Saffron (*Crocus sativus*) from the Spanish Region of Aragon: Valorisation of the quality

AGRIFOOD RESEARCH AND TECHNOLOGY CENTRE OF ARAGON

A.M. Sánchez, C. Mallor, F. Escriu, V. González-García, N. Moratalla-López and A. Gracia

INDEX

1

INTRODUCTION

2

OBJECTIVE

3

METHODOLOGY

4

RESULTS

5

CONCLUSIONS

1

INTRODUCTION

RESEARCH GROUPS

CENTRO DE INVESTIGACIÓN Y TECNOLOGÍA AGROALIMENTARIA DE ARAGÓN

UCLM

DEPARTMENTS:
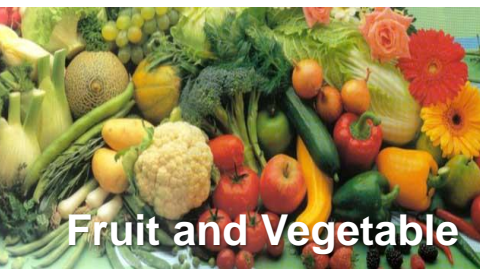
Fruit and Vegetable

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Plant Protection
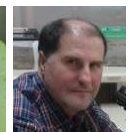
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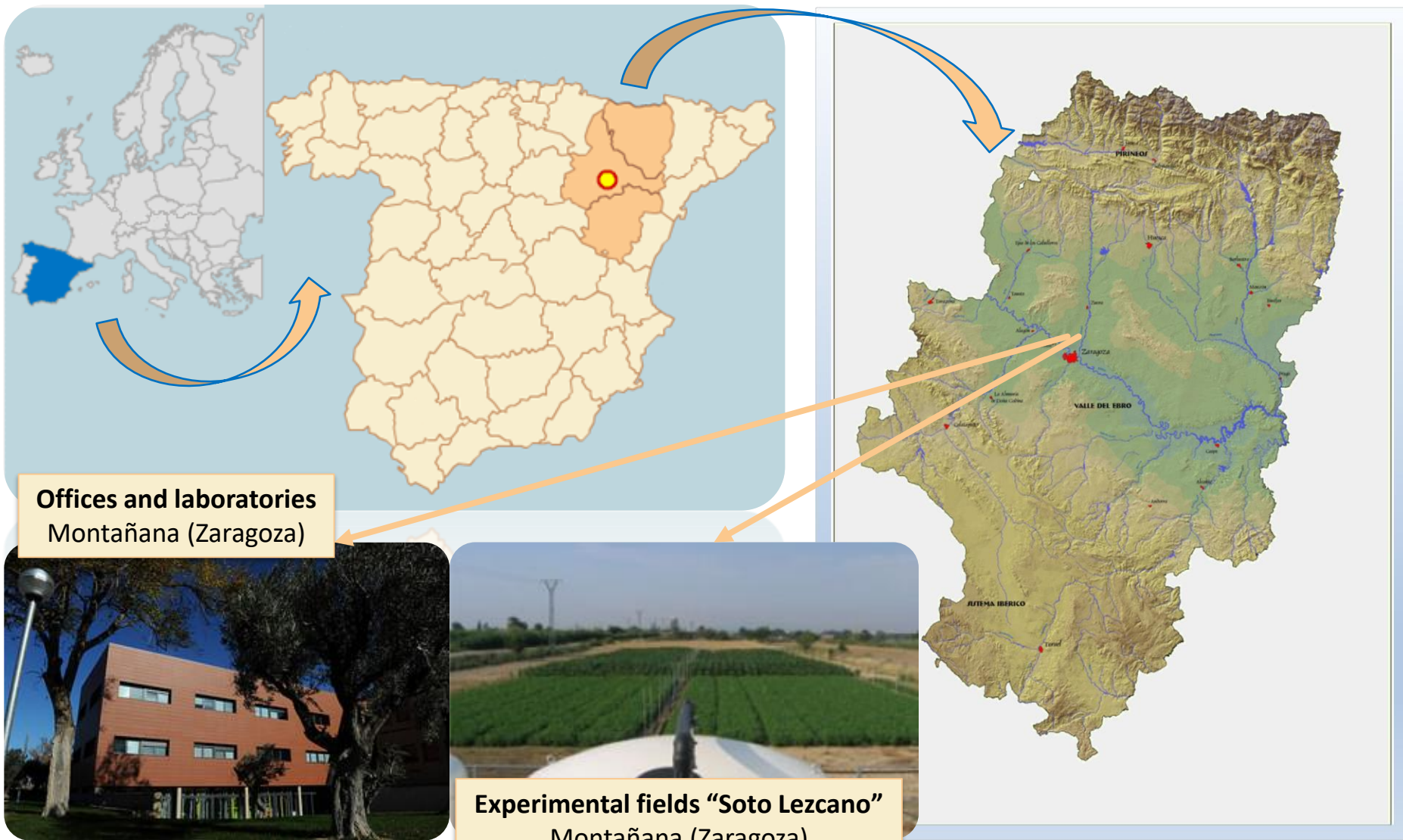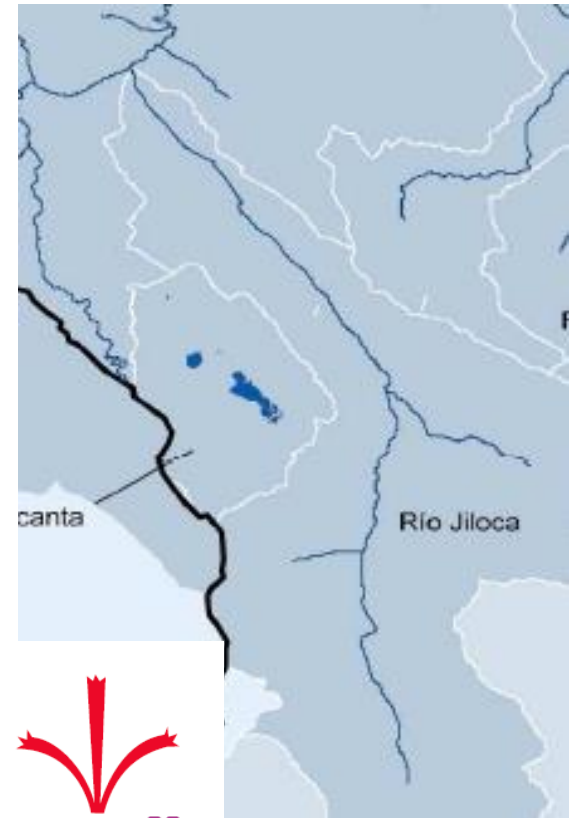

