

EXPLORING THE POTENTIAL OF *QUERCUS ROBUR* KERNEL AND SHELL FOR NOVEL FOOD APPLICATIONS

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INTRODUCTION

Acorns are produced in abundance across Portugal, yet remain largely underutilized, with only 1% being currently incorporated into human diets. However, acorns, as a sustainable, gluten-free, and nutrient-rich raw material, align with current consumer trends^{1,2}. Additionally, acorn by-products present significant potential as sources of bioactive ingredients, offering opportunities to enhance food utilization, encourage upcycling, and deliver new nutritional and health benefits. Rich in bioactive compounds like fatty acids, phenolic compounds, and tocopherols—known for their antioxidant properties—acorns also stand out for their high mineral content, making them a valuable addition to traditional foods³.

OBJECTIVE

This study focuses on characterizing the kernels and shells of *Quercus robur*, an endemic Portuguese species supplied by LandraTech. For that purpose, the two samples, kernel, and shells, were ground as flour and then analyzed regarding the physicochemical characteristics and nutritional value, complemented by the determination of their aqueous extract's antioxidant activity through ABTS and DPPH assays.

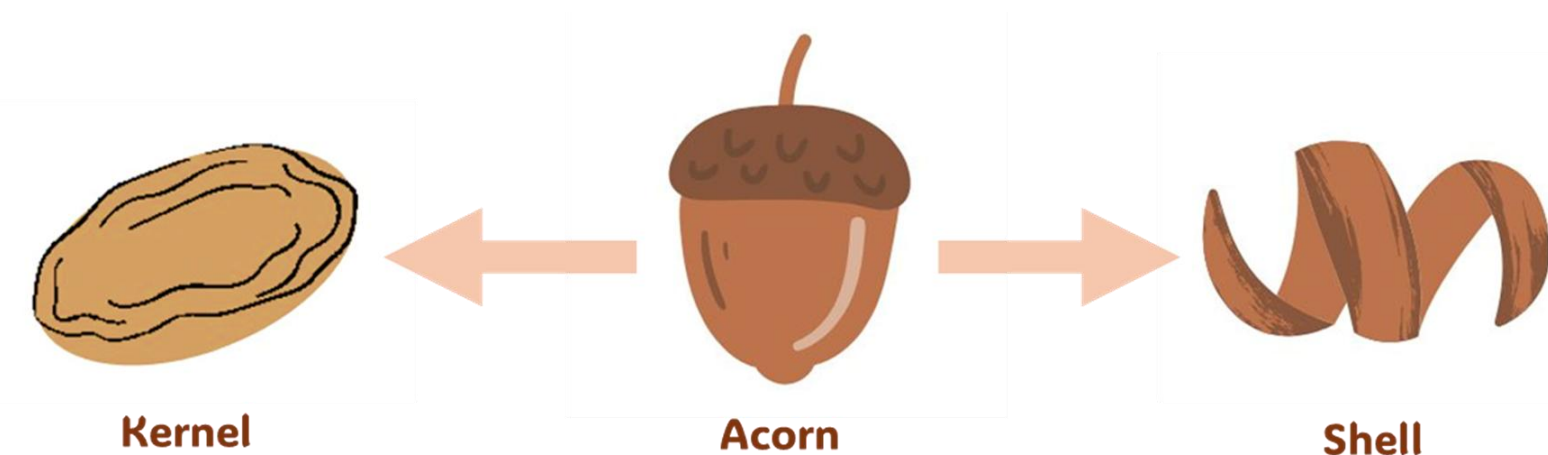


Figure 1. Acorn Kernel and Shell.

