


AÇÕES DE DIVULGAÇÃO

Ação de divulgação	Greener Manufacturing Show
Local e Data	Colónia (Alemanha), 9 a 10 de novembro de 2022
Formas de divulgação	- Stand + prova de conceito
Evidências	

Ação de divulgação	12º Encontro Nacional de Cromatografia
Local e Data	Aveiro (Portugal), 6 a 8 Dezembro de 2022
Formas de divulgação	- Poster
Evidências	<div data-bbox="422 533 1353 1780"> <p>Determination of essential oils compounds responsible for anti-cellulite actions by GC-MS: pre and post encapsulation in β-cyclodextrin nanoparticles</p> <p>Rosado T^{1,2}, Santos A¹, Silva L³, Rodilla J³, Soares S^{1,2}, Menezes D⁴, Parracho F¹, Gomes A³, Belino N⁵, Gallardo E^{1,2}</p> <p>1. Introduction Essential oils (EO) have been used for a long time specially for perfume, food and beverage industry. Their application to treat cellulite, a skin condition commonly considered an unacceptable aesthetically cosmetic problem that resembles an orange peel, is still little researched. The aim of this work was to characterize five EO blends and optimize an encapsulation procedure into β-cyclodextrin (β-CD) nanoparticles. The obtained EO-β-CD complex will later be used to functionalize liposomes that can be further applied for cellulite treatment.</p> <p>2. Materials and methods HP 7890A gas chromatography system (Agilent Technologies, Waldbronn, Germany), equipped with a model 5975C Inert XL MSD mass selective detector (Agilent Technologies, Waldbronn, Germany), a HP5-MS injector and a PFI-injector from Gintec (Mülheim an der Ruhr, Germany). Capillary column: (30m x 0.25-mm I.D., 0.25-μm film thickness) with 5% phenylmethylsiloxane (HP-5 MS), supplied by J & W Scientific (Folsom, CA, USA).</p> <p>3. Results and discussion Table 1. Detection conditions Table 2. Cross-contribution between quantifier ions Table 3. Linearity data Table 4. Quantification of compounds in EO-β-CD complex</p> <p>4. Conclusions The EO blends were characterized, and the main compounds found were β-pinene, limonene, linalyl acetate, linalool, α-pinene, camphor, linalol, geranyl acetate and linalyl acetate. The blend that presented greater quantities of these compounds, was the one encapsulated in β-CD. The optimized encapsulation procedure contained 13.8 ± 1.2 % of total EO, of which 1.2 ± 0.1 % was in the β-CD. The authors acknowledge the financial support from Universidade Tecnológica do Porto (UTP) (Projecto 2021/2022) and Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) 2021/00698-9. The authors acknowledge the financial support from FCT (Fundo Europeu de Desenvolvimento Regional) through the COMPETE 2020 (Programa Operacional da Região de Aveiro) and FCT (Fundo Europeu de Desenvolvimento Regional) through the COMPETE 2020 (Programa Operacional da Região de Aveiro).</p> </div>

Ação de divulgação	iTechStyle Summit 2023
Local e Data	Porto (Portugal), 10 a 12 de maio de 2023
Formas de divulgação	<i>Poster</i>
Evidências	

Ação de divulgação	Renewable Materials Conference 2023
Local e Data	Colónia (Alemanha), 23 a 25 de Maio 2023
Formas de divulgação	Poster
Evidências	

MATERIAL GRÁFICO

Roll-up / Flyer / Poster Científico:

Flyer

NEO FOR FUTURE
Cosmetic Textiles Containing Encapsulated Essential Oils

Preservation of the therapeutic properties of Essential Oils (EOs) during the oil process, but also during the life cycle of the filament and textile structure.

Development of textile filaments and structures containing trapped or encapsulated EOs, in nanocapsules, porous (nano)structures and/or inclusion complexes.

Process


- Natural EOs**
Extracted and mixed by Blossom Essence
- Encapsulation**
Integration of EOs into porous matrices by Smart Innovation and UBI
- Compounding**
Production of bio-based polyester compound with encapsulated EOs by CeNTI
- Fibres**
Melt-spinning production at CeNTI, using the developed compound
- Textiles**
Production of new cosmetextiles containing EOs by UBI and FITEXAR

Co-funded by: COMPETE 2020, PORTUGAL 2020, UNIÓN EUROPEA, Fondo Europeo de Desarrollo Regional

Caderno



Poster- iTechStyle Summit 2023



SUSTAINABLE ANTI-CELLULITE FIBRES AND TEXTILES CONTAINING ESSENTIAL OILS TRAPPED OR ENCAPSULATED IN POROUS (NANO)STRUCTURES


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NEOFUTURE project aims to develop fibres containing encapsulated essential oils (EO) and their subsequent integration into textile structures. Proper encapsulation or fixation of EO in nanoporous structures enables the release of these active principles in a controlled manner, also preserves their therapeutic properties (e.g., antimicrobial, antioxidant, anti-inflammatory) during textile fibres' production and textile life cycle. In this work, the selected EO are encapsulated into silica particles and β-cyclodextrins. Their incorporation into textile filaments is carried out by two extrusion steps: firstly, the EO are mixed with a bio-based polymer matrix, and secondly, the resulting compounds are converted into textile fibres by melt-spinning Mono and Sheath/Core (S/C) bi-component fibres' configurations are attempted. With this work, we develop environmentally friendly functional textiles, by using polymers derived from renewable sources.

