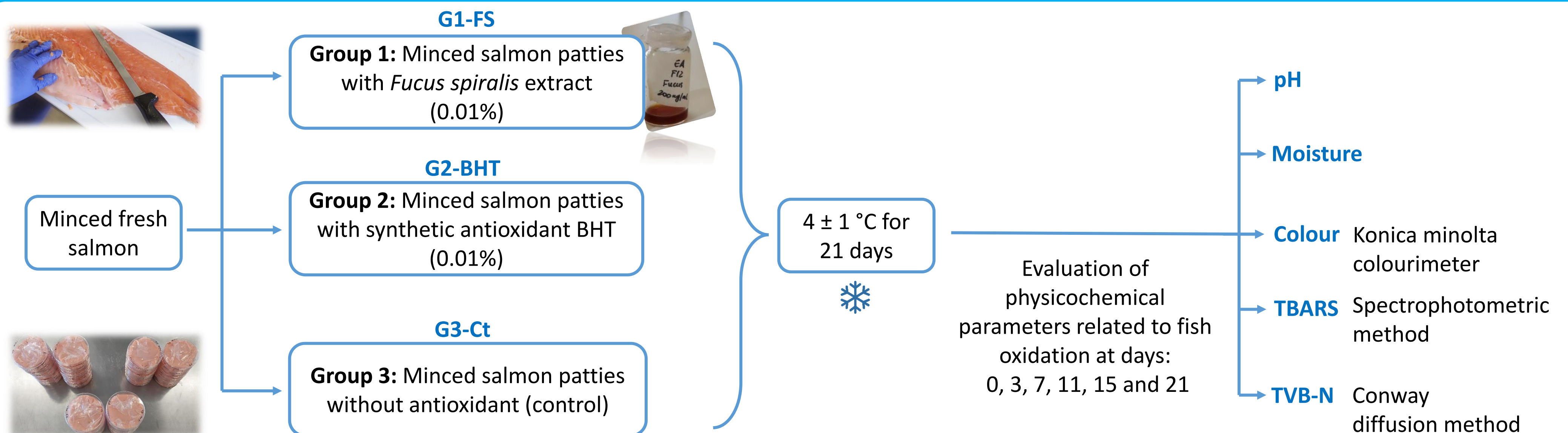




## Introduction

Natural antioxidants derived from macroalgae have great potential for improving oxidative stability of food products. *Fucus spiralis* (*F. spiralis*) is a brown macroalgae rich in bioactive compounds, including phlorotannins that are polyphenols derived from phloroglucinol with important antioxidant properties. A *F. spiralis* phlorotannin-enriched ethyl acetate extract was evaluated as natural antioxidant to extend the shelf-life of salmon homogenates, while comparing it to artificial antioxidant BHT. The extract was obtained by submitting *F. spiralis* biomass collected in summer to an extraction with ethanol:water, followed by a liquid-liquid fractionation with organic solvents (Almeida et al., 2021).

