CHEMICAL COMPOSITIONS OF NON-BIODEGRADED AND FUNGI DEGRADED MAIZE COB AS FEED FOR RUMINANTS

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ABSTRACT

The study evaluated the chemical composition of Non biodegraded maize cobs (NBMC), fungi-degraded maize cobs. Pleurotus tuber-regium (PTRMC), Pleurotus ostreatus (POMC), Pleurotus eryngii (PEMC), and Pleurotus pulmunarius (PPMC) were used in the biodegradation. The results showed significantly (p<0.05) higher amounts of crude protein, ash, and nitrogen-free extract (NFE) in the biodegraded maize cobs compared to the non-degraded maize cob (NBMC). On the other hand, the fungi-degraded maize cob had significantly lower amounts of organic matter, crude fibre, neutral detergent fibre (NDF), acid detergent fibre (ADF), and acid detergent lignin (ADL) than the non-degraded maize cob. Among the fungi-degraded maize cobs, PTRMC had the highest crude protein content (9.77%), followed by POMC (6.35%), PPMC (6.09%), and PEMC (5.32%). PTRMC also had the lowest values for crude fibre (20.29%), NDF (53.35%), ADF (26.44%), and ADL (13.49%). These results suggest that biodegradation by Pleurotus species can improve the nutritional value of maize cob by increasing the content of crude protein, ash, and NFE and decreasing crude fibre, NDF, ADF, and ADL of maize cob making it potential alternative feedstuff for ruminants.

Keywords*:* Biodegradation, maize cobs, alternative feedstuff, lignicellulose, *Pleurotus tuber-regium*

INTRODUCTION

The poor utilization of agricultural by-products in the tropics poses a significant environmental challenge. Most of this agricultural industrial wastes or residues produced by farmers in tropical countries are inappropriately discarded as waste, with consequences of threatening the environment and public health. The farmers lack the needed technology and information on how to convert them into useful products. Most of these by-products are exploited in their raw form as feedstuff by livestock farmers and have been shown to have low feeding value because of their fibrous nature (Okoli, 2023). Maize cob is an example of agro-industrial waste that can be harnessed and as an alternative feed resources that is cheap. Although maize cob usage is rarely accounted for, there have been efforts to evaluate possible applications in Nigeria (Raheem and Adesanya, 2011). The utilization of maize cobs is limited due to the high crude fibre and low protein content. This requires a touch of technology such as fermentation in order to improve its quality to be used as a more optimal feed" (Arwinsyah *et al*., 2019). Proper utilization of maize cob can be achieved by adopting fermentation technology to improve its quality making the nutrients available for ruminants.

MATERIALS AND METHODS

Study area

The inoculation was conducted at the Tissue Culture Laboratory of National Root Crops Research Institute, Umudike, Abia State, from February-March, 2018. The *in vitro* studies and nutritional and anti-nutritional studies were conducted at the Department of Animal Science Laboratory, University of Benin, Edo State from June-July, 2018. Umudike is located at latitude 05E281 North and longitude 07E311 East and lies at an altitude of 122 meters above sea level. Relative humidity ranged from 76-87% by Jiwuba *et al*. (2017).

Preperation and Innoculation of Maize Cobs with White Rot Fungi

The inoculation room was thoroughly be swept, washed and disinfected. The floors was mopped free of water and allowed to dry and locked up for two weeks to kill any surviving contaminant. Thereafter, the milled maize cob was wetted with water at the rate of 1.0 kg straw to 2.0 liters of water and thoroughly mixed to enable complete wetting of the maize cob. White rot fungi species (*Pleurotuspulmunarius Pleurotus ostreatus* and *Pleurotus eryngii*) were obtained from Federal Institute of Industrial Research, Oshodi (FIIRO) Lagos while Tubers of *Pleurotus tuber-regium* (PTR), was purchased from a dealer at Eke Amainyi market, Ihitte/Uboma, L.G.A. Imo State.

