# Development of Natural Preservatives for the Food Industry: An Integrated Strategy Focused on the Use of Sustainable, Low Cost and Efficient Processes

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## Introduction

The demand for natural foods is increasing, since the concern about the use of artificial additives is increasing too.

In the search for alternatives to the synthetic ones, natural preservatives obtained from plants appears as a viable option, ensuring consumer´s safety.

## Objectives

The aim of the present work was to evaluate the preservative capacity of natural matrices such as rosemary (*Rosmarinus officinalis* L.), basil (*Ocimum basilicum* L.) and sage (*Salvia officinalis* L.) and compare their behavior with an artificial one (potassium sorbate). These preservatives were incorporated in yogurts and the physical parameters and nutritional profile were accessed.

## Methods

### Physical parameters

➢ Colour: evaluated using a colorimeter, parameters like luminosity (L*) and cromatic coordenates (a* and b*).

➢ pH
➢ Water activity

### Nutritional profile

➢ Fat: obtained from a Soxhlet extractor, using petroleum ether as an extracting solvent.

➢ Ash: calculated by incineration at 550 °C in a muffle and measure of the final weight.

➢ Proteins: determined by the Macro–Kjedahl method, using a conversion factor of 6,38.

➢ Carbohydrates: measured using the anthrone method and detected with HPLC-RI.

➢ Moisture: using a Moisture Analyzer.

➢ Energy: calculated using the following formula:

$$\text{Energy} = 4 \times (\text{g protein} + \text{g total available carbohydrates}) + 2 \times (\text{g dietary fiber}) + 9 \times (\text{g crude fat}).$$
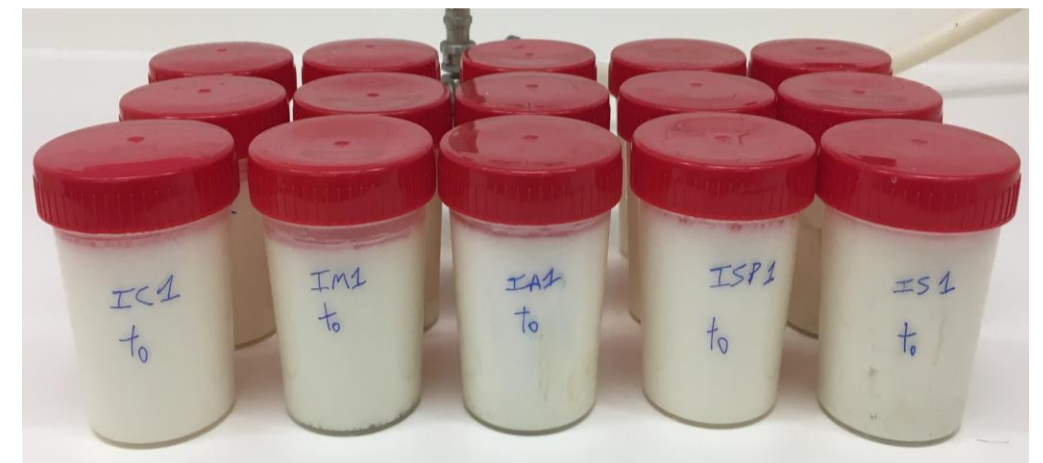


