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PROXIMATE COMPOSITION OF THE SINGLE CELL PROTEIN ENRICHED ONION STALK

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ABSTRACT

Crude fiber, crude fat and total ash are of necessity in the development of alternative feeds for animals. Thus, elucidation of these components of the single cell protein enriched onion stalk was undertaken. Varying effect of the fungal endophytes in dried onion stalk was recorded. Increment in total ash content of 19.59% and 18.82% was obtained in *A. flavus* and *P.citrinum*-treated dried onion stalk, respectively. For the crude fiber content, *A.flavus* – treated onion stalk had the highest percentage crude fiber of 15.84% followed by *Fusarium sp.*1 and *M.ruber* -treated dried onion stalk with 15.72% and 15.44% respectively. On the other hand, reduction in the crude fiber content of *F.semitectum*-treated onion stalk was recorded with 13.46%. Results indicate a perceptible increment in the crude fat content of *P.citrinum (2.36%), C.cladosporoides (2.13%)*-treated onion stalk. While reduction in the crude fat content of onion stalk were observed in *M. ruber* (1.98%), *F. semitectum* (1.82%), and *A. ochraceous* (1.76%), *A. niger (1.63%)* and *Fusariumsp.*1 (1.29%).

Keywords: Single Cell Protein, Enriched Onion Stalk

INTRODUCTION

Utilization of agricultural wastes as alternative animal feeds is gaining its popularity and importance in the sustainability of the feed production systems and solving the worldwide feed scarcity. These include by-products and unused parts of agricultural crops. Onion stalk is one of the agricultural wastes after harvesting the onion bulb. Over the years, increasing demands for these bulbs had led to the production of tons of onion waste (dry brown skin, the outer layers, roots and stalks [1]. Therefore, the necessity to search for potential utilization.

In the previous study of Corpuz et al [2], the suitability of onion stalk as substrates for single cell production of nine fungal endophytes associated with bamboo was revealed. The primary objective of the present the present study is to elucidate the proximate composition (crude fat, total ash and crude fiber) of the fungal enriched onion stalk (*Aspergillus niger, Aspergillus flavus, Aspergillus ochraceous, Cladosporiun cladosporioides, Fusarium semitectum, Fusarium sp.1, Fusarium sp.2, Monascus ruber* and *Penicillium citrinum),* sincethe composition of the fermented substrates will also be based on the growth, proliferation and metabolic activity of the organism (Adedayo et al., 2011). Accordingly, aside from the protein enrichment (about 60-82% of dry cell weight), they also contains fats, carbohydrates, nucleic acids, vitamins and minerals [3]. Hence, this present study was undertaken

MATERIALS AND METHODS

The study is a continuation of the study of Corpuz et al [2], wherein the crude protein content and the moisture content of the fungal enriched onion stalk were analyzed. In the present undertaking, ash content crude fiber and crude fat content of the onion stalk were determined and their corresponding percentage change were also computed. Procedure for solid state fermentation of single cell protein production was adapted from the previous studies. One hundred (100) grams of dried onion stalk were fermented with 10 ml of fungal endophytes with spore concentration of 5.0 x 10^6 / ml. Moisture content of 60-65% was maintained during the solid state fermentation process for 20 days. After which, analysis of the proximate composition of the protein enriched onion stalk was carried out. Total ash was analyzed by incineration, crude fiber by incineration after acid and base digestion and crude fat by Soxhlet extraction [4]. The total ash, crude fiber and crude fat were computed using the following formula:

$$\text{Ash (\%)} = \frac{\text{Weight of ash (W2 – W3) x 100}}{\text{Weight of sample (W2 – W1)}}$$

$$\text{\% change in ash} = \frac{\text{Final \% ash – Initial \% ash}}{\text{Initial \% CP}} \text{ x 100\%}$$

$$\text{Weight of fiber} = \text{(W2-W3) g}$$

$$\text{\% Fiber} = \frac{\text{W2-W3 x 100}}{\text{Weight of original sample}}$$

$$\text{\% change in crude fiber} = \frac{\text{Final \% crude fiber – Initial \% crude fiber}}{\text{Initial \% crude fiber}} \text{ x 100\%}$$

$$\text{Crude fat (\%) (w/w)} = \frac{\text{W4-W3 x 100}}{\text{Weight of sample}}$$

$$\text{\% increase in crude fat} = \frac{\text{Final \% crude fat– Initial \% crude fat}}{\text{Initial \% crude fat}} \text{ x 100\%}$$