Offices and laboratories
Montañana (Zaragoza)

Experimental fields "Soto Lezcano"
Montañana (Zaragoza)

MAIN AREA OF SAFFRON PRODUCTION

Jiloca River
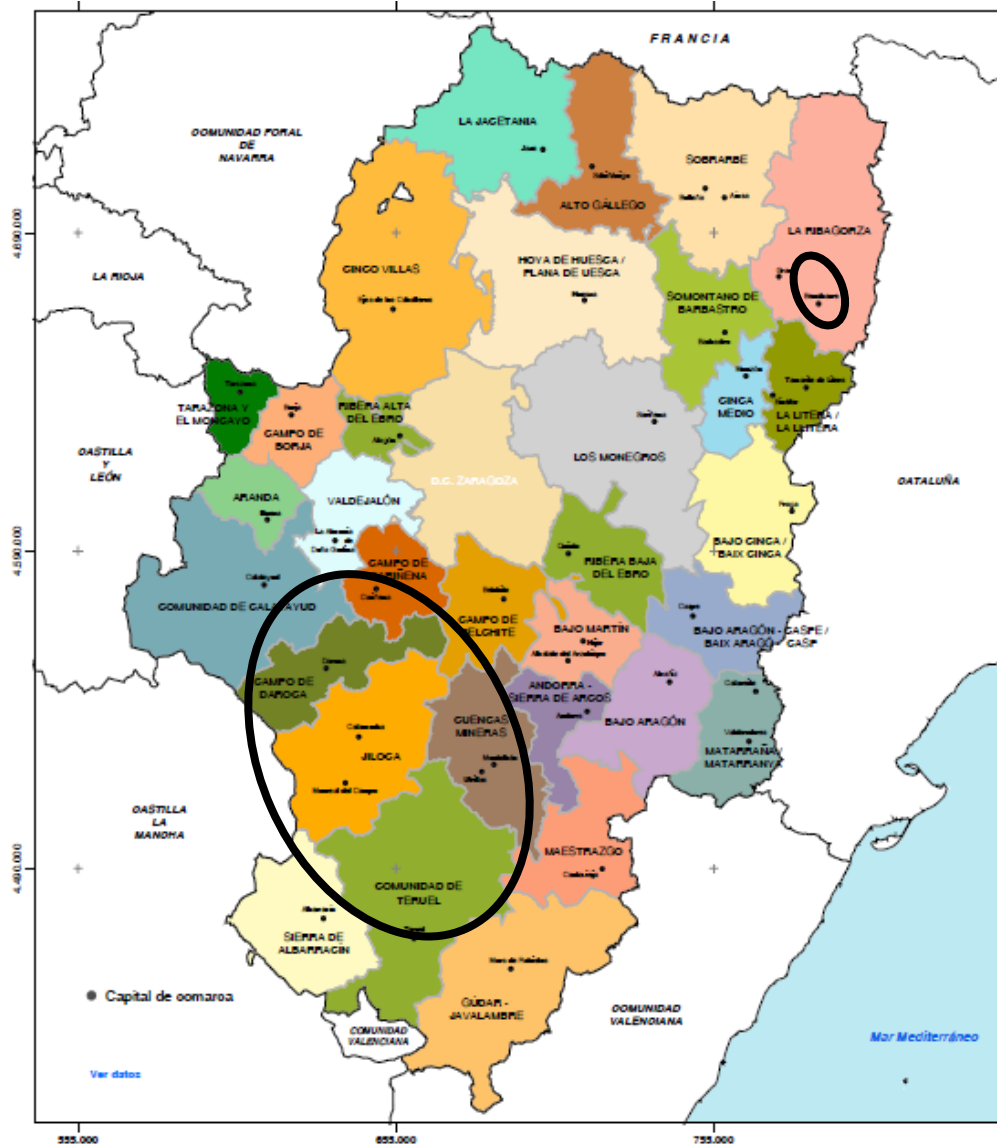
CHALLENGES OF SAFFRON PRODUCTION

