

MECHANO-CHEMICAL PRODUCTION OF PULP AND PAPER MATERIALS BY GREEN MANUFACTURING USING WILD MUSHROOM SPECIES FROM OUR LOCAL ENVIRONMENT

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Abstract

This work reports the formulation of pulp and papers from 3 different spices of mushrooms (*Polyporous umbellatus*, *ganoderma lucidum* and *hydum repandum*) obtained from the wide. Mushroom slurry was prepared by dissolving pulverized mushroom in water/starch (1.5:1) solution and the formulated slurry cast into paper using a mold. Formulated paper samples were characterizedvia tensile stress, force, pressure and area analysis. Results obtained showed that sheets of (*Polyporous umbellatus*) has a tensile stress of (46.21), force (490 N), area (11.5 cm), thickness (0.5 cm). (*ganoderma lucidum*) has a tensile stress of (44.6), force (491 N), area (11 cm), thickness (0.5 cm). (*hydum repandum*) has a tensile strength of (43.90), force (461 N), area (10.5 cm), thickness (0.5 cm). The transformation of these mushrooms into sheets of paper provides a potential alternative to deforestation as a result of pulp and paper manufacture from trees and this will help preserve our forest reserves, safeguard the environment, and provide jobs, particularly at the bottom of the production chain.

Background

- Wood has traditionally been the most widely used lignin cellulosic matter in the production of pulp, furniture and boards of diverse types, and as source for energy. Increasing demand for these materials, together with economic and environmental factor, makes it necessary to research alternative sources of lignin cellulosic matter (Sujith *et al.*, 2022).
- Production of the pulp and paper from non-wood materials has many benefits compared with wood, such as easy to pulp, good-quality bleached pulp, and excellent sources for special types of paper (Franciele et al. 2019).
- For many years, people have consumed and valued mushrooms for their flavour, economic and ecological worth, and medicinal characteristics. They have a chemical composition that is appealing from a nutritional standpoint.
- They have a chemical composition that is appealing from a nutritional standpoint. Mushrooms have 90% water and 10% dry substance in general. Protein ranges from 27% to 48%, carbs are less than 60%, and lipids are 2-8% (Morais et al. 2000). The total energy value of fresh mushroom caps is 1.05-1.50 J/kg (Laborde 1995).

METHOD

- Sample collection and preparation*

The three species of mushroom were collected around a farm located at joseph sarwuan tarkaa university, Benue state, Nigeria. The three mushroom were harvested using a knife, the knife was placed at the mushroom base. Different sizes were harvested, since the harvesting of mushroom is not dependent on the growth stage. They were freshly harvested and placed inside a sack after which they were transported to the Chemistry research laboratory, which is situated in the university's south core axis in Makurdi. The harvested mushroom species were soaked in water for three days for softening after which they were removed and placed inside the oven for drying. The dried mushroom was then broken into different sizes to aid easy pulverization. A grinder was used to pulverize the dried mushroom

- Moulding*

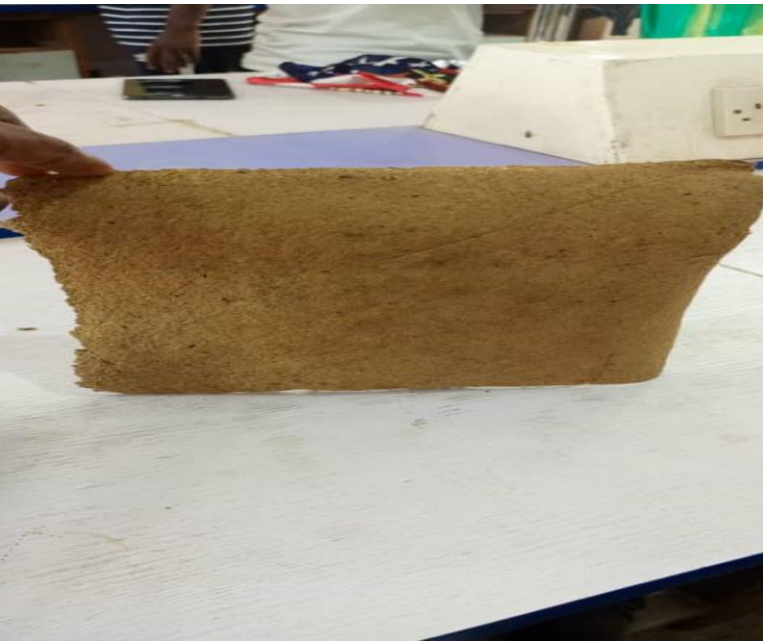
The mushroom slurry was prepared by dissolving pulverized mushroom of 65 g in water/starch (1:5:1) solution and the formulated slurry poured into a paper mold to give a perfect shape of paper. The mould collects the water from the slurry leaving only the mushroom particles. The water-free homogenized mushroom particles is then removed from the mould gently in order to avoid shape deformity. Before the mushroom particle is placed off the mould, newspapers were placed on the table after which a towel was placed upon. The towel also aids collection of water from the homogenized mushroom. The moist fiber is then dried using oven assisted and air drying.



