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RESEARCH ARTICLE

ANTIMICROBIAL POTENTIAL OF SHEA BUTTER PRODUCTION WASTE : IN VITRO ANTIFUNGAL ACTIVITY OF SHEA HULL AND PRESS CAKE METHANOLIC EXTRACTS

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Abstract

Shea shells and press cake (*Vitellaria paradoxa*) are major by-products of shea butter processing that remain largely underutilized despite their content of potentially bioactive compounds. This study aimed to evaluate the *in vitro* antifungal activity of methanolic extracts obtained from shea nut shells and press cake against selected fungal strains associated with mycoses and food contamination. The extracts were prepared by macerating powdered samples in 70% methanol for 48 h at room temperature, followed by filtration and solvent evaporation using a rotary evaporator. Phytochemical screening was performed to identify the major classes of secondary metabolites present in the extracts. Antifungal activity was evaluated using the agar disc diffusion method, while the minimum inhibitory concentrations (MICs) were determined using serial extract dilutions. Phytochemical screening revealed the presence of several bioactive compound classes, including polyphenols, flavonoids, tannins, saponins, and triterpenes. The extraction yields were 21.20% for press cake and 7.20% for shea nut shells. Both extracts exhibited antifungal activity against all tested strains, with inhibition zones ranging from 13 to 17 mm. The lowest inhibitory concentration recorded was 1.56 mg/mL for *Aspergillus flavus* and *Aspergillus fumigatus*, whereas a concentration of 6.25 mg/mL was required to inhibit *Candida albicans*. These findings demonstrate the antifungal potential of shea nut shells and press cake and suggest that their phenolic and terpenoid constituents may contribute to the observed activity. Further studies are required to isolate and characterize the active compounds and to assess their toxicity and *in vivo* efficacy. Shea nut shells and press cake therefore represent promising sources of bioactive compounds and may provide opportunities for the valorization of shea-processing by-products.

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Introduction:-

Infections caused by fungi (*Aspergillus*) or yeasts (*Candida*), also known as mycoses, are increasingly difficult to inactivate, with a rapidly growing frequency, thus causing a real public health problem (Azim and Ahmed, 2024, Esmacili et al., 2025). *Candida* sp and *Aspergillus* are occasional but often dangerous parasites (Azim and Ahmed, 2024, Stemler et al., 2024). *Aspergillus* is a filamentous species of opportunistic pathogenic fungus, but very virulent in the event of a drop in immunity, particularly in HIV-positive patients. It causes cutaneous and systemic infections, particularly bronchopulmonary infections, through its vegetative form or through the spores that it disseminates in the air (Tan et al., 2022, Stemler et al., 2024). As for *Candida* sp, it induces several types of infections ranging from a simple skin infection to more serious cases such as oral and sexual infections. It should also be noted that *Candida* sp and *Aspergillus* cause cases of food poisoning (Lass-Flörl et al., 2024). Despite the availability of antibiotics and appropriate modern drugs, a resurgence of these infections is observed. The appearance of strains resistant to the usual antibiotics and the emergence of the pathogenicity of strains that are usually saprophytic in our environment are the main factors of this strong resurgence (Vitiello, 2023). The increase in fungal resistance to conventional drugs and the fact that most antifungal drugs only have fungistatic activity, justify the search for new strategies to fight fungal infections (Dong et al., 2023, Esmacili et al., 2025). Thus, several works have highlighted the biological activities (antifungal, antibacterial, anti-inflammatory, antioxidant, etc.) of several aromatic and medicinal plants ; in particular the inhibitory power of their extracts on the growth and toxinogenesis of several bacteria and fungi responsible for food and skin infections (Dong et al., 2023, Jadimurthy et al., 2023, Esmacili et al., 2025). These considerations led us to consider the possibilities of using shea to treat various infections involving fungal and bacterial agents.