Long-term decline of cultivation in Aragon and depopulation of rural areas

A renewed interest in saffron as a sustainable high value agricultural product

Valorisation of its quality

**Proper selection of corms
Revision of phytosanitary status**

Consumer knowledge, habits and preferences

**Analysis of quality
Promotion of local consumption**

2

OBJECTIVE

➢ **To valorise the quality of saffron spice from Aragon**

 ✓ **Characterization through ISO 3632 parameters**

 ✓ **Study of phytosanitary problems of the crop influencing quality**

 ✓ **Analysis of consumer knowledge, purchasing habits and preferences regarding saffron quality**

3

METHODOLOGY

QUALITY CHARACTERIZATION: SAMPLES

➢ **78 Saffron samples in filaments from Aragon**

✓ **32 in bulk**

✓ **13 producers**

✓ **Years: <1 (21); 1-2 (9); >10 (2)**

✓ **46 packaged**

Trademarks: A, B, C (organic)

✓ **Chapter 7 - ISO 3632**

500 mg
1000 mg

m_0

Weighing dish

16 hours   103 ºC

$$w_{MV} = (m_0 - m_1) \times \frac{100}{m_0}$$

m_1
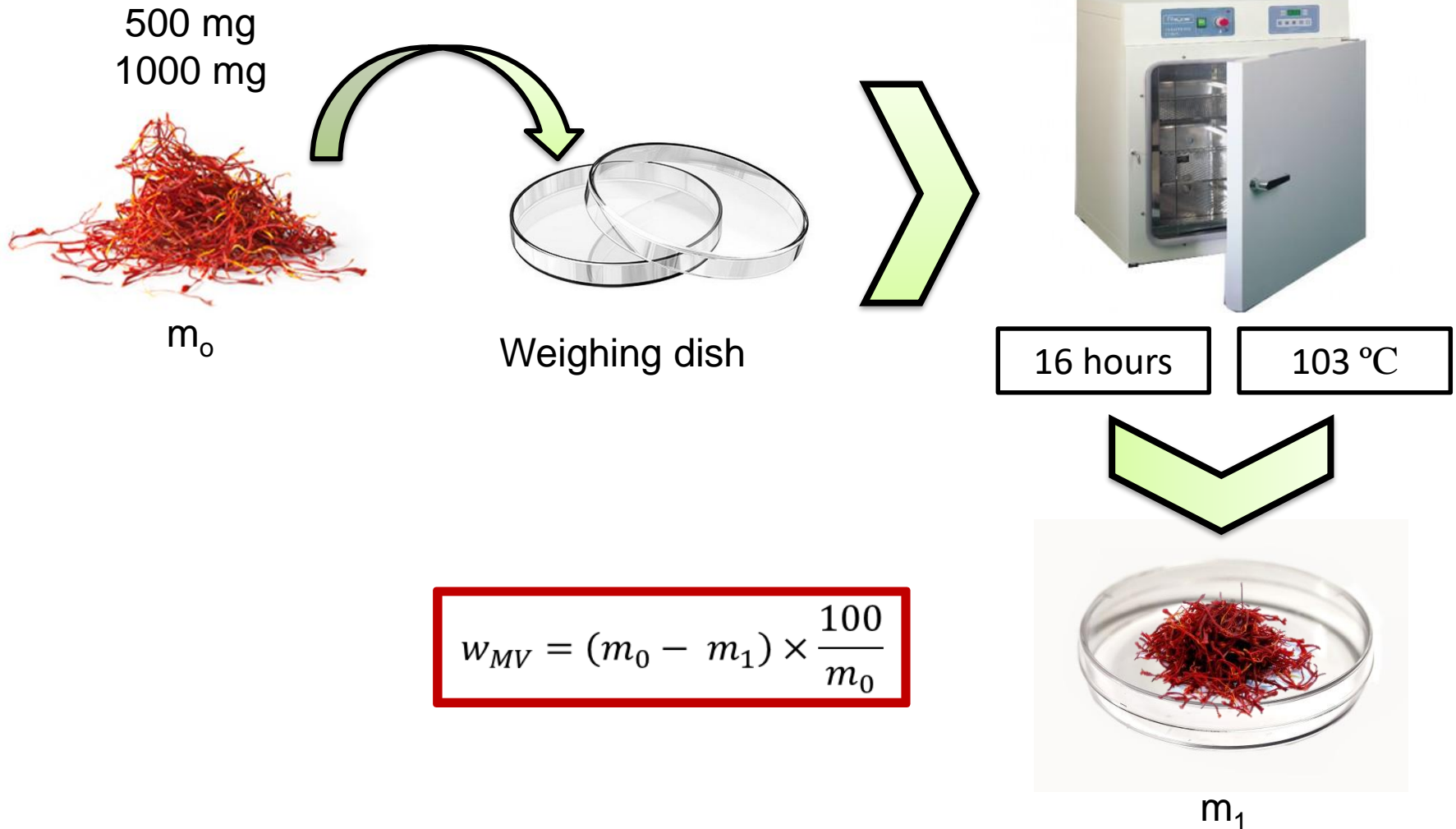
SAMPLE AND EXTRACT PREPARATION FOR DETERMINATION OF MAIN CHARACTERISTICS

✓ Chapter 10 and 14 - ISO 3632

Saffron in filaments

crushing

Saffron in powder

Sieve 500 μm

10 mL

500 mg