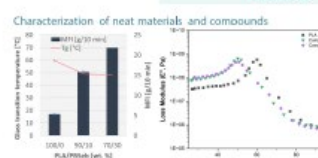
The use of biopolymers, mostly polyesters with a low melting point like polylactic acid (PLA), polybutylene succinate (PBS) and polyhydroxyalkanoate (PHA), as the matrix for the development of innovative textile filaments is considered. Their low melting point is important to protect the EO from thermal degradation. However, it is challenging to work with these materials, due to their strict processing temperatures' range. Luckily, it is possible to produce sustainable cosmetic textiles, given the bio-based origin of fibres' raw materials, both active ingredients (EO) and biopolymeric matrices and their biodegradability.

METHODOLOGY

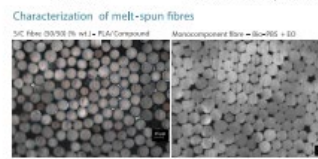


RESULTS

Characterization of neat materials and compounds



Characterization of melt-spun fibres

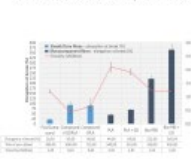


Characterization of textile structures

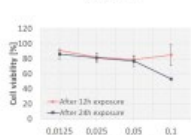
	Fiber 1 (PLA/EO)	Fiber 2 (PLA/PBS)	Fiber 3 (PLA+EO)	Fiber 4 (PLA+PES)
T _g (°C)	0.69	0.25	1.40	1.34
T _m (°C)	1.75	0.17	0.83	0.78
T _g (°C)	1.06	0.17	1.21	1.84
T _m (°C)	3.57	0.40	4.40	2.76
T _g (°C)	2.97	0.17	0.76	0.58

Material	MFI (g/10min) at 210 °C (0.1 mm)	MFI (g/10min) at 210 °C (0.2 mm)
PLA	3.36 ± 0.25	58.60 ± 0.20
PLA+EO	65.19 ± 1.02*	-
PLA+PBS	15.81 ± 0.38	48.10 ± 0.70
PLA+PES	21.39 ± 0.00	48.00 ± 1.20
S/C-EO	18.12 ± 0.25	-


MFI and DMA results of neat and compound materials



Mechanical analysis of S/C and mono-component melt-spun fibres



Cell viability of neat EO, after 12 and 24 hours of incubation with fibres and textiles containing EO












CONCLUSIONS


- The compound production has resulted in a reduction of the T_g when compared to neat PLA as well as an increase of the MFI value, as intended to improve the PLA processability, which was successfully achieved;
- In general, the existence of EO in the compound matrix has decreased the yarn's tenacity of the S/C bi-component fibres;
- PLA mono-component fibres present higher yarn's tenacity values than fibres made of PBS. As expected, the presence of EO has decreased the tenacity of both PLA and PBS fibres;
- It was proven that the mono-component fibres were compatible with knitting processes, since a T-shirt was successfully produced. However, the intended final application of these fibres is related to cosmetics (e.g., mainly for legs and gluteus area);
- The main EO responsible for the anti-cellulite effect were detected and quantified in the produced mono-component fibres and textile structures, proving that the EO were able to survive the melt-spinning and textile processes;
- The metabolic activity of HDF cells after incubation with the fibres and textile structures containing less than 0.05 wt% of incorporated EO, for 12h and 24h, has been above 70% confirming there is no cytotoxicity, according to ISO 10993-5:2009. Therefore, the use of these textile structures containing EO should not present any risk to be used in contact with the skin.

ACKNOWLEDGEMENTS

This work was performed under NEOFUTURE project (no 01912) which is co-financed by PORTUGAL 2020, under the Operational Programme for Competitiveness and Internationalization (COMPETE 2020) through the European Regional Development Fund (ERDF).

Poster – Renewable Materials Conference 2023



GREEN ANTI-CELLULITE TEXTILE FIBRES AND STRUCTURES WITH TRAPPED OR INCORPORATED ESSENTIAL OILS IN POROUS (NANO)STRUCTURES


B. Peltreiro^{1,2}, D. Rodrigues³, N. Durães⁴, A. Falcão⁵, S. Cunha⁶, E. Gallardo⁷, T. Rosado⁸, I. Rodilla⁹, I. Silva¹⁰, A. Rute¹¹, N. Belino¹², A. Afonso¹³, M. Freitas¹⁴, M. Brito¹⁵, D. Menezes¹⁶, F. Parracho¹⁷

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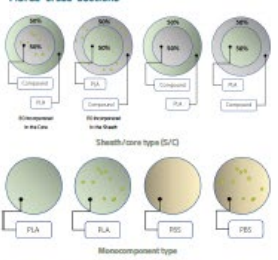
NEO Future projects aims to develop fibres containing encapsulated essential oils (EO) and their subsequent integration into textile structures. Proper encapsulation or fixation of EO in (nano)porous structures enables the release of these active principles in a controlled manner, also preserves their therapeutic properties (e.g., antimicrobial, anti-odor, etc.) during textile fibres' production and textile' life cycle. In this work, the selected EO are encapsulated into silica particles and β-cyclodextrin. Their incorporation into textile filaments is carried out by two activation steps: firstly, the EO are mixed with a bio-based polymer matrix, and secondly the resulting compound is converted into textile fibres by melt-spinning. Mono and Sheath/Core (S/C) bicomponent fibres' configurations are attempted. With this work, we develop environmentally friendly functional textiles, by using polymers derived from renewable sources.

