VALORIZING ACORN BYPRODUCTS: EXPLORING HEALTH-PROMOTING BIOACTIVE COMPOUNDS AND EFFICIENT STARCH RECOVERY METHODS

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INTRODUCTION

Food shortages and waste management have become major global issues. Thus, agrifood and natural resources upcycling has been used as a novel strategy towards sustainability and circular economy. In Portugal, acorns (*Quercus spp.*) are produced abundantly; however, about 55% is left on the fields, leading to a significant resource loss. Acorn kernels from *Quercus rotundifolia* are especially rich in bioactive (e.g., phenolic compounds) and nutritional compounds making them valuable and versatile sources for developing innovative food products. Acorn's starch, particularly, holds distinctive physicochemical and nutritional characteristics, ideal for gluten-free, low-sugar uptake, and prebiotic applications. Hence, it aligns with the growing global demand for sustainable, functional, and allergen-friendly food solutions.

This work emphasizes the acorn's oxidized kernel upcycling potential to support circular economy. Moreover, since acorns are endemic in many regions worldwide, this approach represents a model for reducing food waste while addressing global needs for health-conscious and sustainable food products.

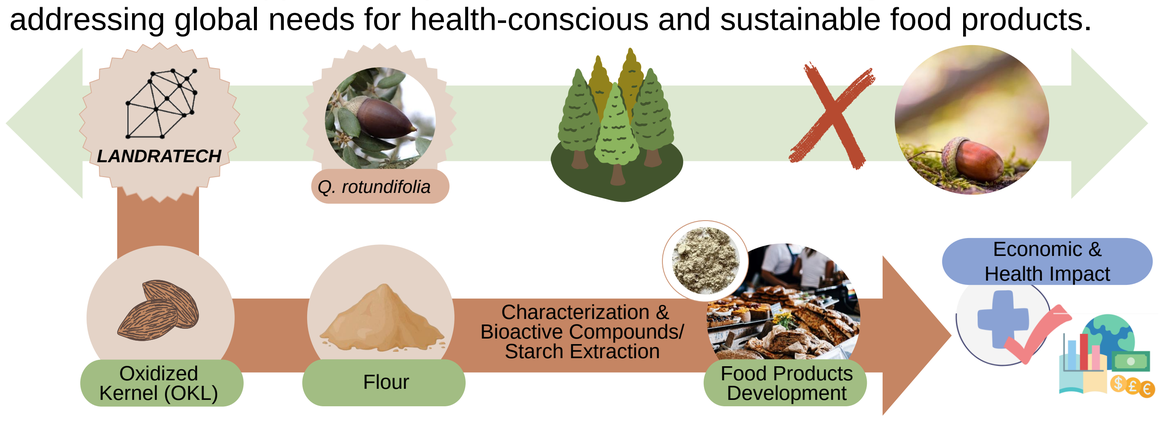


Figure 1. Acorn oxidized kernel (OKL) upcycling diagram.

OBJECTIVE

This work focused on the valorization of the oxidized kernel from *Quercus rotundifolia*, a Portuguese endemic species, as a byproduct of acorn processing provided by LandraTech. This work aimed to: i) characterize the nutritional and physicochemical composition of this overlooked raw material, and ii) extract starch for the development of value-added, gluten-free food products. This aligns with sustainability goals by transforming agricultural waste into innovative, health-promoting solutions, towards circular economy.