MATERIALS AND METHODS

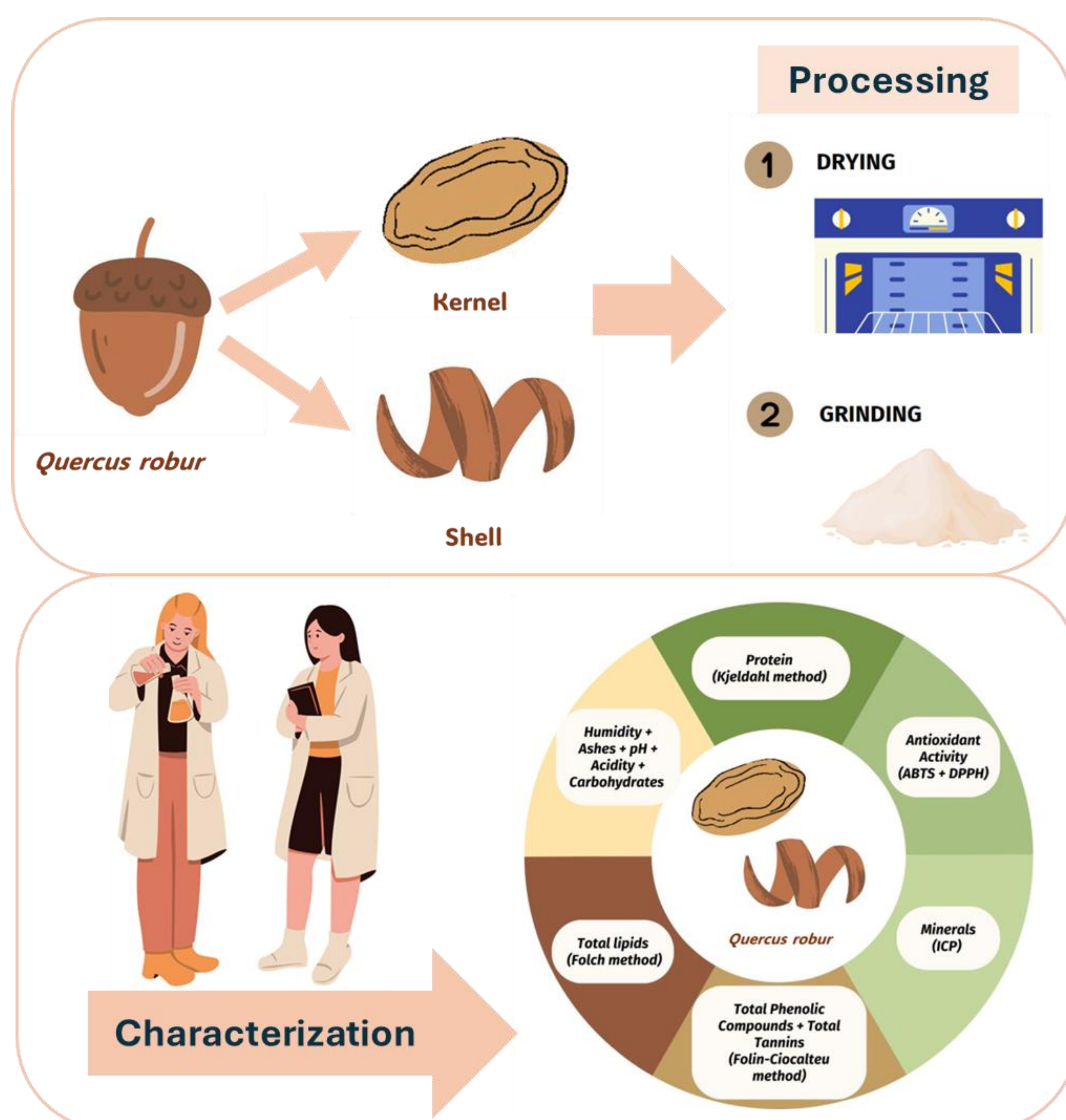


FIGURE 2. Processing and characterization methodologies diagram from the kernels and shells of *Quercus robur*, harvested in 2023.

RESULTS

TABLE 1. Composition of the flours obtained from kernel and shell of *Quercus robur* (DW – dry weight).

	pH	Acidity (g H ₂ SO ₄ /100 g DW)	Humidity (%)	Ashes (% DW)	Protein (% DW)	Total lipids (% DW)	Carbohydrates (% DW)
Kernel	5.01 ± 0.00	0.09 ± 0.00	9.58 ± 0.01	1.95 ± 0.20	6.09 ± 0.22	6.08 ± 0.78	76.30 ± 0.00
Shell	4.95 ± 0.00	0.05 ± 0.00	10.98 ± 0.00	1.64 ± 0.05	2.49 ± 0.16	1.67 ± 0.79	83.22 ± 0.00

TABLE 2. Mineral composition (mg/100 g DW) of the flours obtained from the kernel and shell of *Quercus robur*. DW – dry weight.