Paper from Ganodemar lucidium



Paper from Polyporous



Paper from Hydnum repandum

RESULT AND DISCUSSION

TABLE 1 Shows the weight of sample, quantity of reagent used, weight of dried material and analysis of the three samples

Samples	Wt. of sample(g)	Vol. H ₂ O in pulping(ml)	Vol. of starch(ml)	Wt. of dried paper material(g)
<u>Polyporous</u>	65	390	260	49
<u>Hydum repandum</u>	65	390	260	46.1
<u>Ganodemar lucidium</u>	65	390	260	49.1

TABLE 2. Analysis for the three samples (mushroom)

Samples	Thickness (cm)	force (N)	Width (cm)	Area (cm) = L × B	Tensile stress= F/A (m ²)	Tensile strength
<u>Polyporous</u>	0.5	490	23	11.5	42.61	3.71
<u>Hydum repandum</u>	0.5	461	21	10.5	43.90	4.18
<u>Ganodemar lucidium</u>	0.5	491	22	11.0	44.60	4.05

- The weight of the dry paper produced is shown in table 1 above along with an equivalent amount of the sample used to make the paper. Additionally, the outcome shows that (*Ganoderma Lucidum*) has a heavier paper weight than (*Polyporous umbellatus*) and (*Hydum Repandum*).

- Table 2 shows how the thickness of the paper was also determined. The outcome shows that the thickness of the three mushroom species is the same.

- The three species' tearing strengths were assessed using their tensile strengths, and the findings indicate that (*ganoderma lucidium*) has a higher tensile strength than (*Polyporous umbellatus*) and (*hydnum repandum*). As showed in table 2.

- This formulation of papers from 3 different spices of mushrooms (*Polyporous umbellatus*, *ganoderma lucidum* and *hydum repandum*) obtained from the wide, with the intent of producing paper, comparing and characterizing the paper. The Formulated paper were subjected to tensile stress, force, pressure and area analysis. the pulping process was completed for 65 g of mushroom slurry.

- Additionally, the percentage yield obtained for (*Polyporous umbellatus*) was around (75.38%), for (*Garnoderma lucidum*) approximately (75.53%), and for (*Hydenum rapandum*) approximately (70.92%). The three mushroom species have the same thickness when measured. The tensile stress of (*Ganoderma lucidum*) is higher at 44.6 than that of (*Hydnum repandum*) 43.9 and (*Polyporous umbellatus*) 42.6. The tensile strength for (*Hydnum repandum*) is higher at 4.18 than that of (*Ganoderma lucidum*) which is 4.05 and (*Polyporous umbellatus*) which is 3.71.

CONCLUSION

In conclusion, the production of paper using (Polyporous umbellatus, ganoderma lucidum and hydum repandum) has shown promising results as eco-friendly approach to paper production. The use of (Polyporous umbellatus, ganoderma lucidum and hydum repandum) is significant as the plants are easily available, renewable, and cost-effective sources for reducing and stabilizing agents. Their use for paper production can lead to a reduction in production costs and help establish a sustainable approach to the paper industry. The characterization of the physical properties of the paper is also critical in determining their potential use in various applications. In summary, the use of (Polyporous umbellatus, ganoderma lucidum and hydum repandum) for the production of paper has demonstrated a sustainable approach to paper industry. Their natural reducing and stabilizing agents have enabled the production of paper with significant impact on the environment, and the continued exploration of this method could potentially lead to the reduction of deforestation.

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