Universidade do Minho
Escola de Engenharia

CENTRO DE CIÊNCIA E TECNOLOGIA TÊXTIL

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21st World Textile Conference

HALOCHROMIC PROPERTIES OF A 5-AMINOIMIDAZOLE-4-CARBOXAMIDRAZONE AND ITS APPLICATION TO WOOL

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Introduction

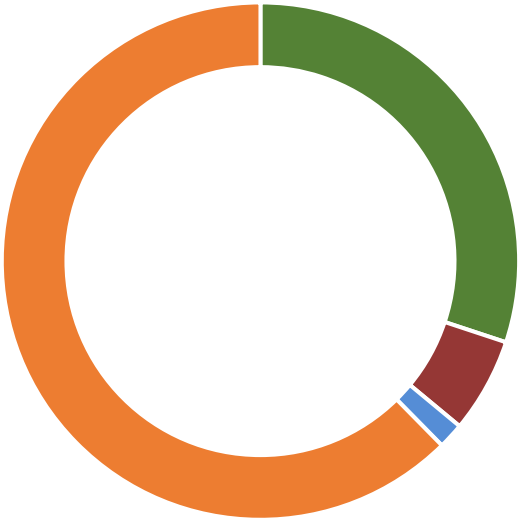
Global fiber production (2021)

Synthetic fibers 62.0%

- **Polyester 52.0%**
- Polyamide 5%
- Polypropylene 2.7%
- Acrylics 1.6%
- Elastane 1.0%

