). Probiotic functional foods: Survival of probiotics during processing and storage. Journal of Functional Foods, 9:225-241.

Tucci, H., Gardello, A.V. (2002). Consumer response to an off flavour in juice in the presence of specific health claims. Food Quality and Preference, 13:561-569.

Wang, C.H., Lai, P., Chen, M.E. and Chen, H.L. (2008). Antioxidative capacity produced by Bifidobacterium- and Lactobacillus acidophilus-mediated fermentations of konjac glucomannan and glucomannan oligosaccharides. J Sci Food Agric, 88:1294-1300.

Wang, S.C., Chang, C.K., Chan, S.C., Shieh, J.S., Chiu, C.K. and Duh, P.D. (2014). Effects of lactic acid bacteria isolated from fermented mustard on lowering cholesterol. Asian Pacific Journal of Tropical Biomedicine, 4(7):523-528.

Yahyahi and Soofyani, Z. (2014). The evaluation of production of probiotic non-dairy juice drinks. Food Prod, 68:592-595.

Yahyahi and Soofyani, Z. (2014). The evaluation of production of probiotic non-dairy juice drinks. Food Prod, 68:592-595.