1:10 Diluted aqueous extracts 50 mg/L

Concentrated aqueous extract 500 mg/L

1L H₂O
Stir for 1 hour

Required particle size
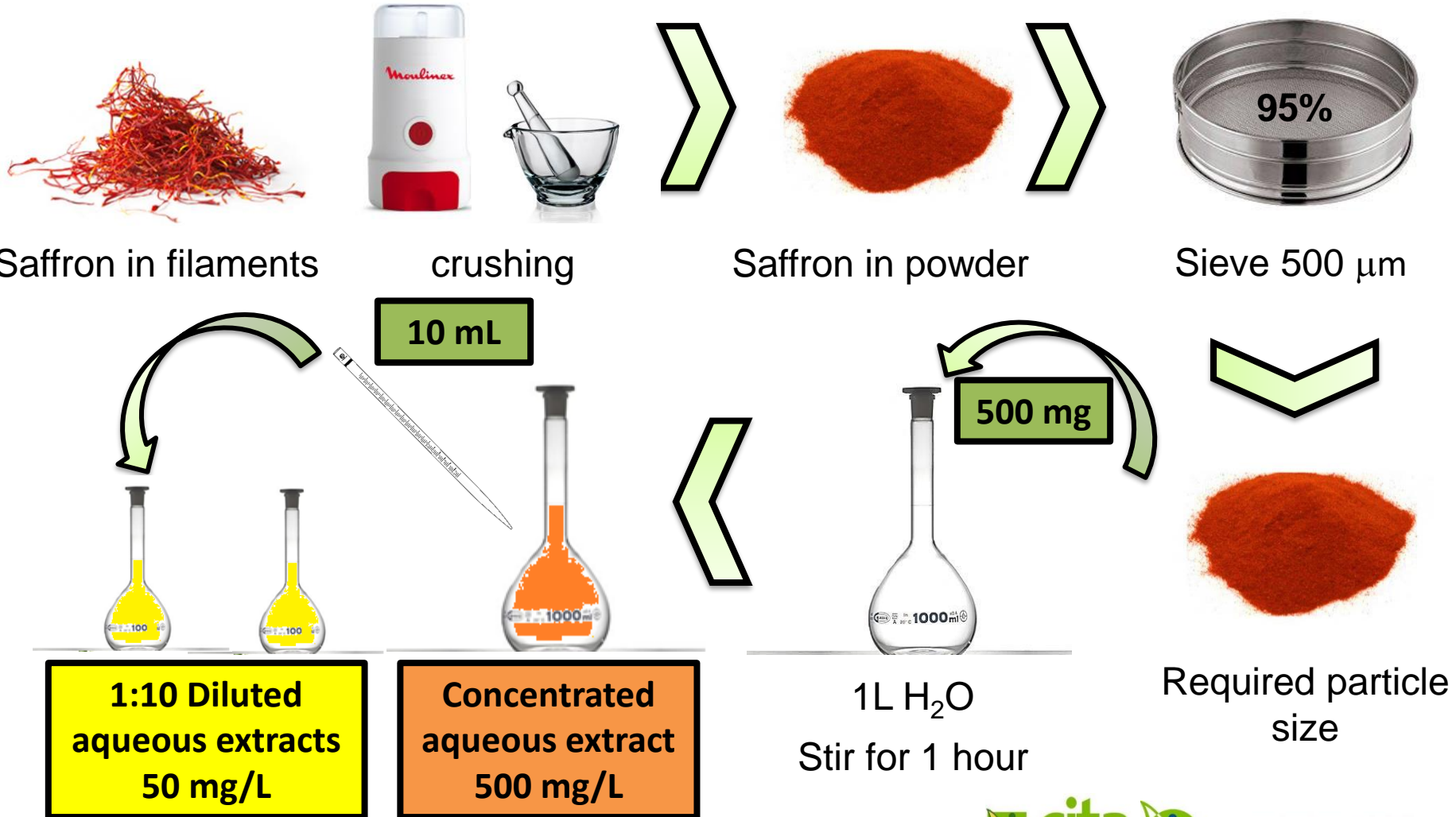
UV-VIS SPECTROPHOTOMETRIC ANALYSIS

✓ **Chapter 14 - ISO 3632**

PTFE
0.45μm

1:10 Diluted aqueous extracts

quartz cells
1 cm pathway

$$A_{1cm}^{1\%} (\lambda max) = \frac{D \times 10000}{m \times (100 - w_{MV})}$$

Flavouring strength ($A_{1cm}^{1\%}$ **257 nm**)

Aromatic strength ($A_{1cm}^{1\%}$ **330 nm**)

Colouring strength ($A_{1cm}^{1\%}$ **440 nm**)

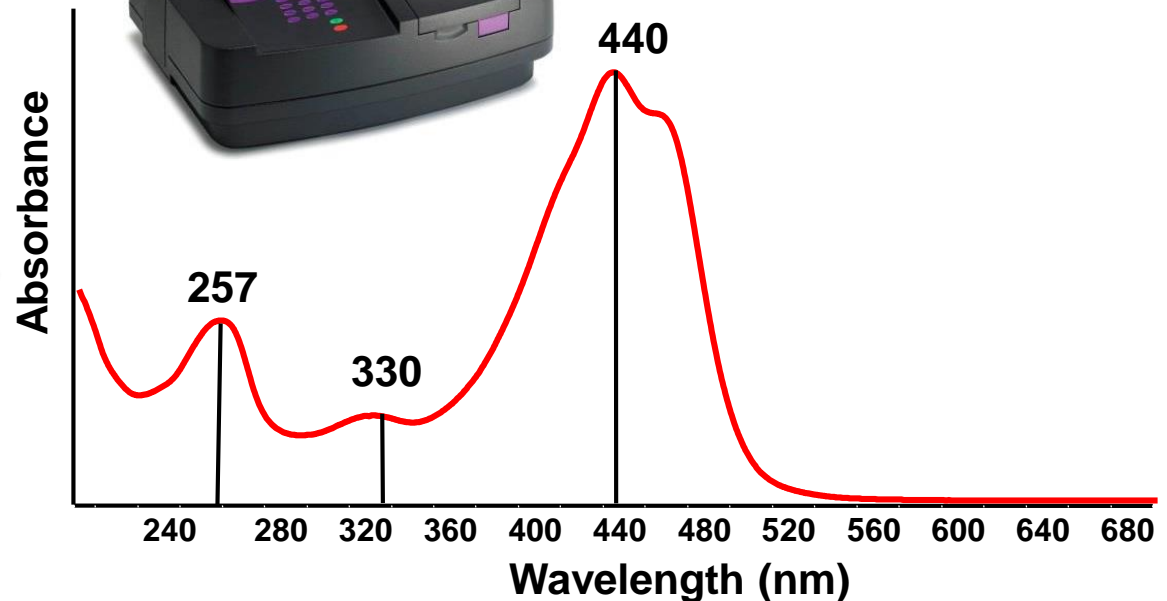## ➢ Isolation and characterization of fungi

