Fostering the Transition to Sustainable Food Systems:
Embracing Novelty and Overcoming Challenges

17-19 November 2025 | Porto, Portugal

ABSTRACT BOOK

Posters

Please note; this abstract book is not edited

Organised by:

EFFoST

Hosted by:

CATÓLICA
ESCOLA SUPERIOR
DE BIOTECNOLOGIA
PORTO

EFFoST 2025 INTERNATIONAL CONFERENCE
17–19 November
Porto, Portugal

www.effostconference.com

P2.1.015

Potential of black quinoa co-products as food ingredients: Impact of particle size on their composition.

Ms Clara Muñoz-Bas[1], Dr Manuel Viuda-Martos[1], Dra Raquel Lucas-González[1], Dra Estrella Sayas-Barbera[1], Dra Juana Fernández-López[1], Dr Jose Manuel Lorenzo[2], Dr José Ángel Pérez-Álvarez[1]
[1]Miguel Hernandez University, Orihuela, Spain, [2]Centro Tecnológico de la Carne de Galicia, Ourense, Spain

Aim: The aim of this work was to analyse the nutritional composition and technofunctional properties of black quinoa (*Chenopodium quinoa*) coproducts as affected by particle size.

Method: Black quinoa coproducts (no commercial grains) were processed (soaking, washing, drying and milling) to obtain quinoa flour (QF), which was separated into different particle sizes (sieving): HQF: 0.70 mm > Ø > 0.42 mm; MHQF: 0.42 mm > Ø > 0.21 mm; MLQF: 0.21 mm > Ø > 0.10 mm; LQF: Ø < 0.10 mm). Physicochemical properties (pH, Aw, color CIELAB), technofunctional properties (water retention capacity-WRC, oil retencion capacity-ORC, and swelling capacity-SWC), nutritional composition (protein, fat, moisture, ash and dietary fiber) and mineral content of all of them were analysed.

Results: QF with the largest particle size showed the lowest pH, ranging between 6.37 and 7.10 which can be considered suitable pHs to be added to food. Significant differences in color properties were observed depending on the QF particle size: the flour with the largest particle size (HQF) showed the highest L* (42.22±1.36) and h* values (71.41±0.65), while the flour with the smallest particle size (LQF) showed the highest a* (4.10±0.07), b* (11.85±0.41) and C* (12.54±0.41) values. WRC and SWC of QF were not affected by particle size ($p>0.05$), however, ORC was higher at medium particle size (MHQF and MLQF). No significant differences were observed between samples in the fat (4 % – 5%) and dietary fiber content (about 60%). However, in terms of moisture and ash, LQF showed higher values than the rest of samples (3.89±0.11 g/100g and 12.68±0.22 g/100 g, respectively). Protein content ranged between 17.07±0.03 mg/100g in MLQF and 18.07±0.06 mg/100g LQF. Regarding mineral content, Ca, K, Mg and P were the main minerals in QF and their content was affected by the particle size: the smaller the particle size, the higher the mineral content..

Conclusion: Black quinoa coproducts can be valorized to obtain quinoa flour, with a high nutritional value (rich in protein, dietary fiber, Ca, K, Mg and P) and with adequate technological properties that make it suibable to be used as an intermediate ingredient for the enrichment of foods. Their classification in different particle sizes will allow to choose specifically one or other, depending on the aim of their addition, because both nutritional value and technological properties are affected by particle size. In addition, the valorization of the quinoa coproducts contribute to the reduction of waste foods promoting a circular economy in line with Sostenible Development Objectives .

Acknowledgment: The work was funded by the Proyect ECOBIOFUN Ref: PID2021-123628OB-C43. All Authors are members of the AlProSos network (sustainable regional protein-rich foods), funded by CYTED (ref.125RT0165).


Fostering the Transition to Sustainable Food Systems:

Embracing Novelty and Overcoming Challenges

EFFoST 2025 INTERNATIONAL CONFERENCE

17–19 November Porto, Portugal

www.effostconference.com

Potential of black quinoa co-products as food ingredients: Impact of particle size on their composition

C. Muñoz-Bas[1], *M. Viuda-Martos*[1], *R. Lucas-González*[1], , *E. Sayas-Barberá*[1], *J. Fernández-López*[1], *J.M. Lorenzo*[2], *J.A. Pérez-Alvarez*[1]
[1]*IPOA Research Group.* Institute of Agri-Food and Agro-Environmental Research and Innovation, *Miguel Hernandez University (CIAGRO-UMH), Spain*
[2] *Meat Technology Centre, CTC. San Cibrao das Viñas, 32900, Ourense, Galicia, Spain.*
*e-mail: clara.munozb@umh.es

INTRODUCTION

Eco-efficiency in the food industry promotes sustainable strategies such as the valorization of co-products to minimize waste generation and optimize resources utilization. Within this framework, circular economy principles encourage the transformation of food co-products into value-added ingredients, thereby enhancing both environmental and economic sustainability. Quinoa (*Chenopodium quinoa*), a highly nutritious pseudocereal rich in proteins, unsaturated fatty acids, minerals, and bioactive compounds, generates considerable quantities of **discarded grains** ("destrío") that, although unsuitable for commercial sale, retain significant nutritional and technological value. However, its potential as a raw material for the development of functional ingredients, such as flour, remains unexplored, representing an opportunity to promote the sustainability of the food system and approaches to a circular economy and sustainability.