Plant fibers 29.9%

- Other plant-based 5.9%
- **Cotton 24.2%**



Animal fibers 1.6%

- **Wool-sheep 1.0%**
- Other wool 0.05%
- Down 0.5%
- Silk 0.1%

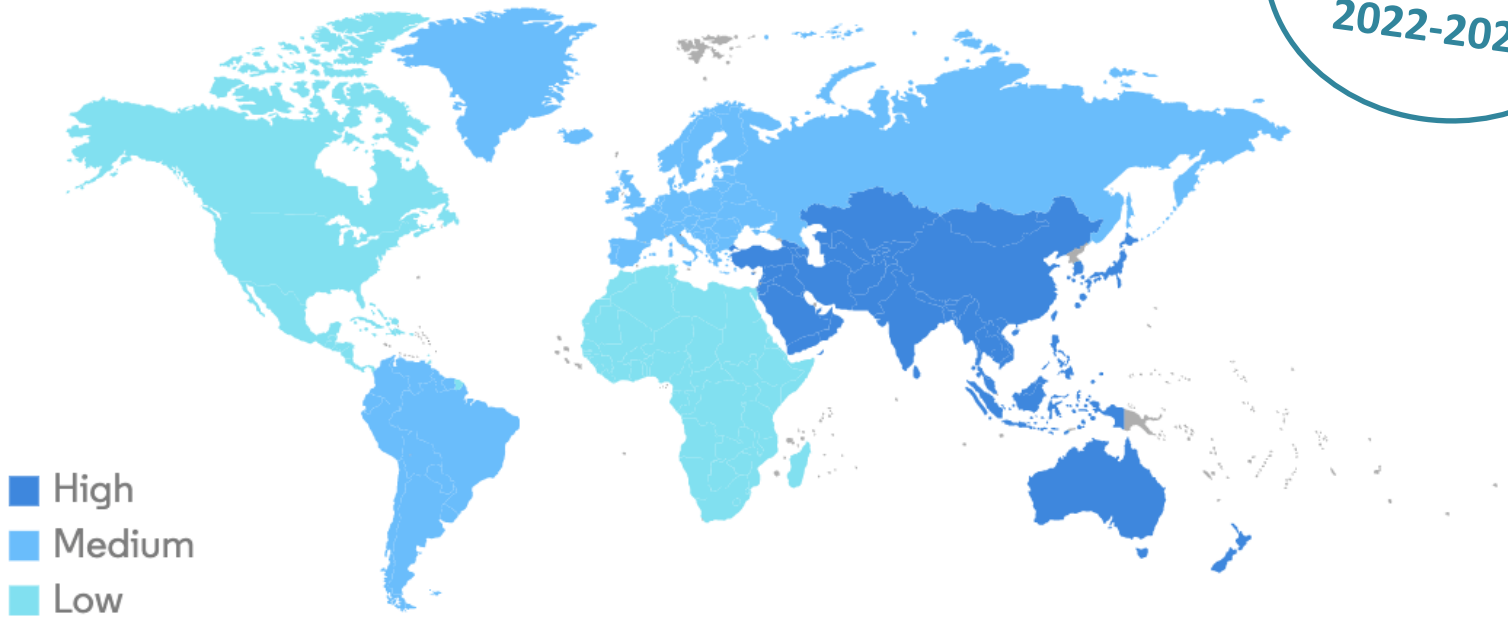
Manmade cellulosic fibers 5.9%

- Viscose 4.7%
- Acetate 0.8%
- Lyocell 0.3%
- Modal 0.2%
- Cupro 0.01%

Source: Textile Exchange website

Introduction

Market size of Wool by region (2021)