✓ **CORMS** **Fungi associated to 173 samples:**
- asynthomatic corms stored prior to plantation
- synthomatic corms removed from conventional culture fields
- diseased corms discarded for cultivation

✓ **SOILS** **Pathogenic fungal species in 47 samples of cultivated saffron soils**

✓ **PLANTS** **Fungal diseases in 26 samples:**
- Grown in pots
- Saffron experimental field of the CITA

✓ **Microbiological methods employing suitable synthetic media to isolate microorganisms**

✓ **Molecular techniques. Direct sequencing of the ribosomal DNA fragment**

➢ **Characterization of viruses: serology (ELISA)**

   ✓ **173 samples of corms from different origins and sizes**

   ✓ **104 plant samples (flowers and leaves) collected in the Jiloca Valley**

   ✓ **28 symptomatic flowers from the pots and experimental field of CITA**

   ✓ **Antisera against the viruses most frequently found in the *Crocus* genus and other bulbous species were used:**

       - general antiserum for viruses within the *Potyvirus* genus

       - specific antisera for *Turnip mosaic virus* (TuMV), *Bean yellow mosaic virus* (BYMV), and *Cucumber mosaic virus* (CMV)

CONSUMER STUDY

- Data was obtained from an artefactual experiment with consumers in Aragon in 2016-2017

- Population consisted of people living in Aragon older than 18 years

- Participants were recruited via consumer associations, and public institutions

- A total of 18 sessions of around 12 participants were carried out

- The final sample of 202 participants was stratified by age, gender and province of residence

CONSUMER EXPERIMENT

➢ **Saffron knowledge**

1. **high quality saffron in filaments**
2. **low quality saffron in filaments**
3. **saffron in powder form**
4. **safflower**
5. **artificial food colorant**

- **Visual inspection**
- **After smelling**

➢ **Hedonic preferences**
  ▪ **9 point hedonic scale**
  (dislike extremely = 1, …, like extremely = 9)

➢ **Consumption and purchasing habits**
socio-demographics and personal characteristics

4

RESULTS

QUALITY CHARACTERIZATION

Range (maximum-minimum)	Saffron in bulk			Packaged saffron		
	<1 year	1-2 years	>10 years	Trademark A	Trademark B	Trademark C
Moisture and volatile matter content (%)	10.7-6.2	10.1-5.9	12.0-7.4	10.1-6.2	7.4-4.1	7.3-5.7
$A^{1\%}_{1cm}$ 440 nm	288-204	256-195	27-26	142-55	274-96	264-243
$A^{1\%}_{1cm}$ 330 nm	38-27	41-29	31-31	51-29	49-32	38-34
$A^{1\%}_{1cm}$ 257 nm	110-77	95-75	45-44	82-50	106-70	100-92
Number of samples:						
category I	21	6	0	0	6	5
category II	0	3	0	0	6	0
category III	0	0	0	6	1	0
not fulfilling specifications	0	0	2	20	2	0
Total analysed	21	9	2	26	15	5

✓ **49% of samples belonged to commercial category I, 11% to category II, 9% to category III, and the remaining samples (31%) did not fulfil the requirements**

✓ **An improvement of quality assurance of saffron spice from Aragon could contribute to its valorisation**

FUNGI

✓ **500 fungal isolates were obtained, associated either to corms, plants, substrate and natural soil of saffron culture.**

✓ **Their characterization revealed the presence of up to 51 different Operational Taxonomic Units (OTUs)**

FUSARIUM

✓ **The identified fungal mycobiota was dominated by Ascomycete species (86%). They were followed by endophytic taxa from the Basidiomycetes and Zygomycetes (6%). A single taxon from the Oomycetes was identified (belonging to genus *Pythium*) (2%).**


PENICILLIUM

FUNGI

✓ **Main contingent of fungal pathogens associated with rotted <u>corms</u> in the Jiloca area**

→ *F. oxysporum*
F. oxysporum f. sp. *gladioli*
F. oxysporum f. sp. *lentis*
F. tricinctum
F. equisetii
F. chlamydosporum
F. solani
F. redolens
F. thapsinum
F. acuminatum

