The Evaluation of the Sensory and Microbiological Properties of the Yogurt Supplemented with *Achillea melifolium* and *Solanum muricatum*

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**Abstract**

This research explored the sensory characteristics and consumer acceptance of novel yogurt. The study aimed to develop a new type of yogurt through addition of microcapsules with *Achillea melifolium* infusion and jelly from the pepino fruit. The effect of yogurt supplementation with four different levels (0%,1%,3%,5%) of microcapsules with *Achillea melifolium* infusion (MI) and four levels (0%,3%,7%,11%) of pepino juice jelly (PJ) on sensory properties and the viability of lactic acid bacteria in yogurts during storage (21 days) at 4°C was evaluated. The yogurt supplementation with 3% microcapsules and 7% jelly significantly improves the stability of the lactic acid bacteria, that contained the recommended levels of $10^8$ cfu/g lactic acid bacteria at the end of 21-days shelf life. All the yogurt samples, however, contained the recommended levels of ($10^6$–$10^7$ cfu/g) lactic acid bacteria at the end of 21-day shelf life. The yogurt with 3% microcapsules and 7% jelly was the most appreciated (6.78 points), followed by the classic yogurt (5.98 points). Total phenols content was 251 mg GAE/g for *A. millefolium* infusion and 117 mg GAE/g for pepino juice. The radical scavenging activity of *A. millefolium* infusion was 78% and for pepino extract 56.30%.

**Keywords**: *Achillea melifolium*, lactic acid bacteria, pepino, yogurt

**Introduction**

Fermented dairy products are popular because of the health benefits provided by the ingestion of probiotics generated by the consumption of these products and among all of the fermented dairy products yogurt is the most consumed (Cruz et al., 2013), 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) (Rotar et al., 2015). The yogurt, to be considered as a healthy product, in order to *Streptococcus thermophilus* and *L. delbrueckii* ssp. *bulgaricus*, as starter cultures, must be at a daily dose of $10^9$ CFU/g. Particularly in the case of yogurts, interaction with the added starter culture, low proteolytic activity, post-acidification, exposure to oxygen and low temperatures during storage may cause negative impacts on the survival of such microorganism, resulting in commercial products inability to provide the benefits to consumer health during shelf life at a daily intake (Batista et al., 2015).

In addition, microcapsules with *Achillea melifolium* (common yarrow) infusion and
Jelly from the pepino fruit are considered to be very nutritious, containing vitamins, sugars, minerals, and dietary fiber, as well as flavonoids and tocopherols, all of which are beneficial in preventing diseases (Dias et al., 2013). The major effect of the soluble fibers occurs by the retarding gastric absorption of sugars and amino acids in the small intestine, reducing the postprandial blood glucose responses (Perina et al., 2015). Therefore, a high consumption of dietary fiber promotes higher satiety, less energy ingestion, and also a contribution to obesity control (Perina et al., 2015).

Consumers have been bombarded with a wide range of new food products, which has led the food industry to use sensory profiling tools to develop more attractive products and meet consumers’ expectations (Esmerino et al., 2017).

In this context, in the present study, Achillea millefolium (common yarrow) infusion and jelly from the pepino fruit were concomitantly incorporated to yogurt aiming to produce functional yogurt, nevertheless chiefly with acceptable sensory characteristics. The influence of yogurt supplementation was investigated in sensory attributes as flavor, texture (on spoon), creaminess (in the mouth) and overall liking were conducted by the application the hedonic scale.

In this study, it was investigated the effect of yogurt supplementation with four different levels (0%, 1%, 3%, 5%) of microcapsules with Achillea millefolium infusion (MI) and four levels (0%, 3%, 7%, 11%) of pepino juice (PJ) on growth of the lactic acid bacteria. Also, sensory properties of the final product immediately and during storage for 21 days were investigated.

**Materials and Methods**

Yogurt is made by fermenting milk 3.5% fat with the starter culture of yogurt consisting of Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus salivarius subsp. thermophilus (TIPO YOGUR FERLAC II). Achillea millefolium infusion (15%) was mixed with 15 g/L sterile sodium alginate solution and dripped using a vibrational unit (Multinozzle Biotech-EncapBioSistems Inc. encapsulator). The microspheres were crosslinked in calcium chloride (Sigma Aldrich, Germany), the hardening bath, for 30 min, and then rinsed with sterile sodium chloride (8.5 g/L). These microspheres were introduced into yogurt before packaging in different levels (0%, 1%, 3%, 5%).

The viability of lactic acid bacteria of yogurt samples were assessed in 4 stages of the storage period, stage 1 - at the beginning of storage; stage 2 - at 7 days of storage; stage 3 – at 14 days of storage and stage 4 - at 21 days. All samples were analysed in duplicate.

The number of lactic acid bacteria was determined on the MRS agar medium after 48 h of incubation (Rotar et al., 2015). Sensory analyzes of the samples, as well as the control sample were evaluated by 25 untrained panelists using a 9-point hedonic scale.

The aqueous extracts (Achillea millefolium infusion and pepino juice) were screened for total phenolics content using the Folin-Ciocalteu reagent, according to Socaci et al. (2013) and antioxidant activity (2,2-diphenyl-1-picrylhydrazyl method) (Anesini et al., 2008).

**Results and Discussion**

The addition of 3% microcapsules and 7% jelly resulted in an increase of the viable cell counts of lactic acid bacteria from $2.8 \times 10^8$ CFU/mL on day 0 to $8.56 \times 10^8$ CFU/mL on day 14 (Tab. 1). After day 14, it was observed a decrease of lactic acid bacteria in all analysed samples.

Total phenols content was 251 mg GAE/g for A. millefolium infusion and 117 mg GAE/g for pepino juice. The radical scavenging activity of A. millefolium infusion was 78% and for pepino extract 56.30%. The results suggested that pepino fruit and A. millefolium infusion could be promising sources of natural antioxidants.

Many studies have shown that the current trend in the food industry is use antioxidant compounds, however, growing consumer concern for natural and healthier products has entailed an increase in the use of natural antioxidants. The natural phenolic antioxidant compounds are able to sequestre free radicals and chelate transition metals, thus halting auto-oxidation decay and the production of poor odors and textures (Pereira et al., 2016).

The new addition influences the sensory properties of yogurt. However, panelists prefer the yogurt with of 3% microcapsules and 7% jelly as is shown in Figure 1. The results of the consumer tests indicate that new type of yogurts had good consumer liking, and the ideal product had higher levels of fruit taste, sweet taste and a good soft texture.
The Evaluation of the Sensory and Microbiological Properties of the Yogurt with Achillea millefolium and Solanum muricatum

Fig 1. Sensory profile of the four type of yogurt

<table>
<thead>
<tr>
<th>Sample</th>
<th>Lactic acid bacteria CFU/ml*10⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Storage period (days)</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Y0</td>
<td>0.85</td>
</tr>
<tr>
<td>Y1</td>
<td>2.8</td>
</tr>
<tr>
<td>Y2</td>
<td>2.8</td>
</tr>
<tr>
<td>Y3</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Note: Y0 – classic yogurt; Y1 - 1% microcapsules and 3% jelly; Y2 - 3% microcapsules and 7% jelly; Y3 - 5% microcapsules and 11% jelly;

Conclusion

This research identified that the rich additions in polyphenolic compounds could be potentially considered as a source of ingredients for yogurt supplementation. The results obtained may be helpful to optimize formulations and will immediately yield optimized products from a sensory point of view, with high potential success in consumer marketing.

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References