The use of biopolymers, mostly polyesters with a low melting point like polylactic acid (PLA), polybutylene succinate (PBS) and polyhydroxybutyrate (PHB), as the matrix for the development of innovative textile filaments is considered. Their low melting point is important to protect the EO from thermal degradation. However, it is challenging to work with these materials due to their strict processing temperatures' range. Positively, it is possible to produce sustainable cosmetic textiles, given the bio-based origin of fibres' raw materials, both active ingredients (EO) and biopolymeric matrix and their biodegradability.

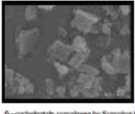
METHODOLOGY



Fibres' cross-sections



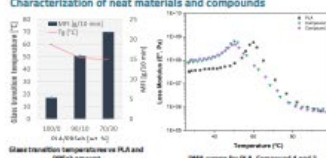
(Nano)porous matrix example



β-cyclodextrin complexed by Scanning Electronic Microscopy

RESULTS

Characterization of neat materials and compounds

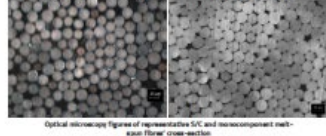


Material	MFI (g/10 min) @ 230 °C, 10 mm	Glass transition (°C)
PLA	1.98 ± 0.28	164.0 ± 0.20
PLA+EO	16.10 ± 1.87 ^a	-
Compound 1 (PLA + 0.5% EO)	14.91 ± 0.92	16.10 ± 0.70
Compound 2 (PLA + 1% EO)	21.78 ± 0.02	16.03 ± 1.20
PLA+EO	16.12 ± 0.21	-

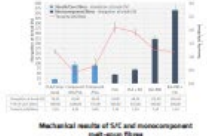
^aMFI tested at 180 °C

Characterization of melt-spun fibres

S/C fibre (MFI 16.12) vs. 1 - PLA+Compound; Monocomponent fibre - bio-PBS + EO



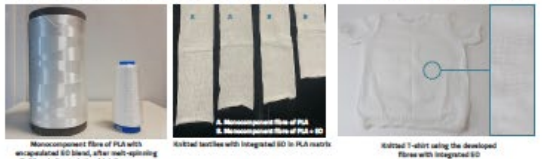
Optical microscopy images of representative S/C and monocomponent melt-spun fibre cross-sections



Characterization of textile structures

	Fibre 1 of PLA + EO (mg/ml)	Fibre 2 of PLA + EO (mg/ml)	Fibre 1 of PLA + EO (mg/ml)	Fibre 2 of PLA + EO (mg/ml)
MFI	0.82	0.71	1.62	1.56
PLA	1.76	0.71	0.69	0.32
PLA	1.08	0.17	1.21	1.08
PLA	0.87	0.63	0.67	0.76
PLA	2.87	0.17	0.78	0.58

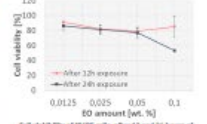
Quantification of the site responsible for the anti-cellulite effect in fibres and textile structures



Monocomponent fibres of PLA with encapsulated EO blend, after melt-spinning (left) and after textile (right) processes

Microscopic images of PLA monocomponent fibres with integrated EO

Microscopic images of PLA monocomponent fibres with integrated EO



Cell viability (%) vs EO amount (wt. %). Cell viability of MRC-5 cells after 12 and 24 hours of incubation with fibres and textile containing EO.

CONCLUSIONS

- The compound production has resulted in a reduction of the T_g when compared to neat PLA as well as an increase of the MFI value, as intended to improve the PLA processability, which was successfully achieved;
- In general, the existence of EO in the compound matrix has decreased the yarn's tenacity of the S/C bicomponent fibres;
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- The main EO responsible for the anti-cellulite effect were detected and quantified in the produced monocomponent fibres and textile structures, proving that the EO were able to survive the melt-spinning and textile processes;
- The metabolic activity of MRC-5 fibroblast cells after incubation with the fibres and textile structures containing less than 0.05% of incorporated EO, for 12h and 24h, has been above 70%, confirming there is no cytotoxicity, according to ISO 10993-5:2009. Therefore, the use of these textile structures containing EO should not present any risk to be used in contact with the skin.

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ESPECIFICAÇÕES TÉCNICAS PROTÓTIPO / DEMONSTRADOR

Prova de Conceito



Protótipos Finais