## Methodology



## Results

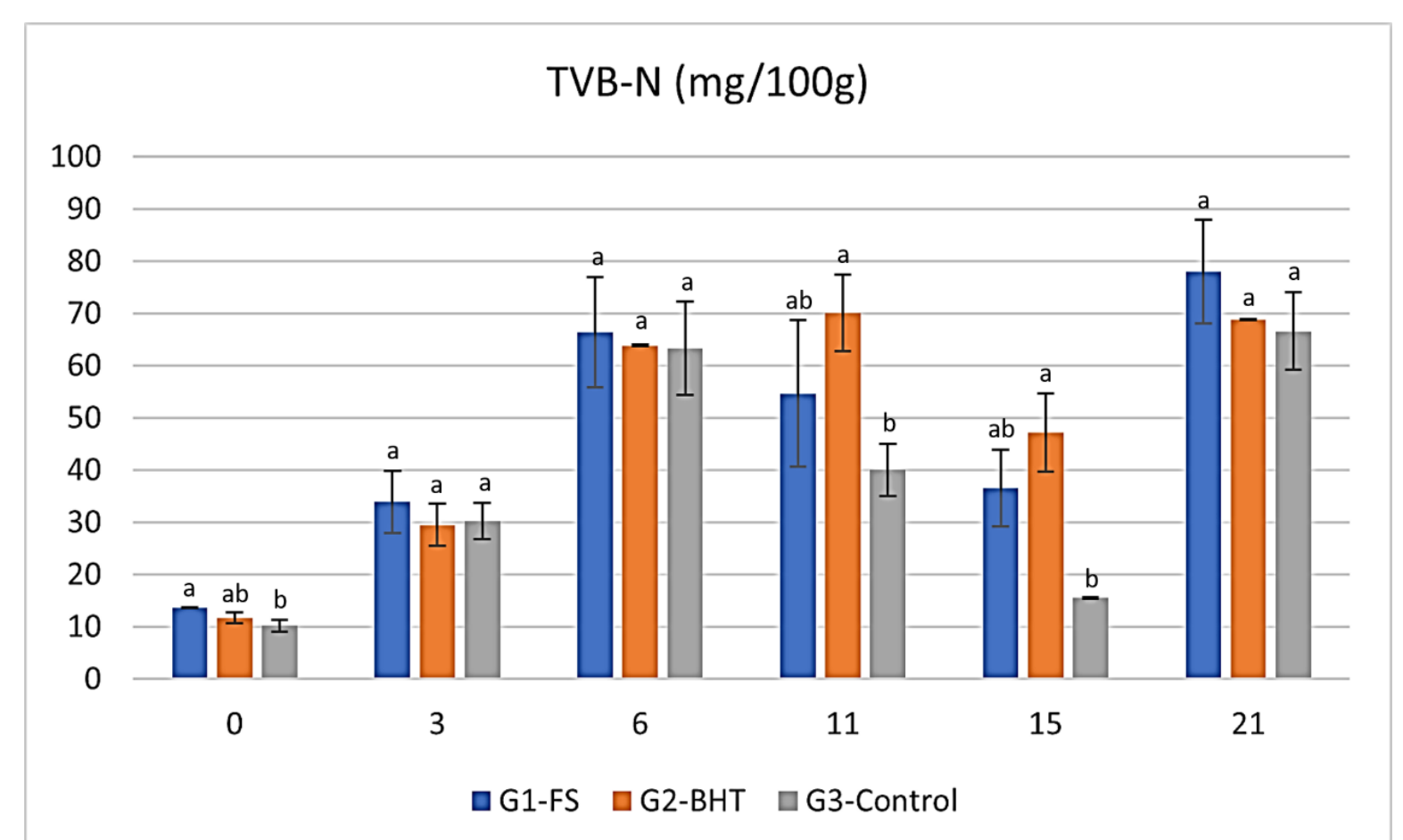
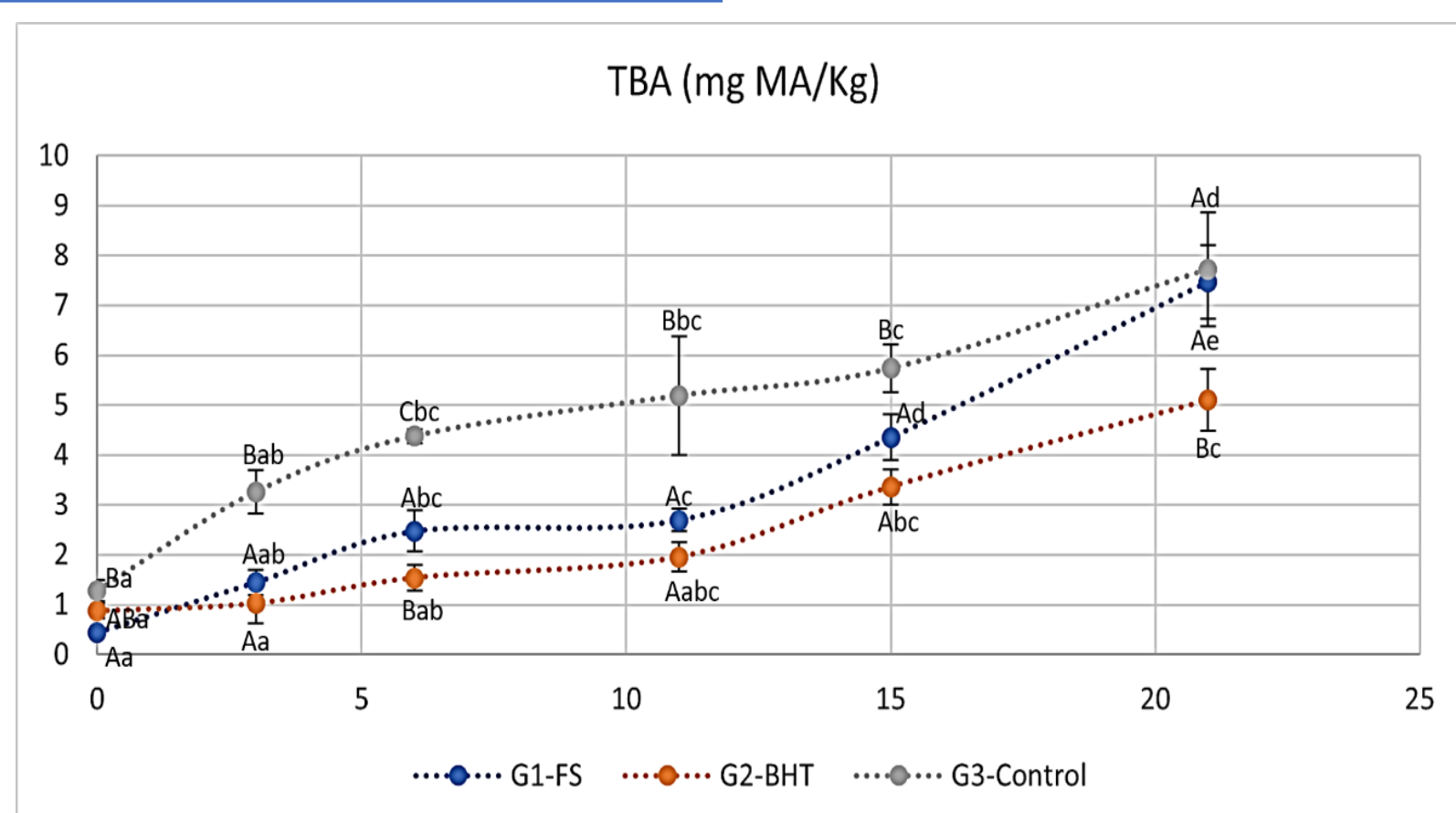
**Table 1.** pH and moisture of salmon patties over storage time. Capital letters mean significant differences between treatment groups and Lowercase letters mean significant differences between the days of storage time (p-value ≤ 0.05).

