

# The Value of Acorn Byproducts: Exploring Novel Ingredients and Nutritional Benefits

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## Introduction

In Portugal, acorns (*Quercus spp.*) are highly abundant, with an annual production of approximately 401,585 tonnes. Yet, about 55% remains in fields, leading to the waste of this biomass<sup>1</sup>. However, acorn byproducts are a novel source of bioactive compounds, offering a solution for reducing food waste, supporting sustainability, and delivering valuable nutritional benefits and health-promoting properties<sup>2</sup>. This potential is especially evident in acorn kernels, which contain oil, abundant in fatty acids, phenolic compounds (e.g., tannins, gallic acid), and starch<sup>3</sup>, all of which hold promising characteristics for developing value-added products within the food, pharmaceutical, and cosmetic industries. The extraction of oil from oxidized acorn kernels (OKL), presents new opportunities for the sustainable use of this abundant endemic resource, transforming waste into functional ingredients with innovative applications.

## Objectives

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) optimize the extraction and yields of its oil, for the potential formulation of value-added products.

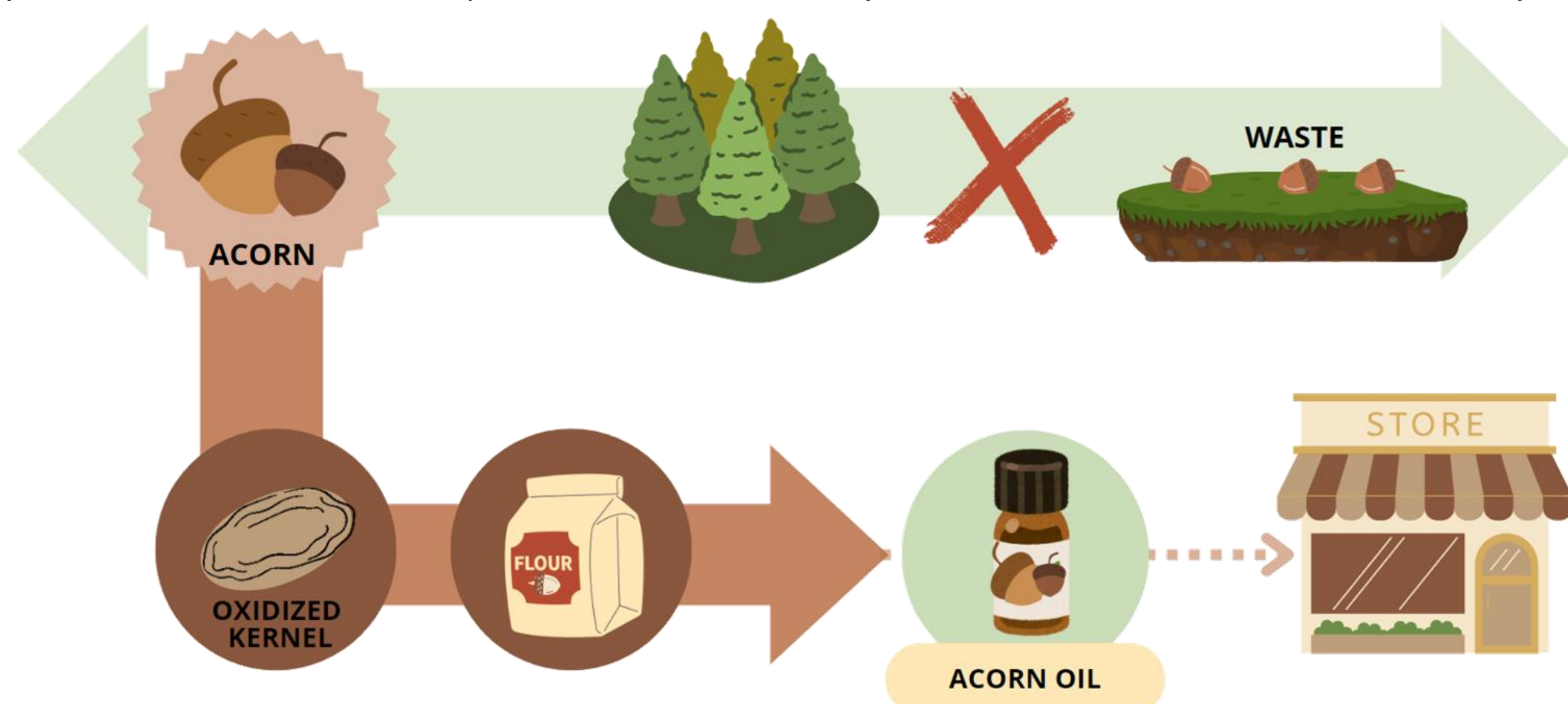


Figure 1. Acorn oxidized kernel (OKL) upcycling diagram.

