Use of Essential Oils from *Citrus sinensis* in the Development of New Type of Yogurt

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**ABSTRACT**

*Citrus* are well known as one of the world’s major fruit crops that are produced in many countries with tropical or subtropical climate. *Citrus* peel essential oils are reported to be one of the rich sources of bioactive compounds namely coumarins, flavonoids, carotenes, terpenes and linalool, etc. Yogurt has long been known as a product with many desirable effects for health. *Citrus* peels, commonly treated as agro-industrial waste, are a potential source of valuable secondary plant metabolites and essential oils. The aim of this work was to use essential oils from *Citrus* peels as flavouring agent in the development of new yogurt. The quality parameters of the new product and the viability of the lactic acid bacteria are maintained throughout the shelf-life, while the addition of orange essential oil impart a citric pleasant aroma and smell. The sensorial evaluation revealed a high acceptability score for the new type of yogurt.

**Keywords:** essential oils, orange, yogurt, new food

**INTRODUCTION**

Herbs and medicinal plants are a valuable source of natural products with potential application in the protection and preservation of certain foods. Medicinal and aromatic plants transmit their multiple benefits to consumers (Coldea et al., 2015). The use of herbs and spices may encourage variety in food intake and support nutrient diversity by encouraging new food choices (Salanță et al., 2014).

The research in the volatile oils field is very useful and very legitimate, from the point of view of content and composition, taking into account their therapeutic properties (respiratory analeptic, antifungal, antibacterial, digestive, tonic, astringent, diuretic, anticancer, antiviral, antiinflammatory, etc.), (Tofănă et al., 2010). The essential oils (volatile oils) were widely used in traditional medicine, and in the recent years, there is a constant demand to improve the quality of essential oils, because consumers demand this quality in their food, pharmaceutical or perfumery products (Socaci et al., 2007).

The main advantage of essential oils was that they could be used in any food and were considered generally recognised as safe (Viuda-Martos et al., 2008). *Citrus* essential oils were a complex mixture of volatile compounds that show, among other properties, antifungal activity by reducing or totally inhibiting fungal growth in a dose-response manner (Sharma and Tripathi, 2008).

*Citrus* are well known as one of the world’s major fruit crops that are produced in many countries with tropical or subtropical climate. *Citrus* fruits and their by-products are of high economic and medicinal value because of their multiple uses, in the food industry, cosmetics and folk medicine. The waste of *Citrus* processing industry, left after juice extraction, such as peels, seeds and pulps, corresponding to about 50% of
the raw processed fruit, can be used as a potential source of valuable by-products (Kamal et al., 2011). *Citrus* peel essential oils are reported to be one of the rich sources of bioactive compounds namely coumarins, flavonoids, carotenes, terpenes and linalool, etc. (Mondello et al., 2005).

Fermented dairy products are popular because of the health benefits provided by the ingestion of probiotics generated by the consumption of these products (Rotar et al., 2015).

Milk and milk products represent a key component of food processing in a global effort to ensure a healthy and balanced diet (Ștețca et al., 2015). Yogurt has long been known as a product with many desirable effects for health. The excellent sensory properties and the health benefits of yogurt can be credited to the action of yogurt bacteria and their metabolites (Pop et al., 2015). Yogurt is considered functional food and an important source of calcium, essential for the prevention of osteoporosis (Jimboorean et al., 2015). Among all of the fermented dairy products, yogurt is the most consumed probably due to the positive perception on the market as being seen by the consumers as a functional dairy product containing living microorganisms like lactic acid bacteria (LAB), streptococci, bifidobacteria or their combinations, coming from the starter cultures, recognised as ingredients that promote human health (Rotar et al., 2015).

*Citrus* peels, commonly treated as agro-industrial waste, are a potential source of valuable secondary plant metabolites and essential oils. The aim of this work was to use essential oils from *Citrus* peels as flavouring agent in the development of new yogurt.

**MATERIALS AND METHODS**

**Plant material**

Mature fruits of sweet orange (*Citrus sinensis*) were purchased from a local supermarket. The fruits were then peeled off carefully with the help of a sharp knife to avoid any damage of oil glands. The peels under testing were used as fresh.

**Essential oil extraction**

The samples of fresh peels (50 g of peels were weighed into a 700 ml distillation flask) were subjected to hydro-distillation for 3.5 h using a Clevenger-type apparatus. At the end of extraction the obtained essential oil was collected and measured.

**Qualitative identification of volatile compounds**

The analyses were carried out on a Shimadzu GC model gas chromatograph. A column DB-5MS (30 m x 0.25 mm x 0.25 μm) was used for the analyses. The orange essential oils sample was processed with 0.01% methylene chloride. The acquisition of chromatographic data was performed by the comparison of the obtained mass spectra with the ones from the mass spectra libraries, NIST and with the data from literature.

**Yogurt preparation**

In order to obtain yogurt, whole milk was used, following specific technological process assortment (Jimboorean et al., 2013). The milk was pasteurized at 95°C in plate heat exchanger and held in the tank for 25 min, cooled to 43°C and inoculated with starter culture of yogurt consisting of *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus*. Orange essential oil was added in quantities established, and samples were thermostatic at 42°C for 3 hours. After pre-cooling, samples were thermostated at 20°C than cooled to 2-6°C for 12 hours. Two types of yoghurt were obtained in this study: yoghurt with orange essential oils (YP) and classic yoghurt (YM) was the control sample.

