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ORIGINAL ARTICLE

Proximate Composition of Peanut Hull as Affected by Enzymatic Activity of Fungi Isolated from Vermicast

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ABSTRACT
This study was performed to determine the effect of fungi associated with vermicast namely: Aspergillus niger, Rhizopus stolonifer, Rhizomucorpusillus and Aspergillus fumigatus in the proximate composition of peanut hull. Proximate composition of the fungi treated peanut hull which includes ash, fiber, moisture, fat and protein were evaluated. Results revealed that after 20 days SSF, fungi caused depletion in the crude protein and crude fat content of the peanut hull, increment in the ash content when treated with A. niger and R. stolonifer, reduction in fiber content by A. niger and A. fumigatus, and increment in the moisture content when treated will the fours fungi.The highest moisture content was obtained in A. fumigatus treated rice hull of 18.82%. For the ash content, A. niger registered the highest value of5.88% and the least with 4.28% by A. fumigatus. Meanwhile, increment in crude fiber was observed when treated with R. pusillusof 67.81% while A. fumigatus had the least fiber with 63.05%. Lastly, A. niger and R. stolonifer registered the least crude fat with 0.36%. Further studies should be done to optimize the utilization of the fungal isolates.
Keywords;*Crude protein, Proximate composition, enzymatic activity*

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INTRODUCTION

Peanut (*Arachishypogaea L.*) is one the most cultivated and important crops worldwide. Peanuts contain important components for human nutrition. Its high nutritional content is attributed to the presence of biologically active compounds such as, tocopherols, flavonoids, phytosterols, resveratrol, as well as to their relatively high level of protein and their easy oil digestibility [1,2]. Meanwhile, large portion of peanut wastes such as meals, skins, hulls, and vines are regarded as the agriculture wastes and remained under-utilized[3,4]. Peanut hull contain cellulose, lignin, and hemicelluloses are rich with cellulosic substances because of this they are also used in bioethanol production [5].

In the present study, peanut hull was used as substrate for fungi isolated in vermicast namely *Rhoizopus stolonifer, Rhizomucorpusillus, Aspergillus fumigatus* and *Aspergillus niger*. Their effect on the proximate composition of peanut hull is indicative of their enzymatic activities.In different industries, filamentous fungi are being utilized for biosynthesis of raw materials due to their ability to produce various enzymatic complexes that leads to production of important commodities out of wastes[6]. Accordingly, different fungal organisms have different characteristics and requirements for their productivity. *A.niger*canproduce of hydrolytic and oxidative enzymes involved in the breakdown of plant lignocelluloses while *R. stolonifer*produces lipase and undergoes lipid oxidation leading to the decrease in fat content of the food[7]. Whereas the proteinases in the *Aspergillus fumigatus* genome attest to the ability of the fungus to grow by degradation of polysaccharides from plant cell walls and acquire nitrogen sources made available by degradation of proteinaceous substrates [8,9]. Thus, the study was carried out.

MATERIAL AND METHODS

Preparation of Fungal Inoculant. Thirty-nine grams of Potato Dextrose Agar (PDA) was suspended in a 1L of distilled water. The mixture was stirred continuously until it is fully homogenized. Half of the media

was placed in a clean Erlenmeyer flask and half was placed in a clean test tube that was sealed with cotton plug. It was sterilized at 15 psi at 121ºC for 30 minutes. After sterilization, fungal inoculants was sub cultured in the slanted media and was grown for seven days.

Preparation of Substrate. Peanut peels was collected from the public market of Science City of Muñoz, Nueva Ecija. It was sun dried and pulverized. One hundred (100) grams of previously sterilized powdered peanut peels was placed in a clean wide mouth bottle and 300 ml of distilled water was added to the substrate. It was sterilized at 15 psi at 121ºC for 30 minutes.

Inoculation of Mycelial Disc. After seven days of incubation, using a sterile 10-mm-diameter cork borer the mycelia was inoculated into the substrate using a sterilized inoculating needle. It was covered with plastic and was incubated for twenty days.

Harvesting. After 20 days of solid state fermentation, the cultures was sterilized at 15 psi for 30 minutes. It was spread in a clean paper individually and was air dried for seven days. Dried samples was pulverized using mortar and pestle.

Proximate Composition Peanut peel (250g) was sent to Lipa Quality Control Center, BocaueBulacan for proximate analysis of the nutritional content such as crude protein, ash content, crude fiber, moisture content and crude fat content.

RESULTS AND DISCUSSION

Crude Protein Content. Crude protein content (CPC) of the fungal enriched peanut hull and their corresponding percentage reduction in CPC is shown in Table 1. Untreated peanut peel had the highest CPC with 7.29% followed by *A. fumigatus* treated peanut peel with 5.12% and *A. niger* treated peanut hull with 4.71%. While *R. stolonifer* and *R. pusillus* treated peanut peel registered the least CPC with 4.66% and 4.35% respectively. All of which are significantly lower than the untreated peanut hull. Thus, the fungal enriched peanut peel had significantly depleted CPC up to 40.33%. Results of the study coincides with the previous studyusing sunflower, sesame, soybean, safflower and groundnut as substrates for the *A. niger, A. terreus, A. ustus, A. versicolor, A. parasiticus* and *A. fumigatus*[10,11].

