Efficacy, Sustainability and Safety of Natural Food Preservatives: A Study on Muffins Preserved with Plant Extracts

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Introduction

Muffin ⇒ Baked product from wheat, sweet, spongy and very popular

Food preservation ⇒ Control unwanted microorganims, inhibit from chemical deterioration and prevent browning

Additives ⇒ Natural preservatives to replace artificial additives

Ensure safety and quality during its shelf life

Plant extracts

- Rosemary (*Rosmarinus officinalis L.*)
- Oregano (*Origanum vulgare L.*)
- Lemon Balm (*Melissa officinalis L.*)

Phenolic compounds

Methods

Plant extracts → Extracted with the aid of ultrassound → Analyzed by HPLC-DAD-ESI/MS

Muffin → Nutritional profile - AOAC; Exterior color - colorimeter

Results

A		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	19±2	14±2a	5.5±0.8a	12.6±0.4a	49±2a	369±12a
	4 Days	18±2	13.7±0.4a	4.9±0.3a	13.7±0.5b	52±1b	388±7b
	8 Days	18.3±0.6	12.8±0.5a	5.6±0.7a	13.5±0.3b	49.8±0.9a	369±5a
p-value (n=15)	Tukey's HSD test	0.0505	0.033	<0.001	<0.011	<0.001	<0.001
Preservative Type (PT)	Control	18±1	13±2	4±1	13.3±0.5	50±3	377±13
	Potassium Sorbate 2 mg/Kg	19±2	13.5±0.5	5±2	13.1±0.8	49±3	372±16
	Potassium Sorbate 0.2 mg/Kg	17.6±0.9	13.4±0.5	4±2	13.5±0.7	51±2	379±11
	Rosemary	17.8±0.3	13.5±0.5	4±2	13.4±0.3	51±3	378±10
	Lemon Balm	19±2	13.5±0.7	4±2	12.9±0.7	50±2	373±11
	Oregano	19±1	13.1±0.6	4±2	13.1±0.6	50±2	373±13
p-value (n=9)	Tukey's HSD test	0.0584	0.969	0.414	0.527	0.589	0.307
ST×PT (n=45)	p-value	0.092	0.623	0.704	0.135	0.798	0.103

B		Top L*	Top a*	Top b*	Bottom L*	Bottom a*	Bottom b*
Storage Time (ST)	0 Days	56±3b	11±1a	27±2	40±3	18±1	30±4
	4 Days	51±2a	13±1b	28±3	43±3	17±1	33±3
	8 Days	50±2a	14±1b	29±2	45±3	16±2	33±2
p-value (n=15)	Tukey's HSD test	<0.001	<0.001	0.167	<0.001	<0.001	<0.001
Preservative Type (PT)	Control	54±3b	12±1a, b	28±3a	46±4	17±2	33.2±0.6
	Potassium Sorbate 2 mg/Kg	52±2a, b	13±1a, b	29±1a	42±3	18.1±0.7	32±4
	Potassium Sorbate 0.2 mg/Kg	52±3a, b	13±1b	29±2a	40±3	17±1	30±4
	Rosemary	54±4b	12±2a	27±3a	44±2	18±1	35±1
	Lemon Balm	52±4a, b	13±2a, b	29±1a	42±4	17±1	30±2
	Oregano	49±2a	12.6±0.9a, b	26.3±0.9	45±2	16.0±0.9	33±2
p-value (n=9)	Tukey's HSD test	<0.001	0.015	0.042	<0.001	<0.001	<0.001
ST×PT (n=45)	p-value	0.155	0.391	0.531	<0.001	<0.001	<0.001

Table 1 – A) Nutritional profile and B) Colour profile of the Muffins over 8 days. 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.

Conclusion

- 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.
- The natural additives should be encouraged to be used as alternatives to synthetic ones. They did not impact the colour of muffins..
- Very little influence was found for the different preservative types on the muffins. In addition, the passage of time showed higher influence than the preservative types.
- The top section saw deeper changes through the passage of time than through the addition of the natural preservatives. No significant changes were verified for the side and bottom sections probably due to the high temperature making the muffin darker in these regions and the differences being faded out.

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