Indeed, shea is a multipurpose tree where all its parts are used by rural populations ; the leaves, bark, flowers, latex, roots and shea butter are widely used in traditional pharmacopoeia (Ojo et al., 2021). For a long time, shea nut shells and press cake, considered by-products of shea butter processing, were discarded. However, the work of Kouakou *et al.* (2021) demonstrated that these by-products are rich in phenolic compounds, which confer significant antioxidant activity. These findings open up new avenues for the valorization of shea nut shells and press cake, particularly with regard to their potential antimicrobial properties. The objective of this study was to evaluate, *in vitro*, the antimicrobial activity of methanolic extracts of shea nut shells and press cake against fungal strains responsible for mycoses and/or foodborne contamination. This study forms part of a broader research effort aimed at identifying new natural sources of bioactive compounds.

Materials and Methods:-**Plant material:-**

Organic material for this study consisted in shea hulls and press cakes which constitute waste products from the shea butter process of (Megnanou et al. 2007). Shea nuts collected in m'bahiakro, town located in the central east of Ivory Coast.

Microorganisms used:-

Antifungal activity of shea hulls and press cakes extracts was tested against two fungal strains (*Aspergillus fumigatus*, *Aspergillus flavus*) and one yeast (*Candida albicans*). These strains were supplied by the National Polyclinic Institute Houphouët Boigny of Yamoussoukro ; they are known to be cause several infections.

Methods:-**Shea hulls and press cake hydromethanolic extracts setting:-**

Method described by Guede-Guina *et al.* (1997) was used for methanolic extraction of shea hulls and press cakes. One hundred grams of powdered shea nut shells or press cake were homogenized under magnetic stirring in 1 L of 70% methanol for 48 h at room temperature. Following filtration of the mixture through hydrophilic cotton and Whatman filter paper, the solvent was evaporated at 40 °C using a rotary evaporator. The resulting extracts, designated SHE and SPCE for shea nut shell extract and shea press-cake extract, respectively, were stored at 4 °C until further analysis. For antimicrobial activity assays, the extracts were resuspended in distilled water to obtain solutions at a concentration of 50 mg/mL. The resulting solutions were sterilized before use.

Phytochemical screening of shea hulls and press cakes extracts:-

Phytochemical screening of shea hulls and press cakes extracts consisted in detecting their the active constituents, namely, as far as polyphenols, flavonoids, saponins, steroids, tannins and triterpennic alcohols are concerned. Therefore, methods described by Martinez et al. (2003), Sofowra (1993) and Wall et al. (1952) were carried.

Evaluation of antimicrobial activity:-

The antimicrobial activity of the extracts was evaluated using the agar disc diffusion method described by Adesokan et al. (2007). One hundred microliters of microbial suspensions adjusted to 10^5 CFU/mL were spread onto Petri dishes containing Sabouraud agar. Sterile 6-mm-diameter paper discs separately impregnated with the extract solutions, together with a disc impregnated with distilled water as a negative control, were placed on the inoculated agar surface.

Petri dishes containing the microorganisms and impregnated discs were maintained at room temperature for 1 h to allow pre-diffusion of the compounds, and were subsequently incubated at 30 °C for 48 h. The antimicrobial activity of the extracts was evidenced by the formation of inhibition zones around the discs. The diameters of these zones were measured to assess the in vitro efficacy of the extracts against each fungal strain. Strains were classified either sensitive, highly sensitive, extremely sensitive or resistant Hamidi (2013) as function to the diameter of inhibition zone.

Hence:-

- Non-sensitive (-) or resistant: diameter < 8 mm.
- Sensitive (+): diameter between 9 and 14 mm.
- Very sensitive (++) : diameter between 15 and 19 mm.
- Extremely sensitive (++) : diameter > 20 mm.

Determination of minimum inhibitory concentration (MIC):-

Serial dilutions of the extract solutions were prepared to obtain concentrations of 50, 25, 12.5, 6.25, 3.13, 1.56, and 0.78 mg/mL. The antimicrobial assay described above was performed at each concentration. The minimum inhibitory concentration (MIC) was defined as the lowest extract concentration at which a visible inhibition zone was observed around the impregnated disc.