CAGR
4.8%
2022-2027

Source: Mordor Intelligence website

Introduction

Wool properties and Benefits

100% natural

100% biodegradable

100% renewable

Wrinkle resistant

Naturally breathable

Warm and cool

Odour resistant

Easy to care for

Soft on skin

Innovative

Stain resistant

Naturally elastic

Fire resistant

Reusable and recyclable

UV resistant

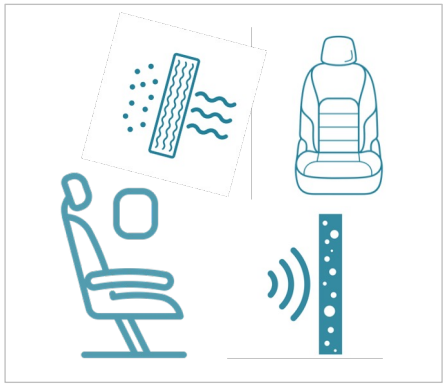
Source: Woolmark website

Introduction

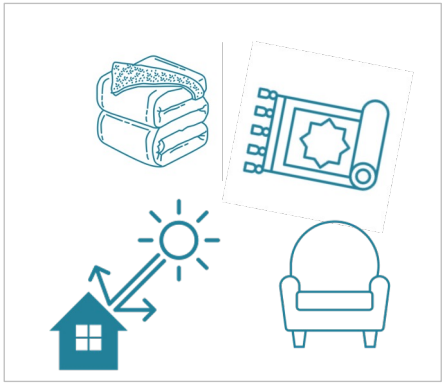
Applications of Wool

Medical

Sports



Automotive and Aviation



Architecture and Design

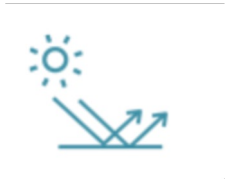
Protective Apparel

Source: Handbook of Natural Fibres, Wool fibres, Elsevier, 2020

Introduction

Functional dyes

- Combination of both conventional textile dyeing and functional finishes



UV-Protective

Antimicrobial

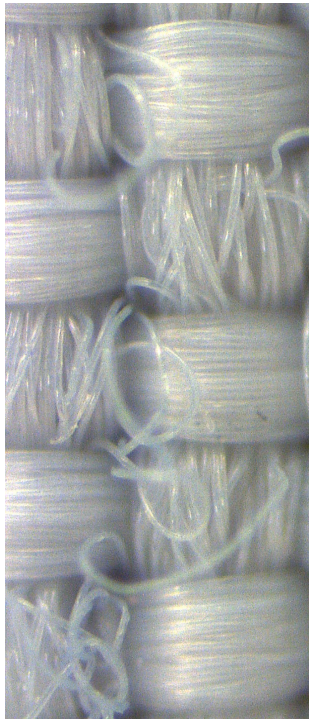
Water Repellent

Moth Repellent

Introduction

Smart dyes - Chromism

- Chromism is a change in color caused by external factors



Photochromism

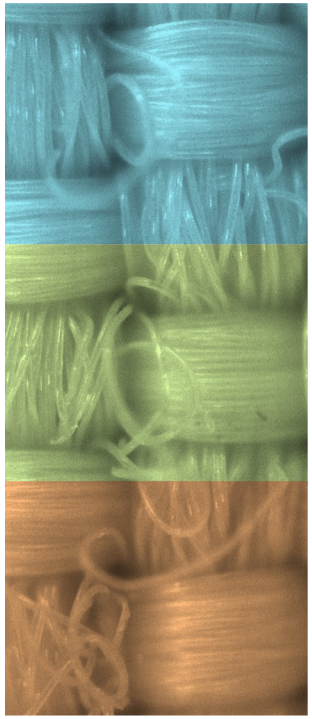
Thermochromism

Electrochromism

Solvatochromism

Ionochromism

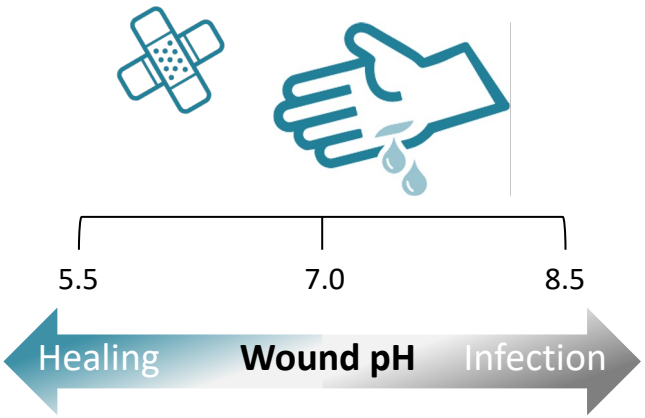
Halochromism



Introduction

Halochromism

- pH plays an important role in the human body
- The colour change remains one of the most cost-effective methods for real-time monitoring of the pH



pH of Sweat to Detect Skin Diseases
Irritant contact dermatitis, atopic dermatitis, ichthyosis, acne vulgaris and *Candida albicans* infections

Introduction

Bioorganic & Medicinal Chemistry Letters
Volume 24, Issue 19, 1 October 2014, Pages 4699-4702

Synthesis and antimicrobial activity of novel 5-aminoimidazole-4-carboxamidrazones

Ana I. Ribeiro [a, †], Carla Gabriel [b, †], Fátima Cerqueira [b, c], Marta Maia [c, d], Eugénia Pinto [c, d], João Carlos Sousa [b], Rui Medeiros [b, e], M. Fernanda Proença [a], Alice M. Dias [a]

Antimicrobial action against:

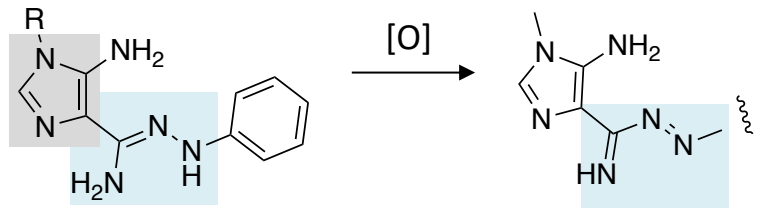
Candida albicans

Candida krusei

Candida parapsilosis

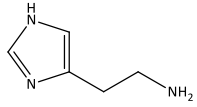
Cryptococcus neoformans

Imidazole

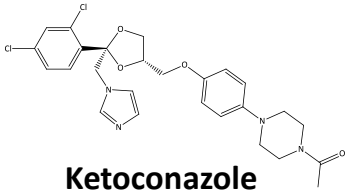


Amidrazone **Azo Group**

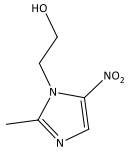
- Important component of various natural molecules
- Extensive pharmacological potential



Histamine
Immune response and neurotransmitter



Ketoconazole
Antifungal



Metronidazole
Antibiotic

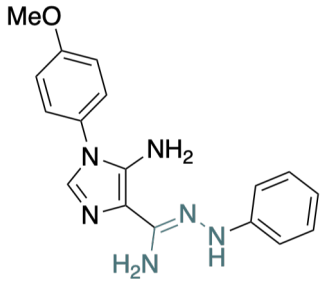
- Extensively used as intermediates of compounds with biological activities due to its high reactivity

Objective and Procedure

The halochromic properties of a 5-aminoimidazole-4-carboxamidrazone were studied, and the first attempt to dye wool with this amidrazone at a low temperature was performed.