MATERIALS AND METHODS

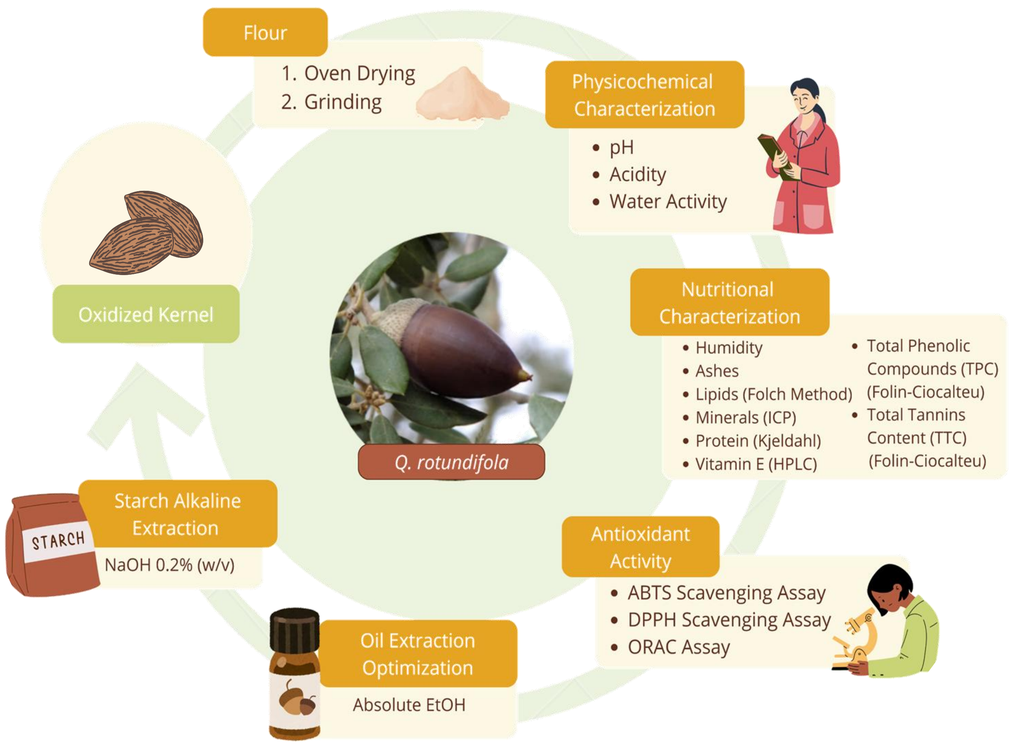
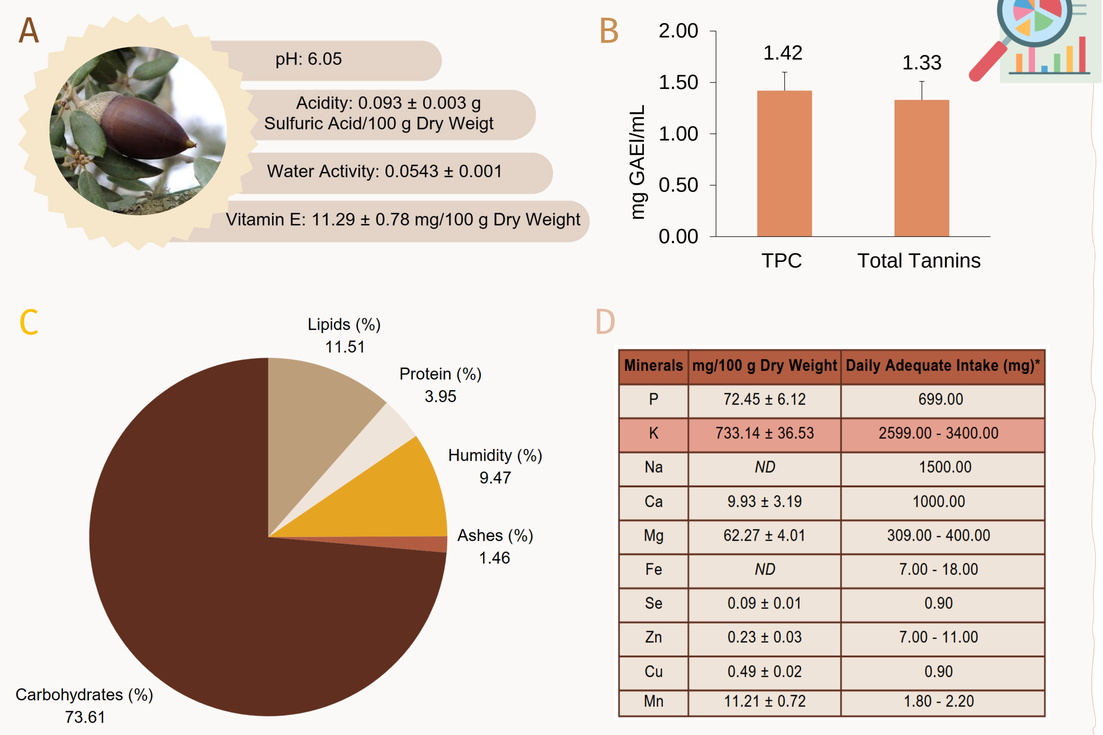


Figure 2. Processing and characterization methodologies diagram from the OKL of *Q. rotundifolia*, harvested in 2022.

RESULTS



Minerals	mg/100 g Dry Weight	Daily Adequate Intake (mg)*
P	72.45 ± 6.12	699.00
K	733.14 ± 36.53	2599.00 - 3400.00
Na	*ND*	1500.00
Ca	9.93 ± 3.19	1000.00
Mg	62.27 ± 4.01	309.00 - 400.00
Fe	*ND*	7.00 - 18.00
Se	0.09 ± 0.01	0.90
Zn	0.23 ± 0.03	7.00 - 11.00
Cu	0.49 ± 0.02	0.90
Mn	11.21 ± 0.72	1.80 - 2.20

FIGURE 3. Physicochemical and nutritional characterization of OKL. A- OKL pH, acidity, and water activity. B- OKL total phenolic compounds (TPC) and total tannins content. C- OKL centesimal composition. D-. OKL minerals composition. ND- below the detection limit. * According to *Harvard T.H. Chan, School of Public Health, 2023.*

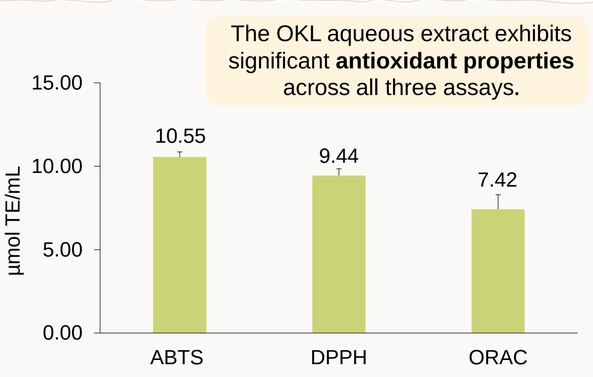


FIGURE 4. Antioxidant capacity of the OKL aqueous extract by ABTS, DPPH and ORAC assays.

FIGURE 5. Starch recovered from OKL by alkaline extraction (NaOH 0.2% w/v), and its potential applications in the food/wellness industry.

CONCLUSIONS

Our work demonstrates that the OKL is a sustainable resource of bioactive and nutritional compounds (e.g., starch, phenolic compounds, potassium) for the development of value-added, and gluten free food products. Moreover, the alkaline starch extraction was revealed to be efficient (yield of 39.56%), although further optimization and characterization are needed.

Overall, this work emphasizes the importance of upcycling food byproducts, contributing to waste reduction, sustainability, and circular economy.

ACKNOWLEDGEMENTS

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