Figure 1. Discarded black quinoa grains

Figure 2. Circular Economy

OBJECTIVE

The aim of this work was to analyse the nutritional composition and technofunctional properties of black quinoa (*Chenopodium quinoa*) co-products as affected by particle size.

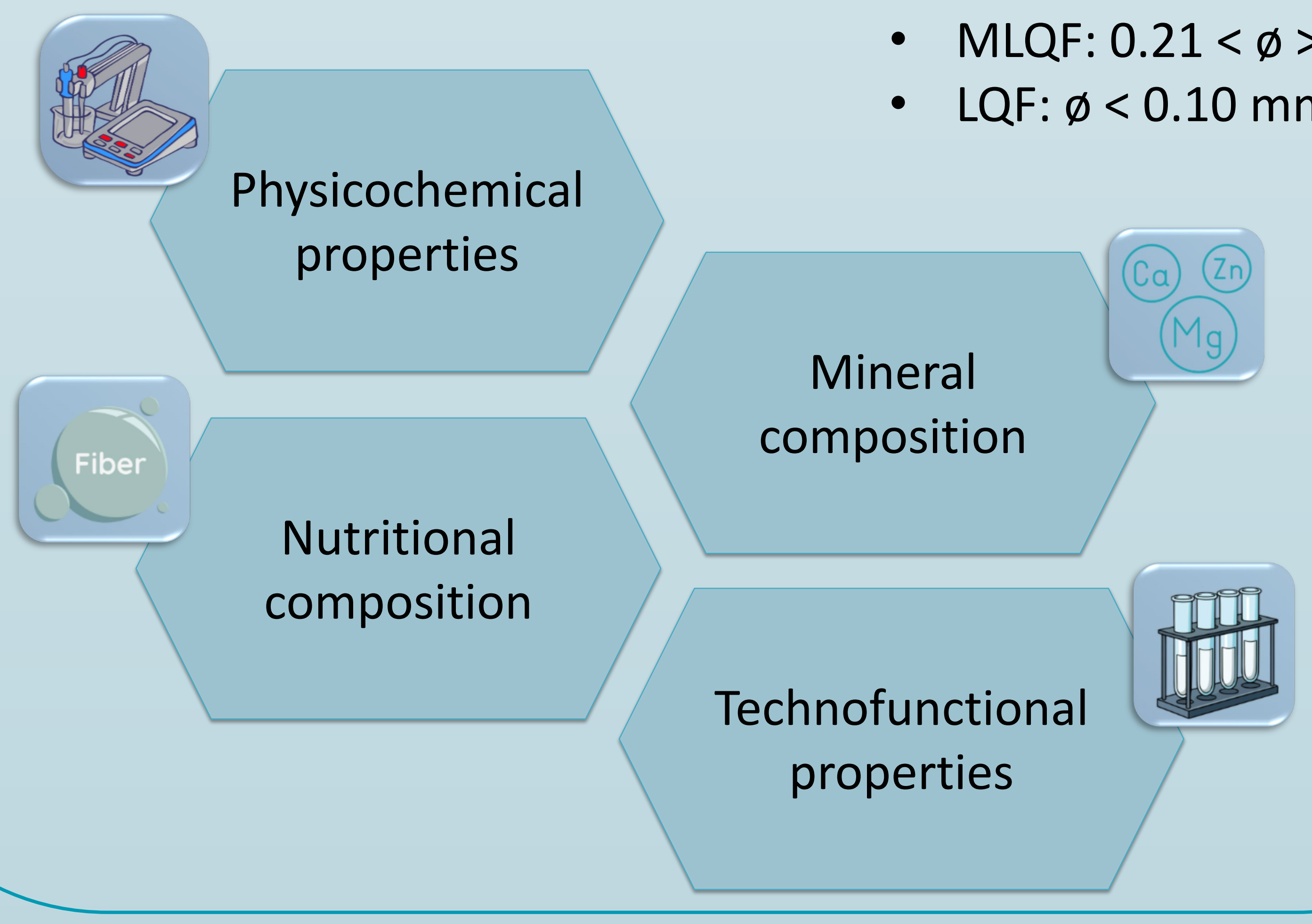
MATERIALS & METHODS

MATERIALS

Different particle size:

- HQF: 0.70 < ø > 0.42 mm
- MHQF: 0.42 < ø > 0.21 mm
- MLQF: 0.21 < ø > 0.10 mm
- LQF: ø < 0.10 mm

METHODS



Physicochemical properties

Mineral composition

Nutritional composition

Technofunctional properties

RESULTS AND DISCUSSION

Table 1. *Composition of quinoa flour with different particle sizes (mean±standard deviation)*