1. Synthesis of the amidrazone

- FTIR
- ^{1}H NMR



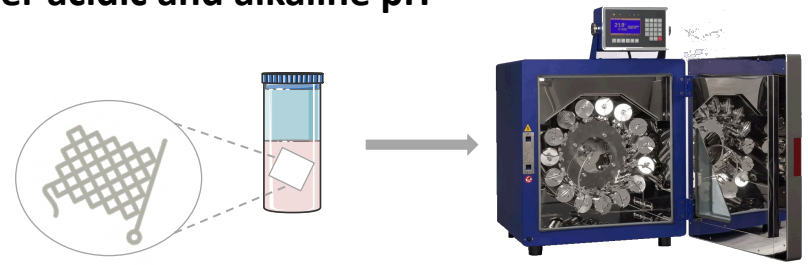
2. Buffered solutions from pH 3 to 12

- acetate,
- phosphate,
- Britton-Robinson,
- Artificial sweat
- artificial wound exudate

- UV-Vis

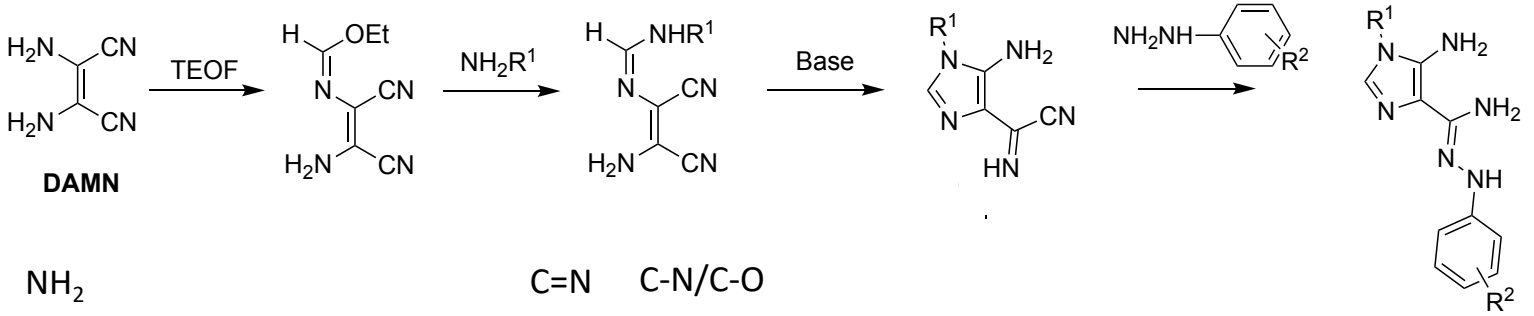
3. Dyeing of wool by exhaustion at 40°C under acidic and alkaline pH