For the *Pleurotus pulmunarius Pleurotus ostreatus* and *Pleurotus eryngii* thirty kilograms (30 kg) of maize cob were soaked in a plastic basin with clean tap water for five hours (5 hrs) to ensure that the residues absorbed enough water. The soaking were to ensure the washing off of soil particles. After draining the water from the substrates, they were allowed to stand for three hours (3 hrs). 500g portions of maize cob were weighed and transferred into three different cleaned, labelled aluminium trays measuring 15cm × 11cm × 4cm. The open end of the aluminium trays were covered with polyethylene films and aluminium foil. The trays and their contents were then steam-pasteurized for four (4 hrs) in a 200-L metal barrel. After, the trays were allowed to cool to room temperature before inoculation were done. Inoculation were done by carefully lifting the foil covering each tray and quickly broadcasting one gram (1g) portion of *Pleurotus pulmunarius Pleurotus ostreatus* and *Pleurotus eryngii* spawn grain onto substrates using a disinfected inoculation spoon. Additionally, a sterilized inoculation pin were used to evenly distribute the spawn onto the substrates, quickly covered and held firmly with rubber band and cellotape. The trays were then arranged in shelves in an incubation room so that fermentation could commence.

The *P. tubberregium* tubers were weighed, washed, dissected to smaller bits and soaked in water for two hour after which they were removed and put in white transparent buckets and covered for three days to enable spore formation of the tubers. Spores of *Pleurotus tubberregium* were inoculated into the wetted *Pleurotus* at the rate of 100 g spores to 5.0 kg Miaze cob. The ends of the polyethene sheets were brought together and sealed using masking tape to create an airtight environment. After 45 days, the mass of composted straw colonized by mycelium of the fungi which were showing whitish growths were taken out of the inoculation trays from the inoculation room for sun drying by spreading thinly on a drying surface to ensure growth of the fungi is terminated and drying of materials. Samples of non-biodegraded and biodegraded maize cob were oven dried to constant weight for chemical analysis.

Chemical composition of Test Ingredients

The air dried white rot fungi biodegraded and non-biodegraded maize cob were analysed for dry matter (DM), moisture**,** crude protein (CP), crude fibre (CF), ash, ether extract, nitrogen free extract (NFE), organic matter (OM) and metabolizable energy (ME) in triplicate according to the methods of AOAC (2000).

The fibre fractions to be measured are neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL), were determined according to the methods of Van Soest*et al*. (1991).

Gross energy determination: The gross energy was calculated using the formula, according to Nehring and Haenlein : T = 5.72Z1+9.50Z2+4.79Z3+4.03Z4±0.9%

Where:

T = Gross energy; Z_I = Crude protein; Z_2 = Crude fat; Z_3 = Crude fibre and Z_4 = Nitrogen free extract

RESULTS AND DISCUSSION

Table 1 shows the chemical composition of non-biodegraded maize cob (NBMC), *Pleurotus tuber-regium* biodegraded maize cob (PTRMC), *Pleurotus ostreatus* biodegraded maize cob (POMC), *Pleurotus eryngii* biodegraded maize cob (PEMC), and *Pleurotus pulmunarius* biodegraded maize cob (PPMC). The fungi-degraded maize cob contained significantly ($P < 0.05$) higher amounts of crude protein, ash, and nitrogen-free extract (NFE), but significantly ($P < 0.05$) lower amounts of organic matter, crude fibre, neutral detergent fibre (NDF), acid detergent fibre (ADF), and acid detergent lignin (ADL) than the non-degraded maize cob. PTRMC had the highest ($p<0.05$) crude protein content (9.77%), followed by POMC (6.35%), PPMC (6.09%), PEMC (5.32%), NBMC (4.96%), which had the lowest crude protein content.

The crude fibre content was highest ($p<0.05$) in NBMC (31.99%), followed by PPMC (26.14%) and PEMC (26.03%), and lowest in PTRMC (20.29%).

