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Full Length Research Paper

Evaluation of proximate changes and microbiology of stored defatted residues of some selected Nigerian Oil seeds

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Studies were carried out to evaluate the proximate changes and microbiology of stored defatted residues of some oilseeds in Nigeria. Oilseeds studied include Melon (*Colocynthis citrullus*), Soybean (*Glycine max*), Cashew *(Anacardium occidentale*), Groundnut (*Arachis hypogeae*) and Coconut (*Cocos nucifera*). On a general note, the proximate parameters such as % protein, % ash, % ether extract, % carbohydrate and % moisture decreased in all the stored defatted residue, with melon residue recording the highest decrease(protein: 48.1 - 42.1%; Ether extract: 19.2 - 18.0%; Carbohydrate: 10.2 - 9.6%) while coconut residue had the lowest decrease(protein: 19.9 - 19.2%; Ether extract: 16.2 - 15.8%; Carbohydrate: 28.6 - 26.7%). There was a significant difference (P < 0.05) in both the total bacterial count (TBC) and total fungal count (TFC) within the period of storage. On melon residue TBC increased from 10.51 log10 to 12.11 log10 cfu/g and TFC from 8.45 log10 to 10.17 log10 cfu/g. However on coconut residue TBC increased from 10.41 log10 to 11.48 log10 cfu/g while TFC increased from 8.41 log10 to 9.30 log10 cfu/g. Prominent organisms isolated include *A. niger, Rhizopus spp, Bacillus. subtilis, B. licheniformis and Proteus mirabilis* .The effect of proliferation of the isolated organisms on the storage qualities of these defatted residues may have been responsible for the reduction in the nutritive value of the stored residues. Results from these studies have revealed that the storage qualities of the defatted residue are time dependent.

Key words: Defatted residues, proximate, microorganisms, oilseeds, nutritive value.

INTRODUCTION

Though most plants store oil in one way or the other, oil seeds have high percentage oil when processed (Gunstone et al., 1986). Oils have been obtained from these oilseeds for thousands of years. Abulude et al. (2007) stated that oils from oilseeds are used in food manufacture, in animal feed, soap manufacturing, tin plating and in cosmetics. Other uses include paints, leather making, cloth, insecticide, printing ink and pharmaceutical application. These diverse applications of plant oils might have been responsible for oil crops and their products being about the second most valuable commodity in the world trade as posited by Ibanga and prominent oilseeds that are of great economic benefits to humanity include melon (*Colocynthis citrullus*), Okon (2004).

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Soybean (*Glycine max*), Cashew (*Anacardium occidentale*), Groundnut (*Arachis hypogeae*) and Coconut (*Cocos nucifera*), Sunflower (*Helianthus annuus*) and Physic nut (*Jatropha curcas*). There are documented reports on the physico-chemical properties and mineral compositions of the oils from these oilseeds (Sharmer et al., 1986; Abulude et al., 2004; Achu et al., 2005).

In addition to the immense usefulness of the oils from oilseeds, the defatted residues of the oilseeds are of economic benefits. Achu et al. (2005) submitted that the defatted residue of Cucurbitaceae oilseeds can be used to prepare food for children, pregnant and lactating mothers, old people as well as dietary supplement to prevent some mineral deficiencies. Groundnut meal is widely used for human food (biscuit, soups and snacks). For instance, in northern part of Nigeria the consumption of '*dokwan*' and '*kulikuli*' (products from groundnut cake) as snacks is a common practice. Other nuts and oilseeds

Table 1. Proximate analysis of oilseeds and their defatted residues.

Sample	Moisture content (%)	Ash (%)	Protein (%)	Ether extract (%)	Crude fibre(%)	Carbohydrate (%)
Soybean	9.7(8.3)	5.1(7.7)	34.1(41)	20.0(5.7)	5.3(7.1)	25.8(30.2)
Melon	6.5(10.1)	5.4(7.9)	30.1(48.1)	50.2(19.2)	2.7(4.5)	5.1(10.2)
Cashew	8.1(9.3)	3.5(4.7)	19.5(28.8)	42.1(12.5)	3.0(4.7)	23.8(40.0)
Groundnut	6.4(4.2)	2.8(3.6)	22.6(39.9)	43.5(10.8)	3.5(5.6)	21.2(36.4)
Coconut	18.5(16.0)	3.8(6.2)	7.4(19.9)	45.4(16.2)	7.4(13.1)	17.5(28.6)

Values are means of three determinations. Data in parenthesis are the values for the defatted residues.

produce by-products that can be used for fuel and animal feeds. These applications of defatted residues of oilseeds are basically owned to their favourable proximate compositions.