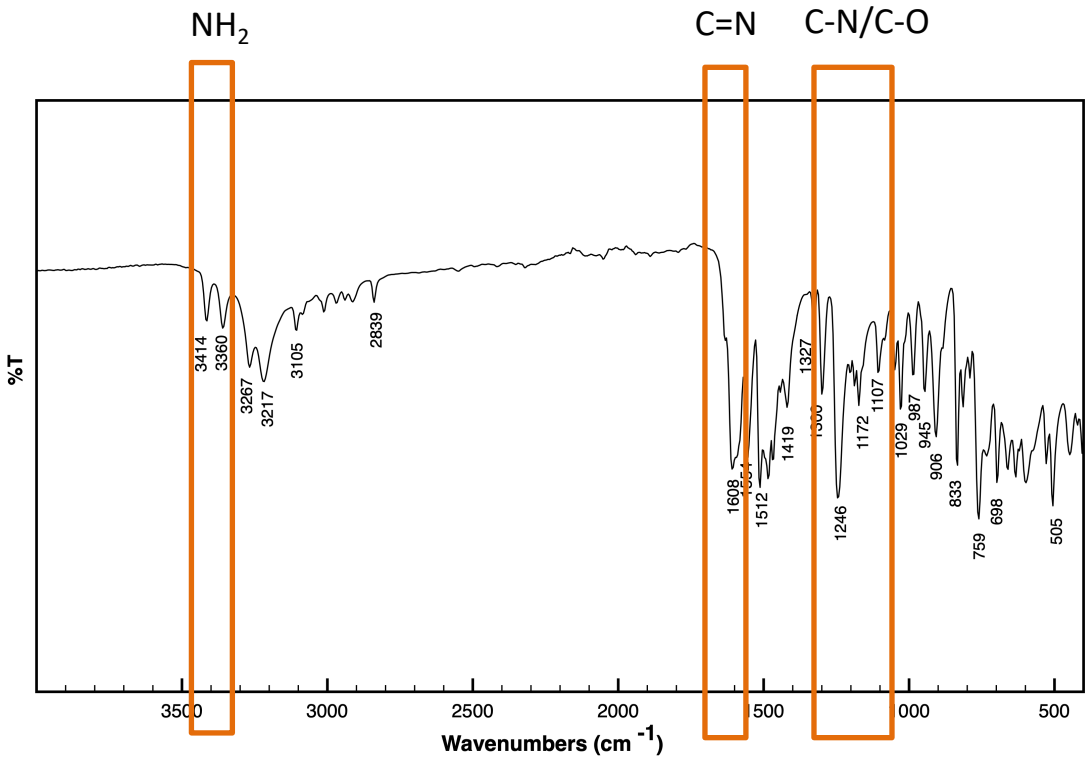
- Color coordinates
- UPF

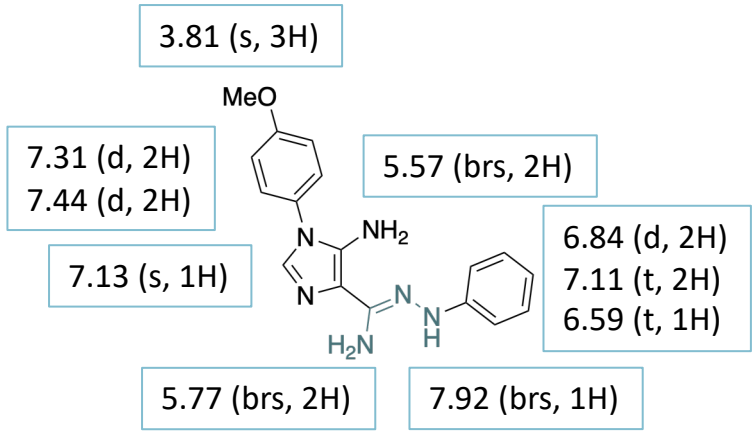


Results

Synthesis of the amidrazone – FTIR and ^{1}H RMN



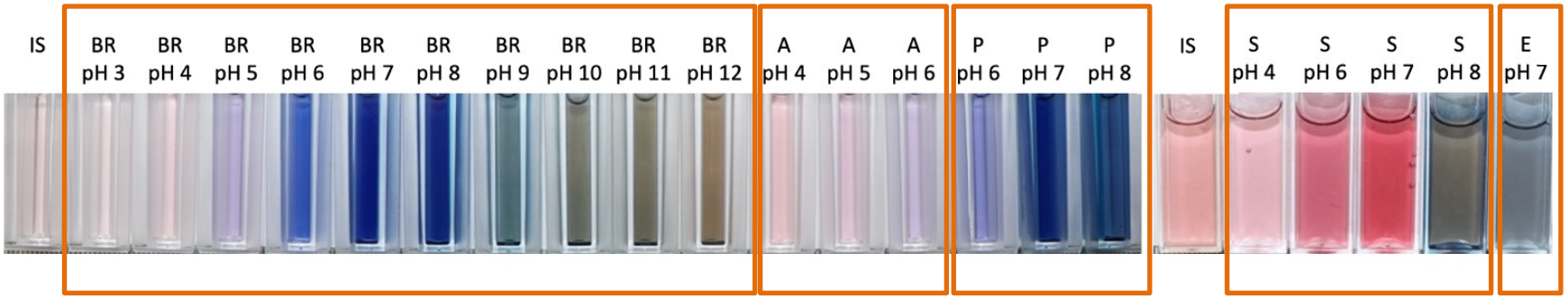


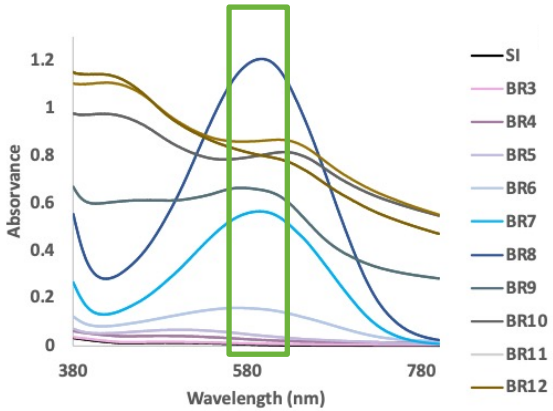


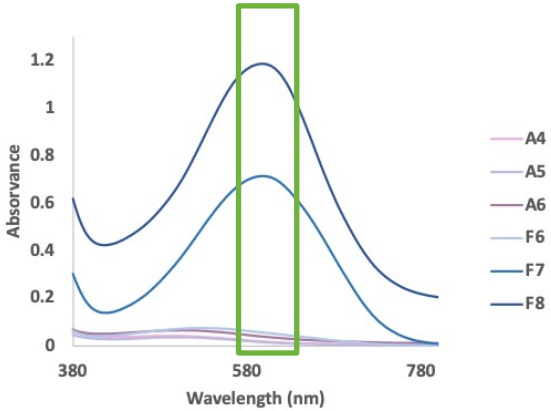
η =94%

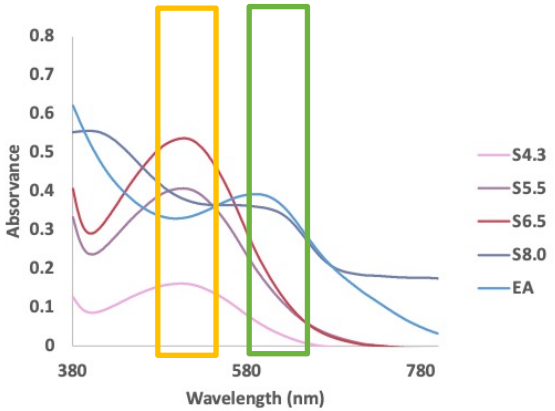
Results

Buffered solutions from pH 3 to 12 – UV-Vis



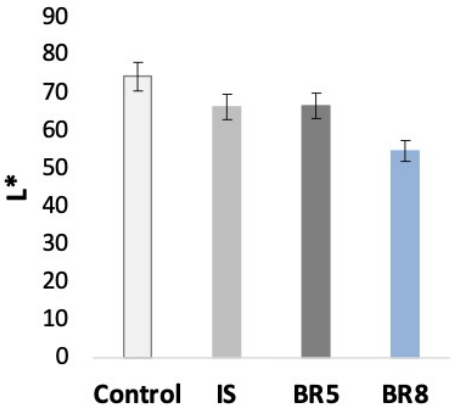


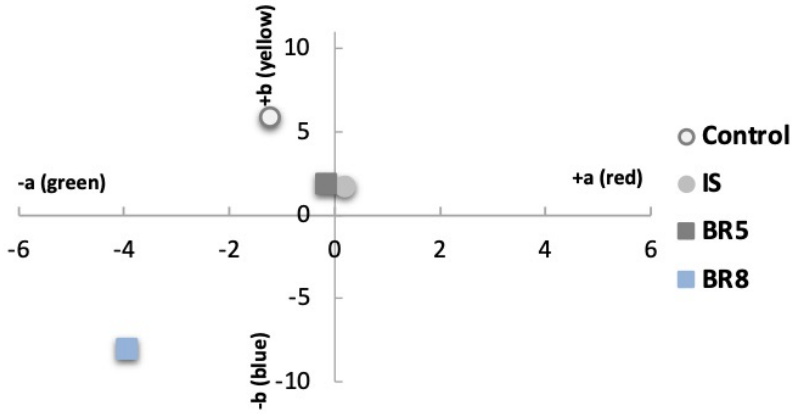