	Day	G1-FS	G2-BHT	G3-Ct
pH	0	6.283 ± 0.006 <sup>Aa</sup>	6.287 ± 0.006 <sup>Aab</sup>	6.287 ± 0.006 <sup>Aab</sup>
	3	6.310 ± 0.010 <sup>Ab</sup>	6.307 ± 0.012 <sup>Aa</sup>	6.303 ± 0.006 <sup>Aa</sup>
	6	6.250 ± 0.010 <sup>Ac</sup>	6.283 ± 0.006 <sup>Bab</sup>	6.263 ± 0.015 <sup>ABb</sup>
	11	6.260 ± 0.000 <sup>Ac</sup>	6.270 ± 0.010 <sup>ABb</sup>	6.280 ± 0.010 <sup>Bab</sup>
	15	6.280 ± 0.000 <sup>Aa</sup>	6.277 ± 0.006 <sup>Ab</sup>	6.290 ± 0.010 <sup>Aab</sup>
	21	6.265 ± 0.007 <sup>Aac</sup>	6.347 ± 0.040 <sup>Aa</sup>	6.340 ± 0.010 <sup>Ac</sup>
	Moisture	0	62.590 ± 1.328 <sup>Aa</sup>	62.918 ± 1.030 <sup>Aa</sup>
3		63.246 ± 0.471 <sup>Aa</sup>	63.774 ± 0.586 <sup>Aa</sup>	63.055 ± 0.308 <sup>Aa</sup>
6		62.675 ± 0.779 <sup>Aa</sup>	63.588 ± 0.668 <sup>Aa</sup>	62.538 ± 0.408 <sup>Aab</sup>
11		62.727 ± 0.441 <sup>Aa</sup>	64.303 ± 0.728 <sup>Aa</sup>	64.075 ± 0.296 <sup>Aa</sup>
15		61.829 ± 0.183 <sup>Aa</sup>	62.314 ± 0.186 <sup>Aa</sup>	61.200 ± 1.212 <sup>Ab</sup>
21		62.945 ± 0.597 <sup>Aa</sup>	63.716 ± 0.478 <sup>Aa</sup>	62.742 ± 0.229 <sup>Aab</sup>

