



Biotech Consortium India Limited

LIGNIN BASED ZINC OXIDE NANOCOMPOSITES AS A UV BLOCKING AGENT

TECHNOLOGY AVAILABLE FOR TRANSFER

UNMET NEED AND OPPORTUNITY

Commercial chemical sunscreens contain high levels of synthetic ultraviolet (UV) filters, which can cause skin issues such as allergies and irritation. To replace these mineral based sunscreens came into action which contain titanium dioxide and zinc oxide nanoparticles, as the main UV blocking ingredients. However, these mineral based sunblocks are costly, require addition of other filters to provide broad-spectrum UV protection and due to their white appearance, they often leave a visible white cast on the face when applied. ZnO and TiO₂ nanoparticles are well-suited for biological applications due to their non-toxic nature, biosafety, biocompatibility, and ease of fabrication. Several chemical synthesis methods are available for producing these nanoparticles, which often require high temperatures, elevated pressures, and the use of hazardous chemicals. ***This highlights the need for the development of broad spectrum UV protective lignin based metal oxide nanomaterials, that are cost effective, synthesized using safer methods, and give a natural color on face.***

TECHNOLOGY

The present technology offers an innovative approach for synthesis of lignin coated metal oxide nanocomposites. Lignin which is derived from agricultural waste serves as the starting raw material, which is then used for encapsulating metal oxides.

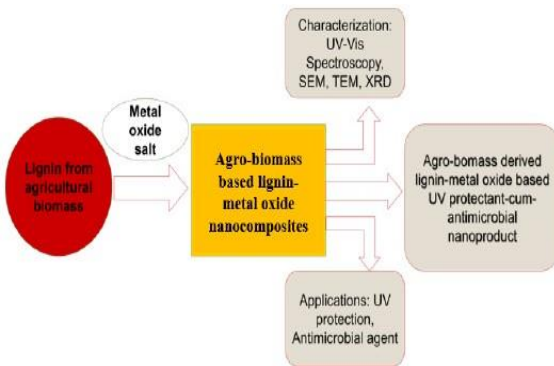


Figure 1. Schematic diagram for the synthesis of lignin based metal oxide nanocomposites and their applications

These lignin-derived metal oxide nanoparticles provide a dual benefit, functioning both as a sunscreen and an antioxidant agent.

UNIQUE SELLING PROPOSITION

- **Quality-** biocompatible, non-toxic, biodegradable
- **Preparation-** quick, easy to prepare, safe, chemical free, no use of extreme temperature
- **UV absorption:** 3 times higher than standard ZnO nano particles.
- **Cost effective-** Lignin offers a cost-effective alternative and is projected to reduce the cost of sunscreen by ~50%
- **Appearance-** provide a natural tinted color suited to the Indian skin tone
- **Size-** presence of small spherical nanoparticles of size range 3–5 nm
- **Antioxidant potential-** shows 75.67% antioxidant activity

STAGE OF DEVELOPMENT

The technology is currently placed at TRL-4.

Patent granted in India

EXPERIMENTAL DETAILS

UV transmittance analysis of the lignin based nanocomposites in the range of 200-400 nm was performed. The transmittance values showed in the table indicate the UV protection efficiency of the metal oxide nanocomposites, where ZnO nanoparticles synthesized from kraft lignin showed the best UV blocking efficiency as it showed **0% UV transmittance** in the entire UV range.

Table 1. Determination of UV protection efficiency of lignin, ZnO nanocomposites and Nivea cream based formulations

S. no.	UV blocking agent	UVA (315–400 nm) % transmittance	UVB (280–315 nm) % transmittance
1	Alkali lignin (AL)	7 ± 0.5	0
2	Kraft lignin (KL)	7 ± 0.5	0
3	Commercial ZnO NPs	10 ± 2.5	10 ± 2.5
4	ZnOAL NCs	10 ± 0.5	0
5	ZnOKL NCs	0	0
6	Cream only	90 ± 2.5	100 ± 2.5
7	Cream + AL	65 ± 0.75	60 ± 2.5
8	Cream + KL	50 ± 5	50
9	Cream + ZnO AL NCs	28 ± 5	25 ± 1.5
10	Cream + ZnO KL NCs	10 ± 2.5	10 ± 0.75

The lignin derived nanoformulations showed excellent UV-blocking efficiency as such and when used as an additive in a commonly used body cream. Among the ZnONCs, the cream based formulation containing ZnOKL nanocomposite showed a very low transmittance of only **10–25%** and also showed excellent sun protection factor (SPF) values (**SPF = 10**) compared to native lignin (SPF = 2, i.e. 5 times more effective) or commercial ZnO nanoparticles (SPF = 4, 2.5 times more effective).

APPLICATIONS

Cosmetic Industry: Acts as a **UV-blocking** agent in skincare products.

LICENSING OPPORTUNITY

BCIL is looking for an industrial partner to license this patented technology for commercialization.

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