

## The Antimicrobial, Anti-Inflammatory and Wound healing Effects of Silver Nanoparticles Synthesized from *Cotyledon Orbiculata*

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*Cotyledon orbiculata*, commonly known as pig's ear, is an important medicinal plant of South Africa [1]. It is used in traditional medicine to treat many ailments, including skin eruptions, abscesses, boils and acne [2]. Medicinal plants have also been used in the synthesis of metallic nanoparticles [3,4]. Nanomaterials produced in this way are more biocompatible and thus more suitable for biomedical applications [5]. This study aimed to synthesize silver nanoparticles using *C. orbiculata* aqueous extract and to investigate the antimicrobial, anti-inflammatory and wound healing properties of the synthesized nanoparticles and the plant extract. The *C. orbiculata* aqueous extract successfully synthesized silver nanoparticles which were then characterized (Figures 1 and 2). The antimicrobial activity of the extract and nanoparticles was evaluated against common skin pathogens (*S. Aureus*, MRSA, *S. epidermidis*, *P. aeruginosa*, *C. albicans*). The immunomodulatory activity of the extract and nanoparticles was evaluated by determining their effects on cytokine production. The cytokine levels (TNF-alpha, IL-1 beta, and IL-6) were measured using the enzyme linked immunoassay. Their wound healing activity was assessed using the scratch assay and gene expression studies. The *C. orbiculata* aqueous extract was able to synthesize silver nanoparticles, which are 20-40nm in size. These nanoparticles exhibited good antimicrobial activity, with the highest activity observed against *P. aeruginosa* (5 µg/mL). The nanoparticles also showed anti-inflammatory activity by inhibiting pro-inflammatory cytokine secretion in macrophages. Both the nanoparticles and the extract showed good wound healing activities. It can thus be concluded that *C. orbiculata* synthesized silver nanoparticles have antimicrobial, anti-inflammatory, and wound healing properties.

- [1] Maroyi, A. J, *Pharm. Sci. Res*, 11 (2019) 3491–3496.
- [2] Aremu, A.O.; Ndhlala, A.R.; Fawole, O.A.; Light, M.E.; Finnie, J.F.; Van Staden, J. S., *Afr. J. Bot*, 76 (2010) 558–566.
- [3] Roshan Balasooriya, E.; Jayasinghe, C.D.; Jayawardena, U.A.; Weerakkodige, R.; Ruwanthika, D.; Mendis De Silva, R.; Udagama, P.V. J., *Nanomater*, 2017 (2017) 1–10.
- [4] Majoumouo, M.S.; Sibuyi, N.R.S.; Tincho, M.B.; Mbekou, M.; Boyom, F.F.; Meyer, M. *Int. J. Nanomed*. 14 (2019) 9031–9046.
- [5] Elbagory, A.; Cupido, C.N.; Meyer, M.; Hussein, A.A., *Molecules*, 21 (2016) 1498.

### Figures

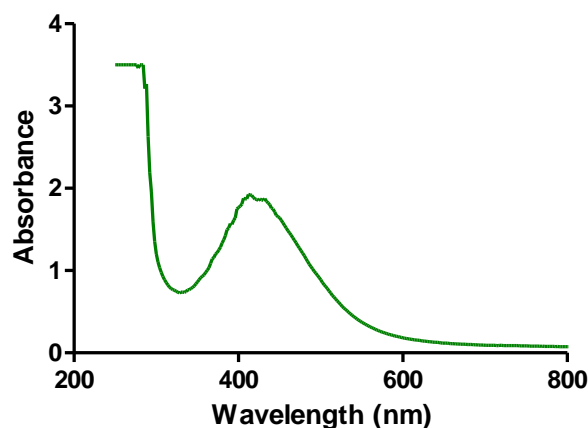


Figure 1. Characterization of *C. orbiculata* synthesized silver nanoparticles using UV-vis spectroscopy

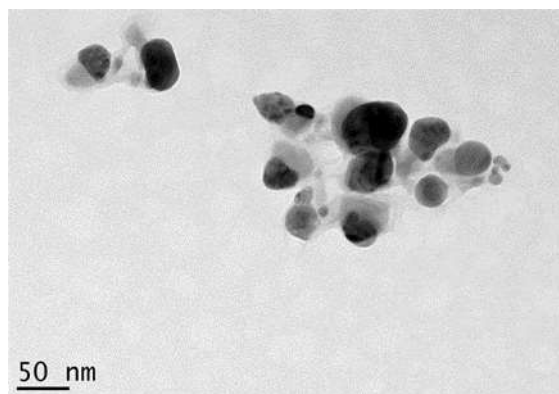


Figure 2. Characterization of *C. orbiculata* synthesized silver nanoparticles using HR-TEM

### References