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Sustainable Dyeing of Wool with Agricultural Wastes

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1. Background
2. Material & methods
3. Results & discussion
4. Conclusion and perspectives
Background

- Introduction
- Synthetic dyes
- Natural dyes
- Problematic
Synthetic dyes and their industrial applications

Textile industry relies on synthetic dyes


Toxicity and the impact of textile dyes

It is necessary to find new green and sustainable alternatives!
Natural dyes: towards sustainable dyeing

01 Harmonized with nature
02 Biodegradable
03 Not hazardous to health
04 Minimal impact on environment
05 Renewable
06 Antimicrobial activity
07 UV-protection
08 Insect repellent
Natural dyes sources

- Vegetable dyes
- Insect dyes
- Mineral dyes

The common widely used natural dyes
Color fading due to weak interaction between dye and fiber.
Mordanting

**Wool**

**Wool-mordant complex**

**Wool-mordant-dye complex**

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**Row fiber**

**Mordant solution**

**Mordanted fiber**

**Plant extract**

**Dyed fiber**

**Washing/light**
Material & Methods
Valorization of agricultural wastes

58,000 tons/year
doi.org/10.1016/j.jssas.2016.06.002.

12,667 tons/2019
https://agronomist.pl/artykuly/morocco-production-of-nuts
Analysis of agricultural wastes

Screening and identification of active coloring compounds

- Pomegranate peels
- Walnut shells

Ultrasound assisted extraction

HPLC-PDA, UV-VIS, LC/MS
Natural dyeing of wool fabric

1. **Mordanting**
   - Use of Alum as mordanting agent

2. **Dye bath preparation**
   - Aqueous extraction of pomegranate peels & walnut shells

3. **Dyeing**
   - Exhaust dyeing of mordanted wool in the dye extracts

Dyed wool

Color coordinates
Results & Discussion
Analysis of pomegranate peel and walnut shell extracts

UV-VIS profile of pomegranate peels.

UV-VIS profile of walnut shells.
Analysis of Pomegranate peels extract

HPLC profiles of pomegranate peels and gallic acid and ellagic acid standards.

Pomegranate peel extract

Ellagic acid

Gallic acid
Analysis of Pomegranate peels extract

LC/MS profiles of pomegranate peels, gallic acid and ellagic acid standards.

Pomegranate peel

Ellagic acid

Gallic acid
HPLC & LC/MS profiles of Walnut shells and juglone standard.

Analysis of Walnut shells extract

Walnut shells extract

Juglone
Natural dyeing of wool fabric with pomegranate peel extract

Effect of dye concentration on K/S of dyed wool

Effect of extraction time on K/S of dyed wool

Effect of pH on K/S of dyed wool

a*b* of dyed wool yarns
Natural dyeing of wool fabric with walnut shells extract

Effect of pH on K/S of dyed wool

Effect of dye concentration on K/S of dyed wool

Effect of extraction time on K/S of dyed wool

\(a^*b^*\) of dyed wool yarns
Natural dyeing of wool fabric

100% Naturally dyed traditional carpets
Synthetic dyes are hazardous to health & environment.

Agricultural wastes can be effective dye sources.

Natural dyes are the sustainable & ecological alternative.
Development of durable process

Optimization of the dyeing method

Color reproduction

Study of the functional properties of naturally dyed fabrics

Cost improvement

Scale-up of dyeing process
Our team

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THANK YOU!