✓ **<u>Soil isolates</u>: an associated mycobiota was characterized dominated mainly by soil saprophytic taxa or weak pathogens**
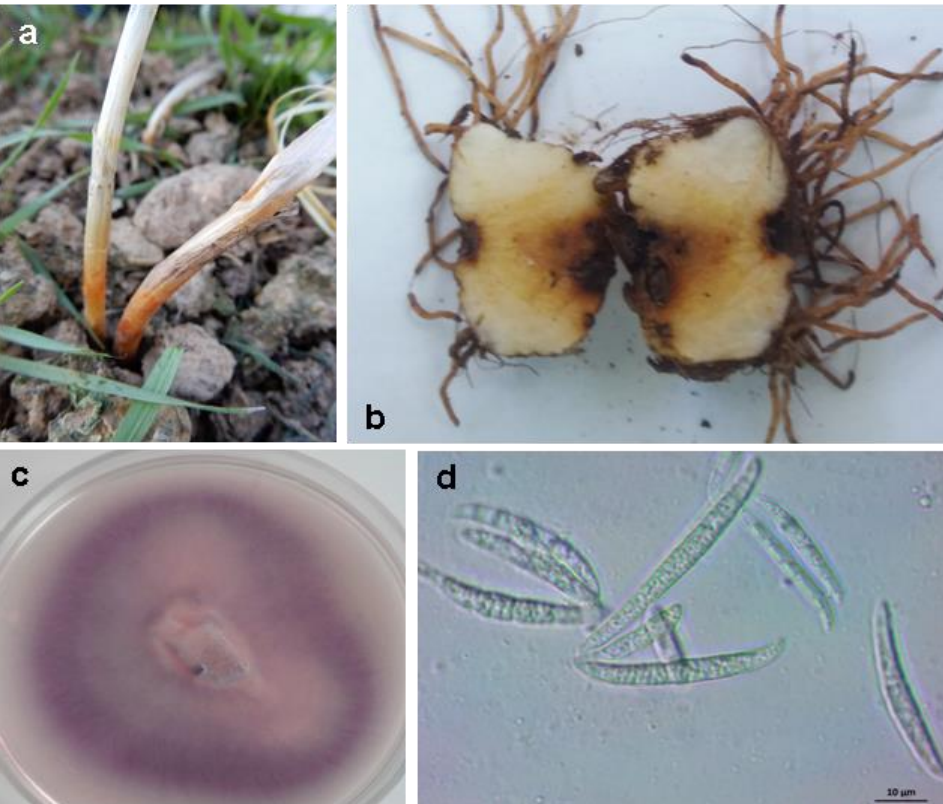
✓ **<u>Plant</u> analyses: *Fusarium* species (*F. oxysporum, F. solani*) or allied genera (e.g. *Ilyonectria radicicola*) as the main fungal pathogens associated to the decay plants observed, together with other frequent endophytic taxa.**

SEROLOGICAL RESULTS

1. PROPAGATION CORMS

Batch	N of corms	TuMV	BYMV	Other potyvirus
Batch 3	55		1 (1.8%)	
Batch 4	28	2 (7.1%)	1 (3.6%)	1 (3.6%)
TOTAL 6	173	2 (1.1%)	2 (1.1%)	1 (0.6%)

2. FIELD PLOTS:

Location	Plots	Samples	TuMV	Other Potyvirus	CMV
Calamocha	2	25			3
Monreal del Campo	6	57	1	11	
Blancas	2	22	1		
TOTAL	10	104	2 (1.9%)	11 (10.6%)	3 (2.9%)