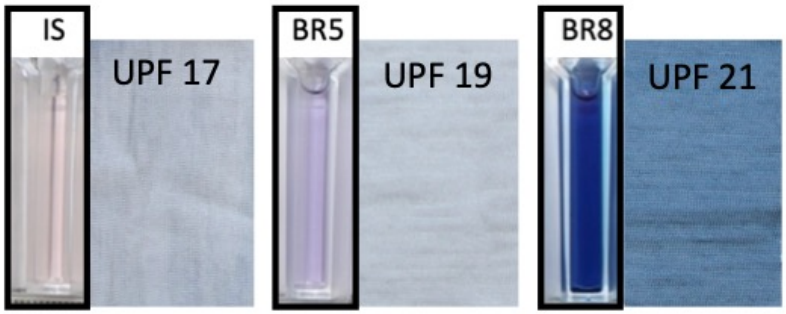


Results

Dyeing of wool by exhaustion at 40° C under acidic and alkaline pH







Conclusion and Prospective work

- The amidrazone was successfully applied on wool knitted fabric and showed interesting halochromic properties in acidic and alkaline conditions.
- The exhaustion process displayed good results at low temperature (40 ° C).
- The functionalization also increased the UPF value of the wool from good to very good.
- This compound present high potential to be used as halochromic dyes for wool in functional textiles for sports, healthcare and sensors.

- Fastness tests
- Reversibility evaluation
- Mechanism of dyeing process
- Antimicrobial action of the fabrics against bacteria and fungi
- Cytotoxicity tests

Acknowledgments

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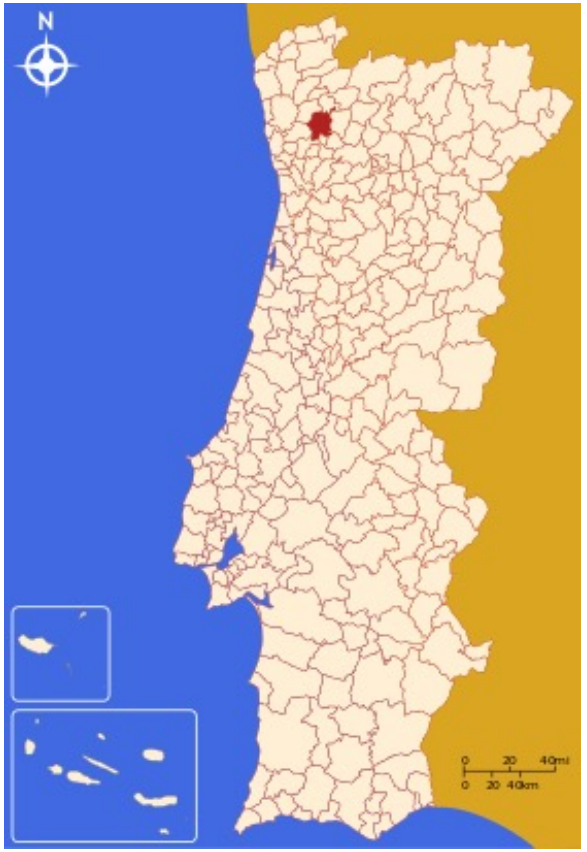

Guimarães - Portugal

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