Minerals (mg/100 g DW)	Kernel	Shell
	P	71.87 ± 5.47
K	713.06 ± 58.47	588.91 ± 41.51
Na	0.26 ± 0.10	2.51 ± 0.05
Ca	28.24 ± 6.05	245.92 ± 12.28
Mg	39.06 ± 5.07	66.34 ± 5.60
Fe	0.20 ± 0.04	2.80 ± 0.52
Se	0.07 ± 0.01	0.21 ± 0.04
Zn	0.17 ± 0.04	0.11 ± 0.01
Cu	0.70 ± 0.07	0.46 ± 0.04
Mn	1.20 ± 0.12	8.00 ± 0.78

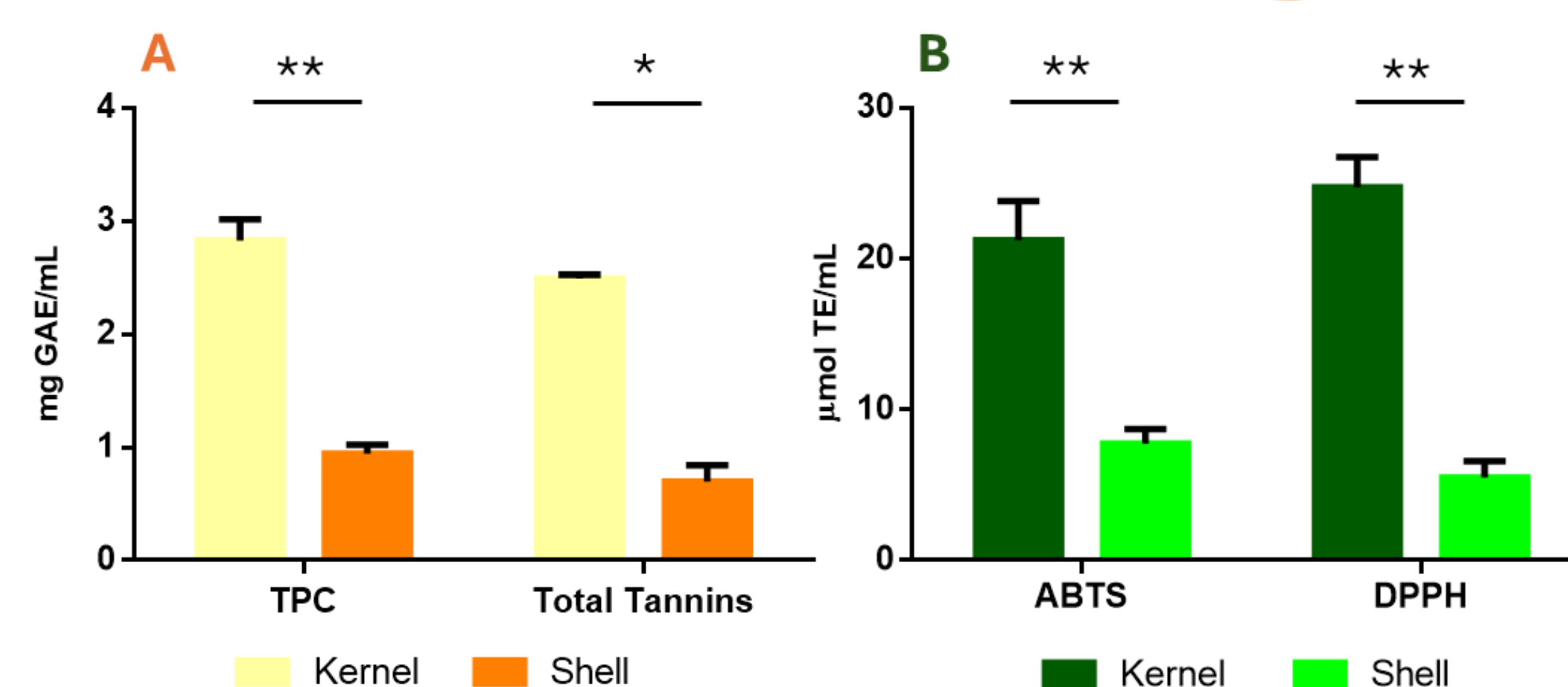


FIGURE 3. Differences between the flours obtained from the kernel and shell of *Quercus robur* regarding (A) the total phenolic compounds (TPC) and total tannins composition; and (B) antioxidant capacity by ABTS and DPPH assays; Significantly different, ** $p < 0.01$, * $p < 0.05$. The statistical significance of the difference between the two groups was assessed by the nonparametric Mann–Whitney test.

CONCLUSIONS

- ❖ The characterization of kernels and shells from *Quercus robur* highlights the significant potential of acorns from native Portuguese oaks as valuable raw materials for sustainable and innovative food applications.
- ❖ This study also emphasizes the importance of exploring underutilized residues as viable resources for the global food industry, promoting a circular economy approach.

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