VIRUS

3. FLOWER ALTERATIONS OBSERVED IN EXPERIMENTAL FIELD PLOT

Unaltered flower

Colour breaking and paleness of tepals

Splitted, filiform and short tepals
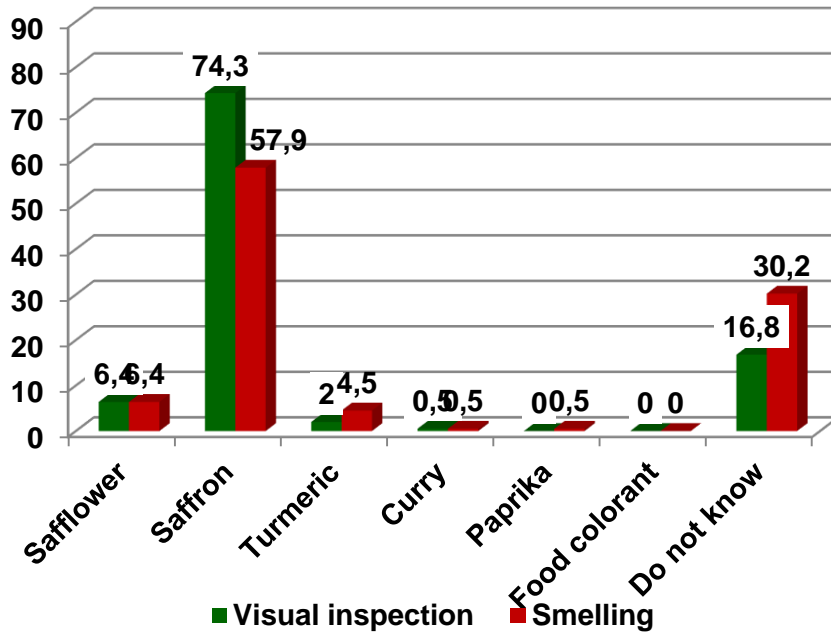

Short stigmas

No visible stigmas

- **Virus infection: 18/28 (64%) synthomatic plants TuMV (14 plants), BYMV (1plant), other different potyviruses (4 plants)**

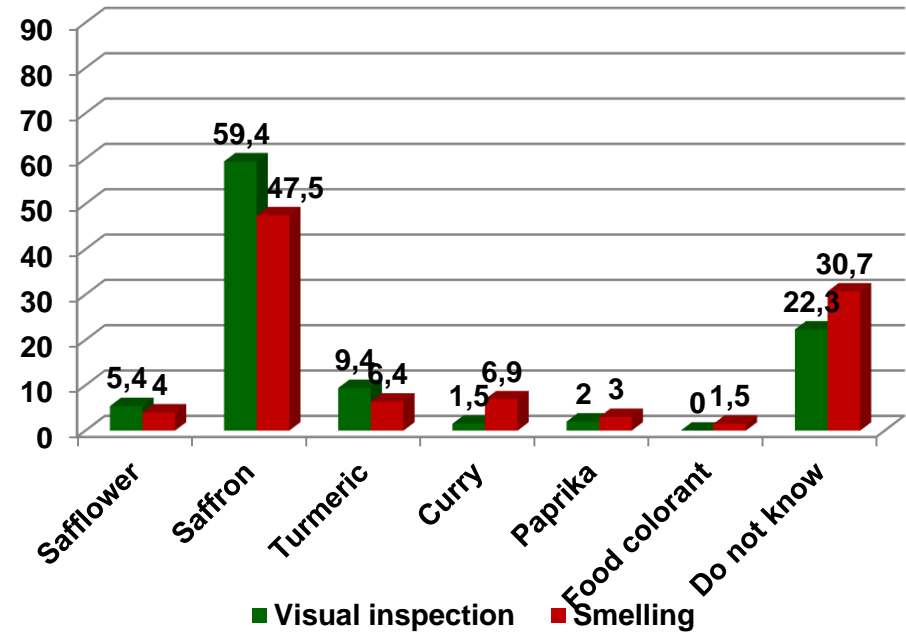- **Association between virus infection and the appearance of flower alterations**

CONSUMER STUDY

➢ **Consumer's knowledge**

✓ **High quality saffron**   ✓ **Low quality saffron**

✓ **More than half of participants stated that saffron in powder was paprika (68% after visual inspection and 50% after smelling)**

➢ **Consumption and purchasing habits**

✓ **Saffron was used at home by 60% of participants while paprika and artificial colouring was used by 70% and 48% of participants, respectively**

✓ **Half of participants indicated that they use saffron occasionally at home mainly to cook paella (88%) and other rice dishes (58%). 21% of participants stated that they never use saffron at home**

✓ **Most consumers buy the saffron in supermarkets and hypermarkets (73%)**

➢ **Hedonic preferences**

✓ **Overall liking after visual inspection, smelling and tasting was statistically higher for high quality saffron (6.0) than for low quality saffron (5.0)**

5

CONCLUSIONS

CONSUMER STUDY

➢ **An improvement of quality assurance of saffron spice from Aragon, especially in packaged saffron, could contribute to the valorisation of its quality.**

➢ **Several species belonging to *Fusarium* were identified as the main causal agent of most saffron corm rot and plant decay, whereas virus species of *Potyvirus* genus seemed to be associated with the appearance of flower alterations affecting quality.**

➢ **Aragonese consumers' knowledge and hedonic preferences for high quality saffron were higher than for low quality saffron.**

➢ **Consumers' habits in Aragon revealed an occasional use at home, to cook rice dishes, and that saffron was bought in supermarkets and hypermarkets.**

Thank you for your attention

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