The ash content is significantly ($p<0.05$) higher in PTRMC (6.01) and PPMC (5.84). The results of PEMC (4.73) and POMC (4.29) were similar with NBMC (4.08) though the figures were numerically higher. The NFE of the maize cob biodegraded by PTRBMC, POMC, PEMC, and PPMC were all higher than the NFE of NBMC (45.59%). The NFE of PEBMC (50.03%), POMC (49.14%), and PTRBMC (48.73%) were similar. The NFE of PPBMC (47.40%) was similar to those of POMC and PTRMC, but significantly higher than that of NBMC (45.59).

Table 1: Chemical compositions of non-biodegraded and fungi degraded maize cob

PARAMETERS(%)	NBMC	PTRMC	POMC	PEMC	PPMC	SEM
Dry matter	90.42	88.21	88.15	88.50	88.01	0.37
Crude protein	4.96^{d}	9.77^{a}	6.35^{b}	5.32^{cd}	6.09^{bc}	0.47
Crude fibre	31.99^{a}	20.29^{d}	22.49^{c}	26.03^{b}	26.14^{b}	1.07
Ether extract	2.92	2.41	2.29	2.39	2.55	0.10
Ash	4.08^{b}	6.01^{a}	4.29^{b}	4.73^{b}	5.83^{a}	0.21
NFE	45.59^{c}	48.73^{ab}	49.14^{ab}	50.03^{a}	47.40^{b}	0.56
Organic matter	86.34^{a}	82.19^{b}	83.86^{ab}	83.77^{ab}	82.18^{b}	0.41
NDF	82.67^{a}	53.35^{c}	66.95^{b}	64.24^{b}	64.22^{b}	2.55
ADF	45.18^{a}	26.44^{c}	36.35^{b}	33.11^{b}	32.77^{b}	1.72
ADL	20.71^{a}	13.49^{c}	18.77^{b}	18.01^{b}	18.18^{b}	0.66
Gross Energy (Kcal/kg)	389.05	370.37	364.82	379.454	375.31	10.73

NBMC = non biodegraded maize cob; PTRMC =*Pleurotus tuber-regium* maize cob; PPMC= *Pleurotuspulmunarius,* maize cob; PEMC = *Pleurotus eryngii* maize cob POMC = *Pleurotus ostreatus* maize cob; NDF = Neutral detergent fibre; ADF = Acid detergent fibre; ADL = Acid detergent lignin; SEM = Standard error of means. $^{a-d}$ means within the same row with different superscripts are significantly different (P<0.05)

Organic matter was higher (p<0.05) in NBMC (86.34%), POMC (83.86%), and PEMC (83.77%) than in PTRMC (82.19%) and PPMC (82.18%).

The NDF, ADF, and ADL values of maize cob that was biodegraded by the *Pleurotus* species were significantly (p>0.05) lower than those of non-biodegraded maize cob. Among the *Pleurotus*-biodegraded maize cob, PTRMC had the lowest (p>0.05) NDF (53.35%), ADF (26.44%), and ADL (13.49%) values.

The significant (p<0.05) improvement in the crude protein content of biodegraded maize cob found in this studies corroborated to the studies of (Akinfemi, 2010).

The significant (P<0.05) improvement in CP values observed in this study by the white rot fungi degradation of corn cob have been reported other researchers (Ibhaze, *et al.*2022). As observed in this study *Pleurotus* species does break down the nutrients in NDF, ADF, and ADL by releasing enzymes that degrade the lignin, hemicellulose, and cellulose in the cob. These enzymes break down the lignocellulose into simpler molecules that ruminants can more easily digest. As a result, the corn cob becomes a more nutritious feed source for ruminants, providing them with essential nutrients like protein, fibre, and energy (Kumar and Chandra, 2020).

CONCLUSION

This study showed that biodegradation of maize cob by *Pleurotus* demonstrated significant improvements in the nutritional value of the biodegraded cob compared to the non-degraded one. Biodegradation led to, increased: crude protein, ash, and nitrogen-free extract (NFE) content of the maize cob. Among the *Pleurotus* species, *Pleurotus tuber-regium* biodegraded maize cob (PTRMC) showed the most significant improvement, boasting the highest crude protein content and the lowest crude fibre, NDF, ADF, and ADL values.

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