Statistical Analysis:-

Analysis test were carried out in triplicate and the data were expressed as mean $\pm$ SD. Statistical was performed utilizing Statistica version 7.1, One-way analysis of variance (ANOVA) followed by the LSD Post Hoc test. The P values more than 0.05, less than ≤ 0.05 and $\leq$ less than 0.01 were considered as not significant, significant and highly significant values respectively.

Results and Discussion:-

According to Sofowora (1993), phytochemical analyses of plant extracts represent an important step in the investigation of medicinal plants because they reveal the presence of compounds known to possess biological activities. Although the extraction yields differed, reaching 21.20% for the press cake and 7.20% for the shells, phytochemical screening of the shea nut shells and press cake revealed the presence of the same bioactive compound classes. These included polyphenols, flavonoids, tannins, saponins, and triterpenes (Table I).

These findings are consistent with the results reported by Kouakou *et al.* (2021), who quantified substantial but variable levels of total phenolics, tannins, and flavonoids in shea nut shells and press cake.

Table I : Phytochemical screening of shea hulls and press cake extract

	Polyphenols	Flavonoids	Tannins	Saponin	Steroids	Triterpenes
SHE	+	+	+	+	+	+
SPCE	+	+	+	+	+	+

(-) = Absent (+) = Presence

SHE : Shea Hull Extract ; SPCE : Shea Press Cake Extract

Given the presence of phenolic and terpenoid compounds in the shea nut shell and press-cake extracts, and based on the known biological properties of these classes of compounds, the antifungal activity of the extracts was subsequently investigated. Indeed, a correlation has been reported between the antibacterial and/or antifungal activity of different plant parts and their phytochemical composition (Rojas *et al.*, 1992). Analysis of the results showed that all tested fungal strains were susceptible to both extracts, as evidenced by the inhibition zones surrounding the extract-impregnated discs. The inhibition zone diameters ranged from 13 to 17 mm (Table II), while the minimum inhibitory concentrations were 1.56 mg/mL for the *Aspergillus* strains and 6.25 mg/mL for *Candida albicans* (Table III).

The inhibition of microbial growth by the extracts may be attributed to the interaction of the phytochemical compounds present in the extracts with the tested microorganisms. Once taken up or interacting with microbial cells, these compounds may interfere with enzymes and other cellular effectors, thereby depriving microorganisms of essential substrates and metal ions (Dhaouadi *et al.*, 2011). Several authors have reported that the chemical composition of plant extracts directly affects their biological properties and, in particular, their ability to inhibit microorganisms (Celiktaş *et al.*, 2007 ; Van Vuuren *et al.*, 2009). Balinadua and Chan (2018) and Aziz and Karboune (2018), in studies conducted on different plant parts, including leaves and roots, attributed the antimicrobial activity of these plants mainly to their phenolic and terpenoid fractions.

Table II : Shea hulls and press cake inhibition halo diameter

Microorganisms	SHE	SPCE	Sterile distilled water
<i>Candida albicans</i>	15 ± 0,8	13 ± 0,3	0
<i>Aspergillus flavus</i>	15 ± 0,9	17 ± 1,3	0
<i>Aspergillus fumigatus</i>	15 ± 1,1	16 ± 0,7	0

SHE : Shea Hull Extract ; SPCE : Shea Press Cake Extract

Table II : Minimum inhibitory concentrations of shea hulls and press cakes extracts against various fungal strains

Microorganisms	Minimum inhibitory concentration (mg/mL)		
	SHE	SPCE	Sterile distilled water
<i>Candida albicans</i>	6.25	6.25	-
<i>Aspergillus flavus</i>	1.56	1.56	-
<i>Aspergillus fumigatus</i>	1.56	1.56	-