Table 2. Crude protein content of enriched peanut peel

TREATMENTS	CRUDE PROTEIN CONTENT	% DECREASE IN CRUDE PROTEIN CONTENT
A. niger-treated peanut hull	4.71*	-35.39*
R. stolonifer-treated peanut hull	4.66*	-36.08*
R. pusillus-treated peanut hull	4.35*	-40.33*
A. fumigatus-treated peanut hull	5.12*	-29.77*
Control (Untreated peanut hull)	7.29*	

*Treatment means among columns with * are significant compared to control; ** are highly significant compared to control; ns not significant compared to control

The observed reduction in CPC of the fermented samples may be due to the fact that the activities of microorganisms may lead to breakdown of some amino acids with the liberation of ammonia [12]. Also, decrease in CPC of the substrates depends on the efficiency of the microorganisms to degrade complex molecules into simpler forms and their successful invasion or colonization which depends on the efficiency of microorganisms to degrade complex molecules into simpler [14, 13].Furthermore, *Aspergillus, Mucor, Fusarium, Penicillum*and *Rhizopus* are potent strains for proteases which catalyzes the hydrolysis of proteins[15].

Proximate Composition. Proximate composition of treated and untreated peanut peel including ash, fiber, moisture and fat were evaluated. Results were presented in Table 2.

Ash Content. *A. niger*-treated peanut hull and *R. stolonifer*-treated peanut hullhad the highest with 5.88% and 5.08% ash content, respectively, followed by *R. pusillus*-treated peanut hull and untreated peanut hullwith 4.3% and lastly *A. fumigatus*-treated peanut hull with 4.28%. The ash content of *A. niger* and *R. stolonifer*-treated peanut hullwere significantly higher than the untreated peanut hull while the rest were comparable to untreated peanut peel. This is line with the findings of Joseph *et al*. [16], caused by dry matter loss during fermentation which therefore increases in the unaltered components of the fermented product. Meanwhile, reduction in ash content signify the presence of more mineral elements in the unfermented peanut hull which could further be attributed to fungal metabolic activities[17].

Table 2. Proximate composition of fungal enriched peanut hull

TREATMENTS	ASH	FIBER	MOISTURE	FAT
A. niger-treated peanut hull	5.88*	63.27*	15.12*	0.36*
R. stolonifer-treated peanut hull	5.08*	65.09*	12.58*	0.36*
R. pusillus-treated peanut hull	4.30ns	67.81ns	10.67*	0.39*
A. fumigatus-treated peanut hull	4.28ns	63.05*	18.82**	0.56*
Control (Uninoculated peanut hull)	4.30	64.04	8.93	5.88

*Treatment means among columns with * are significant compared to control; ** are highly significant compared to control; ns not significant compared to control

Crude Fiber Content.*R. pusillus*-treated peanut hull had the highest crude fiber content with 67.81%, followed by *R. stolonifer*-treated peanut peel with 65.09% and untreated peanut hull with 64.04% while *A. fumigatus*-treated peanut hullhad the lowest crude fiber of 63.05%. Statistical analysis revealed that *R. pusillus*-treated peanut hullcrude fiber content is comparable with the untreated peanut peel while *A. niger* and *A. fumigatus* were significantly lower than the uninoculated peanut peel while *R. stolonifer* is significantly higher than the uninoculated peanut hull. Increment can be due to the formation of resistant starch tannin-protein complex [18]. Also, it can be attributed to the utilization of easily digestible soluble carbohydrates by the growing fungus, leaving the ingestible fiber content high as reported by [19].On the other hand, the reduction in the crude fiber contents of the fermented substrates is an indication of secretion of cellulose/hemicellulose-degrading enzymes by the fungus during fermentation [20].

Moisture Content. For the evaluation of moisture content, *A. fumigatus* has the highest moisture content with 18.82% followed by *A. niger* with 15.12% and *R. stolonifer* with 12.58% and lastly *R. pusillus*and uninoculated peanut peel with 10.67% and 8.93% respectively. The moisture content of all the fungal enriched peanut hull were significantly higher than the uninoculated peanut hull. The increase of moisture content during fermentation in all of microorganisms applied in this study may be due to proteolytic activity of microorganisms that release water through hydrolysis of peptides Moreover, production of carbon dioxide and water by microorganisms also increases the moisture of the content of the substrate[21, 22, 23].

Crude Fat Content. Reduction in the crude fat content of the treated peanut hull were noted. Initially the uninoculated peanut hull had a crude fat content with 5.88% which was reduced to up to 0.56% by *A. fumigatus,*0.39% by *R. pusillus* and 0.36% by *A. niger* and *R. stolonifer*. Statistically, all treated peanut peel were significantly reduced.Findings were also congruent with the study of Khodanazary*et al*. [24].

CONCLUSION

Based on the results of the study, it can be concluded that fungi associated with vermicast namely: *A. niger, R. stolonifer, R. pusillus* and *A. fumigatus* had significantly reduced the crude protein and crude fat content of the peanut hull. Whereas, *A. niger* and *R. stolonifer*caused the increment of the ash content. While, the moisture content of all the treated peanut peel were increased significantly. Additionally, inoculation of *R. pusillus* had resulted to the increase in fiber content of the peanut hull.

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