**The viability of lactic acid bacteria of yogurt**

Monitoring the evolution of lactic acid bacteria in yogurt was followed for a period of 21 days at refrigerated temperature (4°C), samples being analyzed at an interval of 7 days. The number of lactobacilli was determined on the MRS agar at 37°C and the number of streptococci was determined on M17 agar medium at 37°C after 48 h, respectively 72h of incubation (Pop et al., 2015).

**The titrable acidity**

The titrable acidity of samples was also monitored during storage according to standards of AOAC (Association, 2000).

**Sensorial evaluation**

For the sensorial analysis of the yogurt enriched with orange essential oils, the hedonic
method scale (with 9 points) was used in order to determine the degree of acceptance of a new product. The sensory profile of both classical and flavoured yogurt samples was performed by 45 panellists who evaluated the samples’ colour, consistency, texture and aroma.

RESULTS AND DISCUSSION

Essential oil obtained by distillation with a Clevenger-type apparatus, had 1.16 ml/50g yield. Using GC a total of 17 chemical constituents were identified in the peel essential oils of *C. sinensis* (Table 1). D-limonene (90%), the main ingredient in orange peel oil, provides a natural odour (Tan et al., 2011) was identified in our samples.

In the first day of storage, all samples of yogurt were homogenous, fine, white, uniform, creamy consistency, fragrant, typical to yogurt, sour taste pleasant, well expressed.

The titrable acidity of samples was monitored during storage, a correlation between the titrable acidity and the survival of lactic acid bacteria, being observed for samples taken into study (Fig. 1 and Fig. 2).

Tab. 1. Composition of orange essential oil

<table>
<thead>
<tr>
<th>No.</th>
<th>Compound</th>
<th>Retention time (Tr)</th>
<th>Odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>a-Pinene</td>
<td>7.44</td>
<td>terpenic, harsh-pine-like, weak herbal</td>
</tr>
<tr>
<td>2.</td>
<td>b-Pinene</td>
<td>7.76</td>
<td>terpenic, harsh-pine-like, weak herbal</td>
</tr>
<tr>
<td>3.</td>
<td>Sabinene</td>
<td>7.18</td>
<td>woody, terpenic, slightly citrus, weak spicy/herbal</td>
</tr>
<tr>
<td>4.</td>
<td>Limonene</td>
<td>8.13</td>
<td>weak lemon and orange –like</td>
</tr>
<tr>
<td>5.</td>
<td>B-Myrcene</td>
<td>8.25</td>
<td>Spicy/Woody</td>
</tr>
<tr>
<td>6.</td>
<td>Linalool</td>
<td>8.37</td>
<td>fresh, floral and woody</td>
</tr>
<tr>
<td>7.</td>
<td>Cis-Geraniol</td>
<td>8.59</td>
<td>floral, rose-like, sweet- and fruity-notes</td>
</tr>
<tr>
<td>8.</td>
<td>Geranial</td>
<td>8.69</td>
<td>sweet-fruity-rose</td>
</tr>
<tr>
<td>9.</td>
<td>g-Terpinene</td>
<td>9.04</td>
<td>citrus-terpenic, lime with a touch of herbs</td>
</tr>
<tr>
<td>10.</td>
<td>Camphene</td>
<td>9.26</td>
<td>fruity</td>
</tr>
<tr>
<td>11.</td>
<td>4-Terpineneol</td>
<td>10.57</td>
<td>pleasant, sweet-piney, somewhat turpentine</td>
</tr>
<tr>
<td>12.</td>
<td>a-Terpineol</td>
<td>10.82</td>
<td>pleasant, sweet-piney, somewhat turpentine</td>
</tr>
<tr>
<td>13.</td>
<td>Citronellol</td>
<td>10.98</td>
<td>floral, sweet, green odour</td>
</tr>
<tr>
<td>14.</td>
<td>Caryophyllene</td>
<td>13.50</td>
<td>dry, woody-spicy, somewhat oily</td>
</tr>
<tr>
<td>15.</td>
<td>Aromadendrene</td>
<td>13.94</td>
<td>weak lemon</td>
</tr>
<tr>
<td>16.</td>
<td>Germacrene D</td>
<td>14.06</td>
<td>spicy</td>
</tr>
<tr>
<td>17.</td>
<td>Longifolene-(V4)</td>
<td>14.86</td>
<td>sweet, woody</td>
</tr>
<tr>
<td>18.</td>
<td>Copaene</td>
<td>15.15</td>
<td>spicy/woody</td>
</tr>
</tbody>
</table>

Fig.1. The titrable acidity of samples

Fig.2. The viability of lactic acid bacteria of yogurt
The addition of 0.2 ml orange essential oils resulted in an increase of the viable cell counts from $2.56 \times 10^7$ CFU/mL on day 0 to $6.16 \times 10^7$ CFU/mL on day 21, compared with the classical yogurt, where the viable cell increase from $2.86 \times 10^7$ CFU/mL on day 0 to $4.88 \times 10^7$ CFU/mL on day 21. Results showed that the yogurt enriched with orange essential oils improves the viability of the lactic acid bacteria, due to the biological active compounds from orange peels.

The sensorial quality of food products is a key factor in consumer's decision-making process. Hedonic testing is often used to determine consumer's attitude towards the food by measuring the degree of acceptance of a new product or improving the existing food product (Nagy et al., 2015). The addition of orange essential oils influences the sensory properties of yogurt, and smell scored 8.33 points. The sensorial evaluation revealed a high acceptability score (7.50) for the new type of yogurt.

CONCLUSIONS

The quality parameters of the new product and the viability of the lactic acid bacteria are maintained throughout the shelf-life, while the addition of orange essential oil impart a citric pleasant aroma and smell.

REFERENCES