## Methods

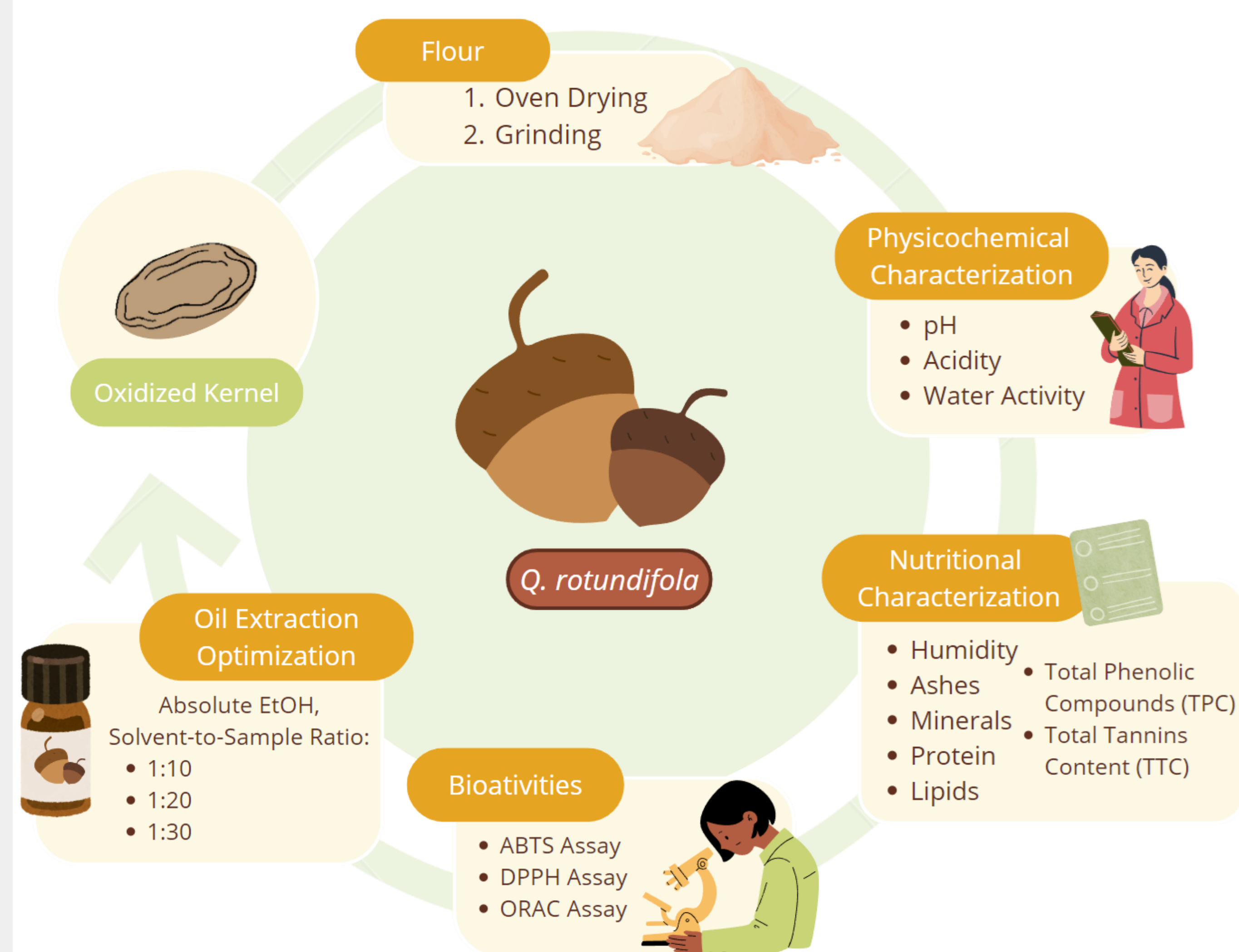


Figure 2. Processing and characterization methodologies diagram from the oxidized kernel (OKL) of *Q. rotundifolia*, harvested in 2022. Regarding nutritional characterization, the minerals composition was obtained by ICP-MS, protein by the Kjeldahl method, lipids by the Folch method, and TPC/TTC by the Folin-Ciocalteu Method.