## Results

| | | Moisture | Fat (g/100g fw) | Ash (g/100g fw) | Proteins (g/100g fw) | Carbohydrates (g/100g dw) | Energy Kcal (g/100 g) |
|---|---|---|---|---|---|---|---|
| Storage Time (ST) | 0 Days | 87±2 | 1.7±0.3b | 1.0±0.2b | 2.9±0.3 | 8±1 | 34±7 |
| | 7 Days | 88±3 | 1.2±0.3a | 0.6±0.2a | 3.0±0.7 | 8±1 | 31±7 |
| | 14 Days | 88±2 | 1.3±0.5a, b | 0.7±0.2a | 2.7±0.8 | 7±1 | 29±6 |
| *p*-value (n=15) | Tukey's HSD test | 0.088 | 0.039 | <0.001 | 0.153 | 0.079 | 0.068 |
| Preservative Type (PT) | Control | 87±2 | 1.6±0.6a | 0.8±0.4 | 2.8±0.4 | 7±1 | 33±6 |
| | Rosemary | 87±1 | 1.6±0.5a | 0.8±0.2 | 3.1±0.3 | 8±1 | 35±5 |
| | Basil | 88±2 | 1.1±0.6a | 0.8±0.1 | 2.9±0.6 | 7±1 | 29±6 |
| | Sage | 89±1 | 1.1±0.4a | 0.9±0.3 | 2.9±0.3 | 8±1 | 29±4 |
| | Potassium Sorbate | 88±2 | 1.6±0.6a | 0.8±0.3 | 2.7±0.8 | 7±2 | 32±10 |
| *p*-value (n=9) | Tukey's HSD test | 0.592 | 0.043 | 0.725 | 0.473 | 0.120 | 0.207 |
| ST×PT (n=45) | *p*-value | 0.088 | 0.186 | 0.306 | 0.080 | 0.009 | 0.110 |

| | | L* | a* | b* | Water activity | pH |
|---|---|---|---|---|---|---|
| Storage Time (ST) | 0 Days | 71±3a | 2.6±0.2b | 10.9±0.7 | 0.992±0.001a | 4.8±0.2 |
| | 7 Days | 79±2b | 2.8±0.5b | 12±1 | 0.995±0.001b | 4.8±0.2 |
| | 14 Days | 82±3b | 2.1±0.2a | 11±2 | 0.996±0.001b | 4.9±0.1 |
| *p*-value (n=15) | Tukey's HSD test | <0.001 | <0.001 | <0.001 | <0.001 | 0.120 |
| Preservative Type (PT) | Control | 78±6 | 2.7±0.5a | 11.5±0.8 | 0.997±0.001b | 4.8±0.2 |
| | Rosemary | 78±5 | 2.2±0.5a | 10.6±0.8 | 0.9944±0.0008a | 4.7±0.1 |
| | Basil | 76±4 | 2.5±0.6a | 12±2 | 0.995±0.001a | 4.9±0.2 |
| | Sage | 78±5 | 2.3±0.3a | 11±1 | 0.995±0.001a | 4.8±0.2 |
| | Potassium Sorbate | 77±6 | 2.0±0.3a | 10±1 | 0.995±0.001a | 4.91±0.05 |
| *p*-value (n=9) | Tukey's HSD test | 0.235 | 0.031 | <0.001 | <0.001 | 0.162 |
| ST×PT (n=45) | *p*-value | 0.416 | 0.096 | <0.001 | 0.852 | 0.399 |

In each row, different letters mean significant statistical differences, with an overall significance value of 0.05. The presented standard deviations were calculated from results obtained under different operational conditions. Therefore, these values should not be regarded as a measure of precision, rather as the range of the recorded values.

➢ Carbohydrates and proteins were the major nutrients.

➢ Very little influence was found among the different preservative types.

➢ The passage of time showed higher influence than the preservative types.

➢ The yogurts became lighter with the passage of time, with significative difference from 0 to 7 days, but no difference between 7 and 14 days. Inversely, the a* showed a tendency to the red over time, with significant difference from the seventh to the fourteenth day.

➢ Water activity increased over time and also showed a significant increase from the control sample to the ones with preservatives, with no significative differences between potassium sorbate and the natural preservatives.

## Conclusions

➢ The natural preservatives do not show deep changes on the nutritional profile, and, pending their efficacy on antioxidant activity, should be encouraged as alternatives to synthetic preservatives.

➢ There are no significant differences between the natural preservatives and potassium sorbate, even though changes to the yogurts are very slight, as expected from food additives.

## Acknowledgments