SHE : Shea Hull Extract ; SPCE : Shea Press Cake Extract

Conclusion:-

The present study demonstrates the antifungal potential of methanolic extracts of shea nut shells and press cake from *Vitellaria paradoxa* against *Candida albicans*, *Aspergillus flavus*, and *Aspergillus fumigatus*. This activity was evidenced by marked inhibition zones and relatively low minimum inhibitory concentrations. Furthermore, phytochemical screening revealed the presence of several classes of secondary metabolites, particularly phenolic and terpenoid compounds. The presence of these compounds may contribute to the antimicrobial activity observed, although their individual contribution was not established in the present study. The inhibitory effect of methanolic extracts of shea nut shells and press cake against the tested fungal strains highlights their potential as sources of bioactive compounds. However, further studies focusing on the isolation and characterization of the active compounds, as well as their toxicity and in vivo effects, are required before any therapeutic applications can be considered. Overall, these findings highlight the potential of shea nut shells and press cake as sources of bioactive substances. They also offer promising prospects for the valorization of these frequently underutilized by-products of the shea industry.

References:-

- Adesokan, A. A., Akanji, M. A., & Yakubu, M. T. (2007). Antibacterial potentials of aqueous extract of *Enantia chlorantha* stem bark. *African Journal of Biotechnology*, 6(22), 2502–2505. <https://doi.org/10.5897/AJB2007.000-2397>. (Musbau Akanji)
- Azim, A. & Ahmed, A. (2024). Diagnosis and management of invasive fungal diseases in non-neutropenic ICU patients, with focus on candidiasis and aspergillosis: a comprehensive review. *Frontiers in Cellular and Infection Microbiology*, 14 : 1256158. <https://doi.org/10.3389/fcimb.2024.1256158>.
- Aziz, M., & Karboune, S. (2018). Natural antimicrobial/antioxidant agents in meat and poultry products as well as fruits and vegetables: A review. *Critical Reviews in Food Science and Nutrition*, 58(3), 486–511. <https://doi.org/10.1080/10408398.2016.1194256>. (PubMed)