## Results and Main Conclusions

### OKL Physicochemical and Nutritional Characterization

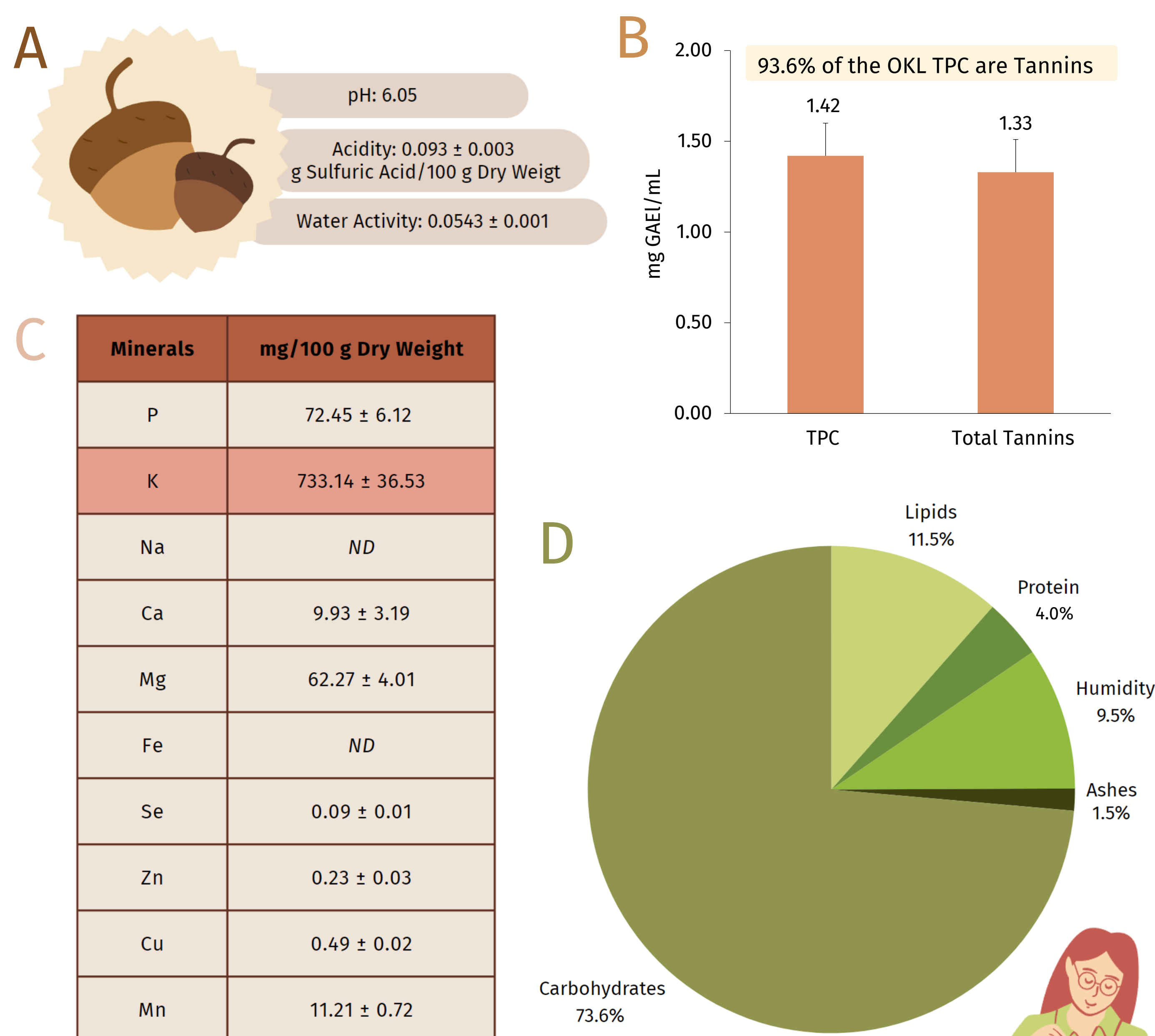
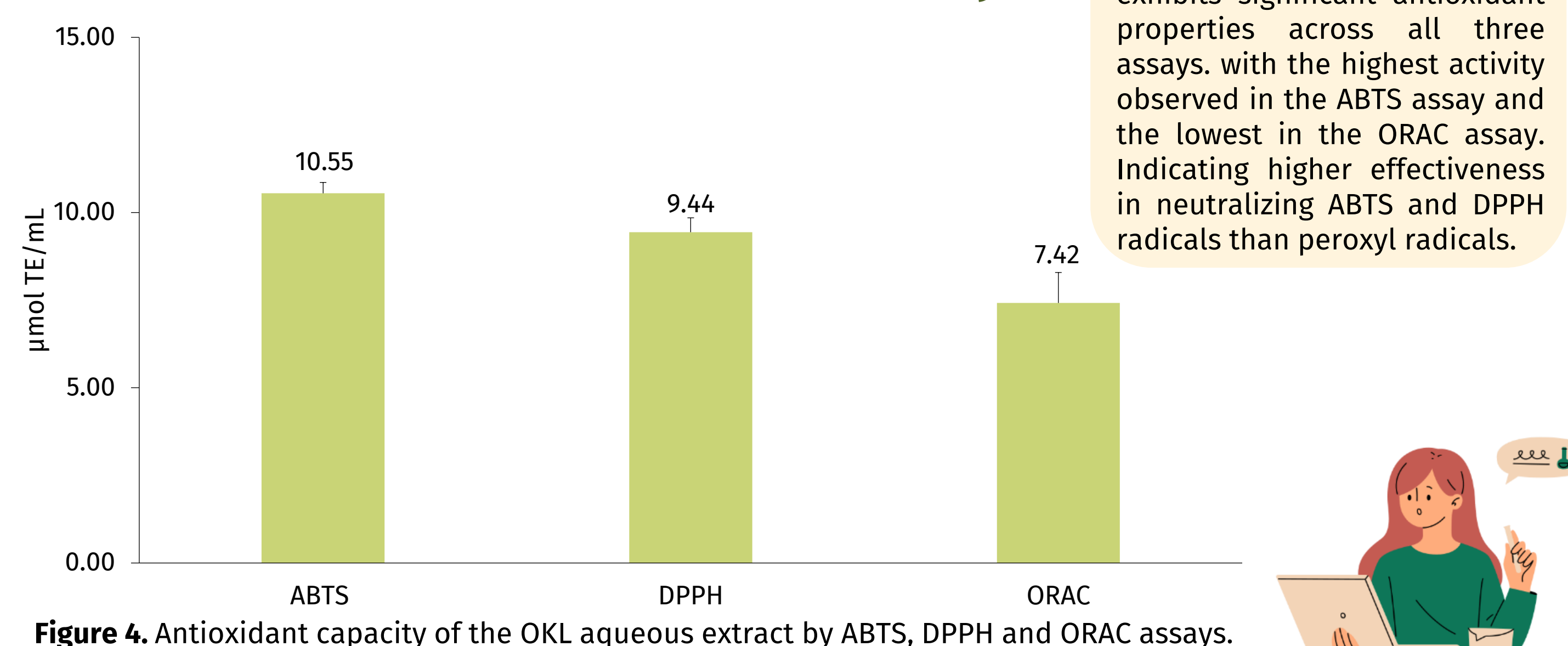
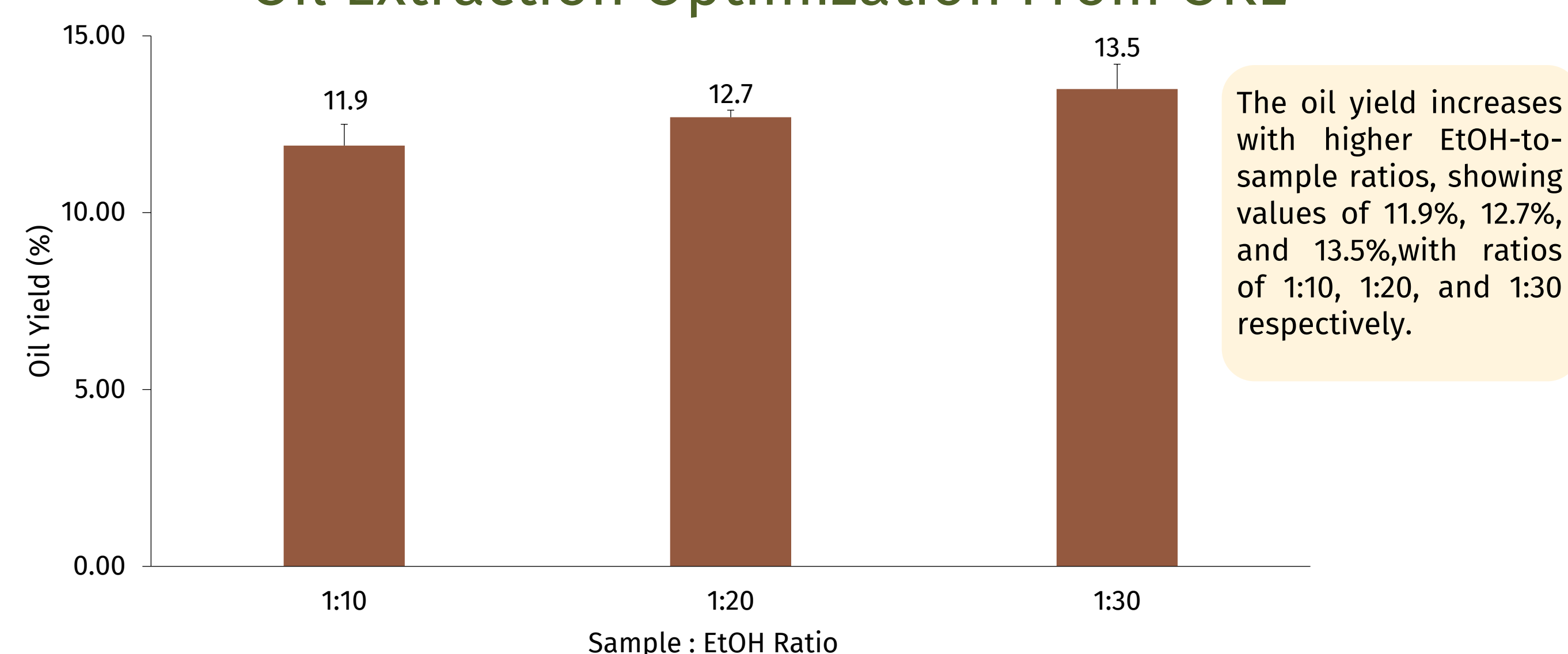


Figure 3. Physicochemical and nutritional characterization of OKL. A- OKL pH, acidity, and water activity. B- OKL total phenolic compounds (TPC) and total tannins content. C- OKL minerals composition. D- OKL centesimal composition. ND- below the detection limit.

### OKL Antioxidant Activity



### Oil Extraction Optimization From OKL



In conclusion, the valorization of acorn byproducts, particularly the oxidized kernel from *Quercus rotundifolia*, emphasizes the importance of recovering and repurposing biomass waste, into new value-added ingredients, towards sustainability. This process fosters circular economy by upcycling these by-products into nutritionally rich and health-beneficial resources, with potential applications in the food, pharmaceutical, and cosmetic industries.

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