Sample	% Protein	%Fat	%Moisture	%Ash	%Dietary fiber
HQF	17.18 ± 0.81^{ab}	4.76 ± 0.77^{a}	2.60 ± 0.71^{b}	7.49 ± 0.30^{c}	↓ 54.57±1.24^{a}
MHQF	18.20 ± 0.02^{a}	5.35 ± 0.46^{a}	3.49 ± 0.02^{ab}	9.25 ± 0.27^{b}	↑ 63.13±4.90^{a}
MLQF	17.07 ± 0.03^{b}	4.28 ± 0.07^{a}	3.80 ± 0.13^{ab}	9.34 ± 0.18^{b}	63.20±3.40^{a}
LQF	18.07 ± 0.06^{ab}	5.54 ± 0.79^{a}	3.89 ± 0.11^{a}	12.68 ± 0.22^{a}	60.48±1.71^{a}

$^{a-b}$For the same parameter, different letters between rows indicate significant differences (p<0.05)

Table 2. *Physicochemical properties of quinoa flour with different particle sizes (mean±standard deviation)*

Sample	pH	Aw	L* (D65)	a* (D65)	b* (D65)	C* (D65)	h (D65)
HQF	↓ 6.37 ± 0.11^{b}	0.30 ± 0.00^{c}	↑ 42.22 ± 1.36^{a}	3.82 ± 0.12^{b}	11.37 ± 0.39^{a}	12.00 ± 0.38^{a}	71. 41 ± 0.65^{a}
MHQF	↑ 7.03 ± 0.04^{a}	0.39 ± 0.00^{b}	↓ 30.69 ± 0.31^{c}	3.35 ± 0.11^{d}	7.92 ± 0.18^{c}	8.60 ± 0.20^{c}	67.06 ± 0.47^{c}
MLQF	7.10 ± 0.01^{a}	0.39 ± 0.01^{b}	34.84 ± 0.90^{b}	3.58 ± 0.16^{c}	9.37 ± 0.44^{b}	10.04 ± 0.47^{b}	69.06 ± 0.25^{b}
LQF	7.08 ± 0.01^{a}	0.41 ± 0.00^{a}	39.25 ± 1.00^{b}	4.10 ± 0.07^{a}	11.85 ± 0.41^{a}	12.54 ± 0.41^{a}	70.88 ± 0.44^{a}

$^{a-c}$For the same parameter, different letters between rows indicate significant differences (p<0.05)

Figure 4. *Technofunctional properties of quinoa flour with different particle sizes (mean±standard deviation); (WHC: g/g; ORC: g/g; SWC: mL/g)*

Table 3. *Mineral composition of quinoa flour with different particle sizes (mean±standard deviation)*

Sample	HQF	MHQF	MLQF	LQF
Ca	↓ 930.75 ± 7.16^{d}	↑ 1059.14 ± 34.26^{c}	↑ 1299.75 ± 17.85^{b}	↑ 2015.64 ± 14.81^{a}
Cu	0.92 ± 0.02^{a}	0.94 ± 0.02^{a}	0.95 ± 0.05^{a}	0.94 ± 0.00^{a}
Fe	19.04 ± 1.15^{b}	19.74 ± 0.23^{b}	21.37 ± 1.73^{b}	47.90 ± 0.91^{a}
K	↓ 1.783.33 ± 49.44^{c}	↑ 2090.86 ± 117.91^{ab}	↑ 2194.01 ± 10.71^{a}	↑ 2020.62 ± 13.75^{b}
Mg	468.91 ± 14.34^{c}	512.10 ± 6.54^{b}	497.91 ± 5.91^{bc}	552.14 ± 12.18^{a}
Mn	18.21 ± 0.37^{d}	21.53 ± 0.65^{c}	22.53 ± 0.14^{b}	23.90 ± 0.11^{a}
Na	39.70 ± 0.45^{b}	44.41 ± 2.09^{a}	44.05 ± 2.19^{ab}	43.65 ± 1.27^{ab}
P	362.91 ± 18.56^{ab}	366.78 ± 39.07^{ab}	326.40 ± 1.63^{b}	395.81 ± 3.60^{a}
Zn	4.88 ± 0.73^{a}	3.87 ± 0.52^{a}	4.73 ± 0.23^{a}	4.85 ± 0.34^{a}

$^{a-d}$For the same parameter, different letters between columns indicate significant differences (p<0.05)

CONCLUSIONS

Black quinoa co-products can be valorized to obtain quinoa flour, with a high nutritional value (rich in protein, dietary fiber, Ca, K, Mg and P) and with adequate technological properties that make it suitable to be used as an intermediate ingredient for the enrichment of foods. Their classification in different particle sizes will allow to choose specifically one or other, depending on the aim of their addition, because both nutritional value and technological properties are affected by particle size. In addition, the valorization of the quinoa coproducts contribute to the reduction of waste foods promoting a circular economy in line with Sostenible Development Objectives.

ACKNOWLEDGEMENTS

Research Project ECOBIOFUN (PID2021-123628OB-C43) "Development and innovation of functional dairy products using bioactive compounds from the valorization of agri-food co-products.
This work was (partially) supported by Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo (CYTED) (through Red AlProSos 125RT0165).