4. Balinadua, L. O., & Chanb, M. A. (2018). Determination of antimicrobial properties of crude aqueous leaves extracts of selected medicinal plants using resazurin-based microtiter broth dilution method. *Arabian Journal of Medicinal and Aromatic Plants*, 4(2), 1–14. <https://doi.org/10.48347/IMIST.PRSM/ajmap-v4i2.13922>. (AGRIS)
5. Celiktaş, O. Y., Hames Kocabas, E. E., Bedir, E., Vardar Sukan, F., Ozek, T., & Baser, K. H. C. (2007). Antimicrobial activities of methanol extracts and essential oils of *Rosmarinus officinalis*, depending on location and seasonal variations. *Food Chemistry*, 100(2), 553–559. <https://doi.org/10.1016/j.foodchem.2005.10.011>. (ScienceDirect)
6. Dhaouadi, K., Raboudi, F., Estevan, C., Barrajón, E., Vilanova, E., Hamdaoui, M., & Fattouch, S. (2011). Cell viability effects and antioxidant and antimicrobial activities of Tunisian date syrup (Rub El Tamer) polyphenolic extracts. *Journal of Agricultural and Food Chemistry*, 59(1), 402–406. <https://doi.org/10.1021/jf103388m>. (PubMed)
7. Dong, F.-R., Gao, L., Wang, L., Jiang, Y.-Y. & Jin, Y.-S. (2023). Natural products as antifungal agents against invasive fungi. *Current Topics in Medicinal Chemistry*, 23(19): 1859–1917. <https://doi.org/10.2174/1568026623666230417105227>.
8. Esmacili, A., Saleh, I. & Abu-Dieyeh, M. H. (2025). Antifungal potential of plant-based extracts against *Candida* species: values, safety concerns, and possible applications. *Phytochemistry Reviews*, 24: 5801–5844. <https://doi.org/10.1007/s11101-025-10093-x>.
9. Guede-Guina, F., Kra, A. M., Vangah-Manda, M., Bonga, G. M. & De Souza, C. (1997). Inhibition par MISCA-F2 de la croissance de *Aspergillus fumigatus* ; *Candida albicans* et *Cryptococcus neoformans*, 3 germes fongiques opportunistes au cours du SIDA. *J Afr Biomed*, 2: 11-16.
10. Hamidi, A. (2013). Etude phytochimique et activité biologique de la plante *Limoniastrum guyonianum*. Thèse de doctorat, Université Kasdi Merbah, Ouargla, Algérie, 86.
11. Kouakou, A. B., Doué, G. G., Mégnanou, R.-M. & Djoman, A. E. S. (2021). Shea shells and press-cake as new sources of bioactive phenolic compounds: GC-MS profile and in vitro antioxidant activity. *European Journal of Biology and Biotechnology*, 2(5): 53–59. <https://doi.org/10.24018/ejbio.2021.2.5.252>.
12. Lass-Flörl, C., Kanj, S. S., Govender, N. P., Thompson, G. R. III, Ostrosky-Zeichner, L. & Govrins, M. A. (2024). Invasive candidiasis. *Nature Reviews Disease Primers*, 10: 20. <https://doi.org/10.1038/s41572-024-00503-3>.
13. Martinez, A., Valencia, G. & Marcha, F. (2003). Phytochemical screening methods. In *Manual de Practicas de Farmacognosia y Fitoquímica*, edited by Medellín, Universidad de Antioquia, pp. 59-65.
14. Megnanou, R.-M., Niamke, S. & Diopoh, J. (2007). Physicochemical and microbiological characteristics of optimized and traditional shea butters from Côte d'Ivoire. *African Journal of Biochemistry Research*, 1 (4): 41-47.
15. Ojo, O., Kengne, M. H. K., Fotsing, M. C., Mmutlane, E. M. & Ndinteh, D. T. (2021). Traditional uses, phytochemistry, pharmacology and other potential applications of *Vitellaria paradoxa* Gaertn. (Sapotaceae): a review. *Arabian Journal of Chemistry*, 14: 103213. <https://doi.org/10.1016/j.arabjc.2021.103213>.
16. Rojas, A., Hernández, L., Pereda-Miranda, R., & Mata, R. (1992). Screening for antimicrobial activity of crude drug extracts and pure natural products from Mexican medicinal plants. *Journal of Ethnopharmacology*, 35(3), 275–283. [https://doi.org/10.1016/0378-8741\(92\)90025-M](https://doi.org/10.1016/0378-8741(92)90025-M). (PubMed)
17. Sofowora, A. (1993). *Medicinal Plants and Traditional Medicine in Africa* (2nd ed.). Ibadan: Spectrum Books. (Google Livres)
18. Stemler, J., Nacov, J. A., Sprute, R., Cornely, O. A., Joest, M., Becker, S. & Klimek, L. (2024). *Aspergillus*-associated diseases from an infectious diseases and allergological perspective. *Allergo Journal International*, 33: 140–152. <https://doi.org/10.1007/s40629-024-00286-9>.
19. Tan, L. F., Yap, V. L., Rajagopal, M., Wiart, C., Selvaraja, M., Leong, M. Y. & Tan, P. L. (2022). Plant as an alternative source of antifungals against *Aspergillus* infections: a review. *Plants*, 11(22): 3009. <https://doi.org/10.3390/plants11223009>.
20. Van Vuuren, S. F., Suliman, S., & Viljoen, A. M. (2009). The antimicrobial activity of four commercial essential oils in combination with conventional antimicrobials. *Letters in Applied Microbiology*, 48(4), 440–446. <https://doi.org/10.1111/j.1472-765X.2008.02548.x>. (EnviroMicroJournals)
21. Vitiello, A., Ferrara, F., Boccellino, M., Ponzio, A., Cimmino, C., Comberiati, E., Zovi, A., Clemente, S. & Sabbatucci, M. (2023). Antifungal drug resistance: an emergent health threat. *Biomedicines*, 11(4): 1063. <https://doi.org/10.3390/biomedicines11041063>.
22. Wall, M. E., McClenna, M. L. & Klump, M. E. (1952). Detection and estimation of steroid and sapogenins in plant tissue. *Analytical Chemistry*, 24: 1337-1342.