**Table 2.** Colour parameters L\*, a\* and b\* of salmon patties during storage. Different lowercase letters represent significant differences between the days of storage time (p-value ≤ 0.05)

	Day	0	3	6	11	15	21
L*	G1	65.187 ± 1.280 <sup>a</sup>	65.544 ± 1.911 <sup>a</sup>	64.713 ± 1.695 <sup>a</sup>	65.612 ± 0.992 <sup>a</sup>	65.024 ± 0.396 <sup>a</sup>	65.596 ± 2.891 <sup>a</sup>
	G2	64.290 ± 0.681 <sup>a</sup>	64.086 ± 1.977 <sup>a</sup>	65.667 ± 0.789 <sup>a</sup>	64.403 ± 0.929 <sup>a</sup>	64.584 ± 1.093 <sup>a</sup>	64.208 ± 1.309 <sup>a</sup>
	G3	63.628 ± 1.543 <sup>a</sup>	65.177 ± 0.449 <sup>a</sup>	64.382 ± 0.903 <sup>a</sup>	65.026 ± 0.262 <sup>a</sup>	63.918 ± 0.267 <sup>a</sup>	64.673 ± 1.246 <sup>a</sup>
a*	G1	14.961 ± 0.231 <sup>a</sup>	14.794 ± 0.290 <sup>ab</sup>	13.491 ± 0.301 <sup>bc</sup>	13.264 ± 1.042 <sup>cd</sup>	12.172 ± 0.559 <sup>de</sup>	11.887 ± 0.433 <sup>e</sup>
	G2	15.258 ± 0.208 <sup>a</sup>	14.760 ± 0.550 <sup>ab</sup>	14.711 ± 0.280 <sup>bc</sup>	13.748 ± 0.265 <sup>cd</sup>	13.072 ± 0.453 <sup>de</sup>	12.616 ± 0.320 <sup>e</sup>
	G3	15.074 ± 0.257 <sup>a</sup>	14.634 ± 0.221 <sup>ab</sup>	13.608 ± 0.322 <sup>bc</sup>	12.938 ± 0.416 <sup>cd</sup>	12.323 ± 0.159 <sup>de</sup>	11.149 ± 0.643 <sup>e</sup>
b*	G1	23.772 ± 0.683 <sup>a</sup>	25.490 ± 0.515 <sup>b</sup>	23.457 ± 0.627 <sup>ab</sup>	24.107 ± 2.007 <sup>a</sup>	22.993 ± 0.323 <sup>a</sup>	23.502 ± 1.480 <sup>a</sup>
	G2	23.657 ± 0.525 <sup>a</sup>	24.881 ± 1.415 <sup>b</sup>	25.354 ± 0.397 <sup>ab</sup>	23.739 ± 0.506 <sup>a</sup>	23.537 ± 0.718 <sup>a</sup>	22.938 ± 0.756 <sup>a</sup>
	G3	22.983 ± 0.342 <sup>a</sup>	25.043 ± 0.386 <sup>b</sup>	24.156 ± 0.500 <sup>ab</sup>	23.740 ± 0.497 <sup>a</sup>	23.732 ± 0.074 <sup>a</sup>	22.824 ± 0.186 <sup>a</sup>

**Figure 1.** TBARS values of salmon patties during storage. Different capital letters represent significant differences between the treatment groups while different lowercase letters represent significant differences between the days of storage time.



**Figure 2.** TVB-N of salmon patties during storage. Different lowercase letters represent significant differences (Dunn Test, p-value ≤ 0.05) between groups for each day of storage time.

## Conclusions

- The addition of the algal extract did not show significant differences in the maintenance of pH and humidity of the samples throughout testing time (21 days) when compared to the samples with artificial antioxidant BHT and the control.
- However, the extract had a similar behavior to the artificial antioxidant BHT regarding the diminishing of deterioration compounds in fish (decrease of thiobarbituric acid reactive species TBARS) on the first days of the study (until day 11) when compared to the control.
- Relative to color alteration, none of the antioxidants decreased color loss, as no significant changes were observed in the measured parameters. Regarding the quantification of total volatile basic nitrogen (TVB-N), no significant difference was observed among treatments.

### References

[Almeida, B, Barroso, S., Ferreira, A. S. D., Adão, P., Mendes, S., Gil, M. M. (2021). Seasonal Evaluation of Phlorotannin-Enriched Extracts from Brown Macroalgae *Fucus spiralis*, *Molecules*, 26, 4287.

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