RESULTS AND DISCUSSION

The total ash content, crude fiber and crude fat content as influenced by fungal endphytes associated with bamboo which include *Aspergillus niger, Aspergillus flavus, Aspergillus ochraceous, Cladosporiun cladosporioides, Fusarium semitectum, Fusarium sp.1, Fusarium sp.2, Monascus ruber* and *Penicillium citrinum.*

Ash Content

Results as represented in Table 1revealed increment in the total ash content of the onion stalk. The highest percentage ash content of 19.59% and 18.82% was obtained in *A. flavus* and *P.citrinum*- treated dried onion stalk correspondingly. While the untreated dried onion stalk had the least ash content of 14.57% followed by *A.ochraceous*-treated dried onion stalk with 17.55%. Enrichment of total ash content of the onion stalk ranging from 18.60% (*A. ochraceous* treated onion stalk) to 44. 45% (*A. flavus* treated onion stalk) was also elucidated. Moreover, statistical analysis indicated that all the fungal enriched dried onion stalks were significantly higher than the untreated dried onion stalk. Thus, the nine endophytic fungi had improved the ash content of the dried onion stalk. Results were in agreement with the study of Joshi et al [5], Sanusi et al.[6] and Adeyemi et al.[7], Obizoba and Atti [8] and Obizoba [9]. This also indicates the biosynthetic or hydrolytic mechanisms of the fungal endophytes which led to the increase of the inorganic mineral elements of the dried onion stalk. The potential breakdown of organic molecules and the release of the mineral elements from organic phase into inorganic phase should be in consideration as well [7, 10].

Crude Fiber Content

For the crude fiber content (Table 2), *A.flavus* – treated onion stalk had the highest percentage crude fiber of 15.84% followed by *Fusarium sp.*1 and *M.ruber* - treated dried onion stalk with 15.72% and 15.44% respectively. Correspondingly, *A. flavus, Fusarium* sp1 and *M. ruber* had the most percentage increase of 16.81%, 15.30% and 13.86%. On the other hand, reduction in the crude fiber content of *F.semitectum*-treated onion stalk was recorded with 13.46% and a percentage reduction of 0.74%. Statistical analysis shows that the treatment means were significantly higher than the untreated dried onion stalk except for the *F.semitectum.* This could be due to secretion of extracellular enzymes such as ligninases, cellulases and hemicellulases by the fungi which are capable of hydrolyzing carbohydrates and crude fiber into simple sugars which the organisms could use as carbon source and transform them to other macromolecules and fats [8]. Meanwhile, higher crude fiber is poorly digested by animals and interferes with other nutrients, thus making them unavailable for use [7].

Crude Fat Content

Lipids constitute the main energy reserve of animals and it has the highest caloric value among all nutrients. As shown in Table 3, results indicate a perceptible decrease in the crude fat content of the fungal enriched onion stalk was noticeable. *P. citrinum* treated onion stalk exhibited the highest value of crude fat content which is 2.36% followed by *C.cladosporoides*–treated onion stalk and uninoculated onion with 2.20% and 2.13%. While reduction in the crude fat content of onion stalk were observed in *M. ruber* (1.98), *F. semitectum* (1.82), and *A. ochraceous*(1.76), *A. niger (1.63) and Fusariumsp.*1(1.29). In addition, maximum increase of 10.80 % was recorded in *P. citrinum* treated onion stalk and the maximum decrease of 39.44% was noted in *Fusarium sp 1.*The same results in increase of crude fat content was also exhibited by the study of Tope [10]. Enrichment in the crude fat content could be due to the possibility of the fermenting fungi to transform carbohydrate content of the onion stalks to fat and their potential synthesis of microbial oil [7, 11, 12, and 13]. In addition, fungi have more lipogenic ability than lipolytic ability [6].

