EVALUATION OF THE NUTRITIONAL PROPERTIES AND MINERAL COMPOSITION OF ALMONDS INTERCROPPED WITH CHICKPEAS AND CLOVER IN DIFFERENT IRRIGATION SYSTEMS IN NORTHEASTERN PORTUGAL

Bruna MOREIRA[1,2,3], Ermelinda SILVA[1,4], Alexandre GONÇALVES[1,4], Rosalina MARRÃO[5], Miguel A. PRIETO[3], Márcio CAROCHO[1,2], Lillian BARROS[1,2], Cristina CALEJA[1,2*]

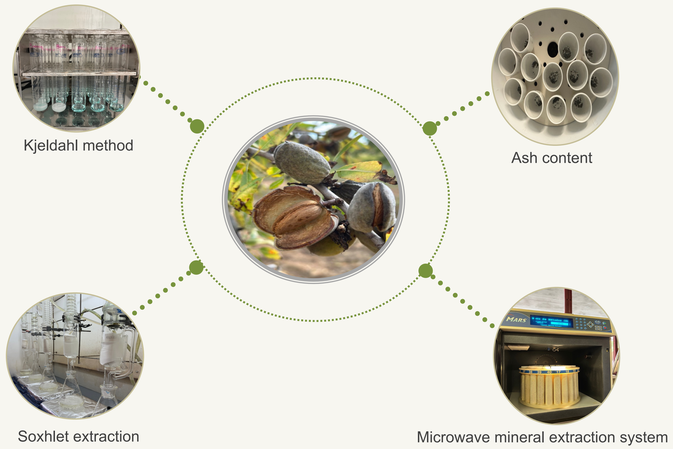
[1] Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
[2] Laboratório Associado para a Sustentabilidade e Tecnologia em Regiões de Montanha (SusTEC), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
[3] Nutrition and Bromatology Group, Department of Analytical and Food Chemistry, Faculty of Food Science and Technology, University of Vigo-Ourense Campus, E-32004 Ourense, Spain
[4] MORE - Collaborative Laboratory Mountains of Research, Brigantia Ecopark, 5300-358 Braganca, Portugal
[5] CNCFS - Centro Nacional de Competências dos Frutos Secos, Brigantia Ecopark, 506, 5300-358, Bragança, Portugal
* ccaleja@ipb.pt

https://valmedalm.eu

Introduction

Crop diversification in almond orchards is a useful strategy to improve the quality of the ecosystem, prevent erosion through sustainable maintenance, mitigate the effects of climate change and improve soil quality. Despite these benefits, research on the effects of water stress on almond quality remains limited, and a deeper understanding of plant biochemical responses is needed to maintain almond production and quality. The objective of this study is to evaluate the nutritional and mineral composition of almonds, focusing on the benefits of intercropping under different irrigation systems.

Methodology



Results

The results show that almonds from non-irrigated systems had a higher protein content, with significant differences observed between almonds from intercropped systems (**Table 1**).

Table 1. Nutritional profile of almonds produced under different conditions by intercropping systems

	Moisture (g/100g fw)	Proteins (g/100g fw)	Ash (g/100g fw)	Crude Fat (g/100g fw)	Carbohydrates (g/100 g fw)	Energy (Kcal/100g)	Energy (Kj/100g)
AIC	5±0.12	15.3±0.3	3±0.1	54±0.04	23.4±0.03	637.3±1	2668.2±3
AIGB	5.33±0.2	14.6±1	3.4±0.1	50±2	27±3.1	614.2±13	2571.4±53
AIT	5±0.1	12.4±0.02	3.2±0.03	52±1	27.4±1	629±3	2632.3±11
ANIC	5±0.10	15±1	3±0.1	47±2	31±1	602.3±8	2522±36
ANIGB	5.01±0.12	16±0.3	3±0.02	49±1	28±1.2	613.1±4.1	2568±17
ANIT	5,.±0.11	18±1	3±0.06	42±2	33±1	577±8	2414.1±32

AIC: control irrigated almonds; **AIGB**: Irrigated almonds intercropped with chickpeas; **AIT**: Irrigated almonds intercropped with clover; **ANIC**: control non-irrigated almonds; **ANIGB**: Non- irrigated almonds intercropped with chickpeas; **ANIT**: Non- irrigated almonds intercropped with clover.

In terms of mineral content, the copper content was significantly higher in irrigated intercrops. The manganese content was higher in irrigated almonds intercropped with chickpeas. The potassium content was higher in irrigated almonds intercropped with clover, and the calcium content was also higher in irrigated almonds intercropped chickpeas and clover compared to the control (**Table 2**).

Table 2. Mineral content of intercropped almonds produced in Portugal

	[K] (mg/Kg)	[Na] (mg/Kg)	[Ca] (mg/Kg)	[Mg] (mg/Kg)	[Fe] (mg/Kg)	[Mn] (mg/Kg)	[Cu] (mg/Kg)	[Zn] (mg/Kg)
AIC	7200±0.1	20±0.4	1500±0.01	112±1	36.5±1	26.5±1	8.1±1	35±3
AIGB	8000±0.1	14.1±0.2	2500±0.1	131.2±3	43.1±2	44±2	8.3±2	29.3±1
AIT	9000±1	11±0.1	2200±0.01	121±0.5	39±1	30±1	8±1	29±1
ANIC	7000±0.3	12.3±1	2000±0.1	124.3±1	43±3	28,5±1	8±0.1	31.1±0.3
ANIGB	7000±0.2	10.4±1	2000±0.03	124±3	47±0.3	28±0.4	7.3±0.3	30±0.1
ANIT	8000±0.1	10.3±0.5	2000±0.02	130±5	44±0.4	34±3	7.3±1	33±5

Conclusions

In conclusion, crop diversification in agroforestry systems combined with efficient irrigation management improves the nutritional quality of almonds. This approach not only supports sustainable agricultural practices, but also fulfills the twin goals of food security and environmental protection. Further research to optimize these systems could bring even greater benefits for agricultural productivity and environmental sustainability.

Acknowledgments

This work was funded through national funding from FCT, within the scope of the Project PRIMA Section 2 - Multi-topic 2021: VALMEDALM (PRIMA/0014/2021). Bruna Moreira is also grateful to the VALMEDALM project for funding her PhD research grant. This work was supported by national funds through FCT/MCTES (PIDDAC): CIMO, UIDB/00690/2020 (DOI: 10.54499/UIDB/00690/2020) and UIDP/00690/2020 (DOI: 10.54499/UIDP/00690/2020); and SusTEC, LA/P/0007/2020 (DOI: 10.54499/LA/P/0007/2020). L. Barros and M. Carocho (CEEC/00831/2018) are grateful for national funding by FCT, P.I., through the institutional and individual scientific employment program-contract for their contracts. C. Caleja is thankful for her contract through the project VIIAFOOD (PRR | Aviso n. º02/C05 -i01/2022; n. º de agenda: C644929456 -00000040).