The Use of Ultrasound in Culinary Extraction Processes: A study in stocks and infused oils enriched with the seaweed *Codium tomentosum*

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INTRODUCTION

Broths are savoury liquids (prepared from meat, fish or vegetables) commonly used in Western cuisine for various culinary preparations (e.g. soups and sauces). Flavoured oils (for example with herbs or spices) are considered an effective way of homogeneously concentrating the aromas and flavours, allowing the addition of "essences" to dishes without the ingredient itself [1]. For both, broths and oils, extraction of components from food matrices usually involves the action of heat, which causes softening and rupture of the cell walls and consequently release their contents to the media [2]. New cooking techniques are nowadays used in the extraction of compounds from food matrices. In addition to the traditional long simmering technique, *sous-vide* (vacuum-sealed food cooked at a low temperature) and, more recently, ultrasound-assisted extraction (UAE) have been used. UAE is still rarely used in cooking but, in recent years, has been shown to be a promising technique in the food industry [3]. The comparison of the efficiency of the *sous-vide* and ultrasound extractions for the preparation of *Codium tomentosum* green seaweed broths and flavoured oils was evaluated. The extraction was done using identical time-temperature conditions in both cases (60° C for 45 minutes) – see Figure 1.

Figure 1: A – Extraction by *sous-vide* technique. B – Ultrasound bath. C – *Codium tomentosum*.
D – Aqueous extraction by *sous vide* (SV) only and ultrasound (US). E – Oil extraction by *sous vide* (SV) only and ultrasound (US)

INSTRUMENTAL ANALYSIS

The headspace solid-phase microextraction (HS-SPME) followed by gas chromatography-mass spectrometry method (GC-MS) was used to compare the volatiles profiles. It could be noted that UAE (*sweep* modulation and frequency of 37 KHz) is a more efficient technique, particularly for the preparation of broths. The results were not so clear in the case of the infused oils. The UAE seems to improve the richness of the preparation, more than increasing the yield. Despite this, in both cases, the UAE technique proved to deliver different products compared with the *sous-vide* one.

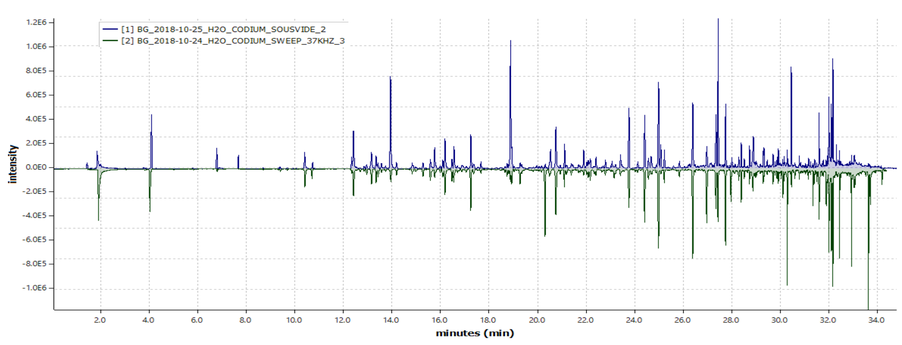

Figure 2: GC-MS Chromatograms –
Comparison between extractions in aqueous medium with and without ultrasounds.

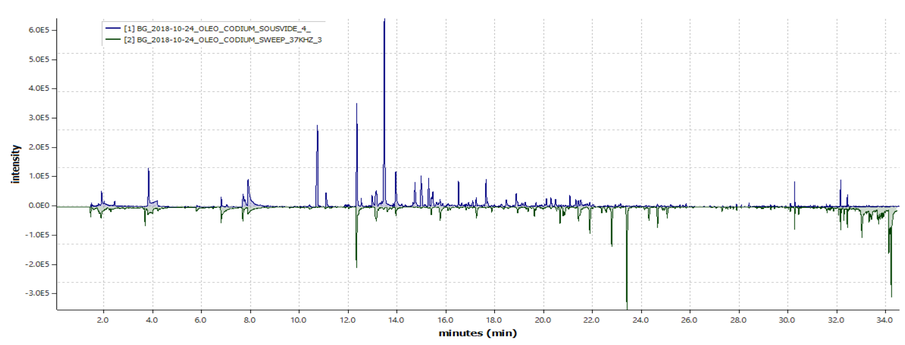

Figure 3: GC-MS Chromatograms –
Comparison between extractions in oil with and without ultrasounds.

SENSORY ANALYSIS

Subsequently, focus groups and differential sensory analysis tests (tetrad tests) were performed for broths and flavoured oils. Significant differences were also encountered. The assessors were able to identify significant differences between the oils prepared with or without ultrasound ($\alpha < 0,1\%$; $\delta = 3,0$; power > 95%). Regarding the broths it is estimated to exist a δ value of 1,1. Although there were identified significant differences between the broths prepared with or without ultrasounds ($\alpha < 0,1\%$; power = 43,5%), it's necessary to increase the sample size for the tetrad test because of the low power of the experiment conducted. The focus groups identified a higher intensity of the global sensory attributes on the products prepared with ultrasounds – both taste (bitter and salty), aroma and *flavour.*

CONCLUSION

Both chromatographic analysis and sensory tests endorse that the UAE can be a differentiating tool in the production of quality extracts from food matrices, allowing in some cases results with better organoleptic characteristics and an increased intensity of *flavour*.

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