Whereas, reduction in total ashsignifies that the fugal endophytes had utilized the lipid as carbon source and energy for growth and protein synthesis [7,14, and 15]. Finally, solid state fermentation can be applied for producing phospholipids as well as for decreasing total fat and saturated fat. Dos Santos et al [16].

Table 1: Total ash content of the protein enriched onion stalk

Treatments	Ash	% Change in Ash
Control (Uninoculated onion stalk)	14.57^{f}	
Aspergillus flavus- treated onion stalk	19.59^{a}	34.45^{a}
Aspergillus niger - treated onion stalk	18.18^{c}	24.78^{c}
Aspergillus ochraceus- treated onion stalk	17.55^{de}	20.45^{de}
Cladosporium cladosporoides- treated onion stalk	17.9^{cd}	18.60^{cd}
Fusarium semitectum- treated onion stalk	18.17^{c}	24.71^{c}
Fusarium sp.1- treated onion stalk	18.78^{b}	28,89^{b}
Fusarium sp.2- treated onion stalk	18.18^{c}	24.78^{c}
Monascus ruber- treated onion stalk	18.03^{cd}	23.75^{cd}
Penicillium citrinum- treated onion stalk	18.82^{b}	29.17^{b}

Table 2. Mean percentage (%) in fiber content of single cell protein enriched dried onion stalk

Treatments	Fiber	% Change in Fiber
Control (Uninoculated onion stalk)	13.56^{d}	
Aspergillus flavus- treated onion stalk	15.84^{a}	16.81^{a}
Aspergillus niger - treated onion stalk	14.82^{bc}	9.29^{bc}
Aspergillus ochraceus- treated onion stalk	15.39^{ab}	13.50^{ab}
Cladosporium cladosporoides- treated onion stalk	13.95^{cd}	2.88^{cd}
Fusarium semitectum- treated onion stalk	13.46^{d}	-0.74^{d}
Fusarium sp.1- treated onion stalk	15.72^{a}	15.30^{a}
Fusarium sp.2- treated onion stalk	13.7^{d}	1.03^{d}
Monascus ruber- treated onion stalk	15.44^{ab}	13.86^{ab}
Penicillium citrinum- treated onion stalk	14.17^{cd}	4.50^{cd}

Table 3. Mean percentage (%) in fat content of the protein enriched dried onion stalk

Treatments	Fat	% Change in Fat
Control (Uninoculated onion stalk)	2.13^{abc}	
Aspergillus flavus- treated onion stalk	2.04^{abc}	-4.23^{abc}
Aspergillus niger - treated onion stalk	1.63^{cd}	-23.47^{cd}
Aspergillus ochraceus- treated onion stalk	1.76^{bcd}	-17.37^{bcd}
Cladosporium cladosporoides- treated onion stalk	2.20^{ab}	+3.29^{ab}
Fusarium semitectum- treated onion stalk	1.82^{abcd}	-14.55^{abcd}
Fusarium sp.1- treated onion stalk	1.29^{d}	-39.44^{d}
Fusarium sp.2- treated onion stalk	1.71^{bcd}	-19.72^{bcd}
Monascus ruber- treated onion stalk	1.98^{abc}	-7.04^{abc}
Penicillium citrinum- treated onion stalk	2.36^{a}	+10.80^{a}

CONCLUSION

In entirety, varying effects of different fungal endophytes were observed. Increment in total ash content, reduction in crude fat and enhancement in crude fiber content of the protein enriched onion stalk were elucidated. All of which can be attributable to the growth and physiological action of the fungal endophytes in the substrate.

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