Much of the researches on oilseeds have focused on the extracted oils, while there is dearth of information on the defatted residues, especially the storage properties of the defatted residues of oilseeds. The present study is therefore carried out to evaluate the proximate changes and microbiology of stored defatted residues of some common oil seeds in Nigeria. This is with a view to providing nutritional and food safety information as these residues are used in food and feed applications.

MATERIALS AND METHODS

Samples of five oilseeds namely, Groundnut, soybean, Melon, Cashew and Coconut were purchased from local market in Ibadan and Ogbomoso, Nigeria. The samples were dehulled, sundried for 48 - 72 h, ground in a Kenwood blender to reduce their particle size so as to improve yield. The oils were obtained by cold solvent extraction of the ground samples using n-hexane. 200 ml of n-hexane was mixed with 500 gm of each sample in five batches. The mixture was shaken vigorously and left for about 72 h to settle. The supernatant was slowly decanted and poured into a sterile reagent bottle. The extracts from all the five batches were pooled together and allowed to settle again for 24 h. The mixture was distilled by simple distillation. The recovered oil was transferred into sterile bottle while recycled n-hexane was kept for further extraction. The extracted oil was later dried over anhydrous sodium sulphate in the oven at 105^{o}C. The defatted residues were stored in different sterile containers at room temperature for four weeks. The proximate analysis was carried out on the five oilseeds and their resultant defatted residues. Proximate parameters such as % crude protein, % ether extract, % crude fiber, % ash and % moisture content were determined using standard procedures as described by AOAC (1990). Carbohydrate content was obtained by difference.

The storage experiment was done in March 2006. The method of Omafuvbe et al. (2000) was adapted for the enumeration of microbial population in the stored defatted residue samples. Bacterial counts were done on Nutrient Agar with plates incubated at 35^{o}C for 24 - 48 h. Counted bacteria colonies were expressed as colony forming unit per gramme (cfu/g) of samples. Mean values of triplicate plates were recorded. For the fungal counts, potato dextrose agar (PDA) and incubation temperature of 28^{o}C for 2 - 3 days were used. Pure cultures of the isolated bacteria and fungi were obtained by repeated streaking. Bacterial isolates were characterized and identified according to Cowan and Steel (1985) and definition given with reference to Bergey's manual (Sneath et al., 1986). Fungal isolates were identified using the key given by Onions et al. (1981).

RESULTS AND DISCUSSION

The results of proximate analyses of both the oilseeds and their defatted residues are represented in Table 1. The moisture contents of the used oilseeds range from 6.4 (Groundnut) to 18.5% (Coconut). These values are similar to those earlier reported for some other edible oilseeds such as Groundnut (4.58%), soybean (11.07%), coconut (14.3%) (Karshaw and Hacckett, 1987; FAO, 1982). It is noteworthy that the low moisture content of these seeds enables them to be preserved for long periods of time. The protein contents of the oilseeds studied range from 7.4 (coconut) to 34.1% (soybean). These results compare favourably with those obtained by other workers. Vodouhe and Capo-Chichi (1998) reported melon seeds have between 30 and 40% protein and groundnut with protein content of 23 - 30%. FAO (1982) reported the value of 22.8% for cashew nut.

The lipid content (ether extract) of the investigated oilseeds ranges between 20.0 (soybean) to 50.2% (melon).These values are similar to that reported for melon, 45 to 48% (Phillips, 1977); Groundnut 47.5%, soybean 19.1% (Oyenuga, 1968). The high levels of oils in the investigated seeds qualify them as good sources of oils for both industrial and culinary applications. The ash content of the seeds studied ranges from 2.8 (groundnut) to 5.4% (Melon). These values are similar to those of melon (2.5%) (Silou et al., 1999), groundnut (2.79%), soybean (5.06%) (Oyenuga, 1968).

The effect of oil extraction from studied oilseeds on the proximate qualities of the resultant residues is deducible from Table 1. Generally speaking, the process of oil extraction resulted in a significant increase ($P<0.05$) in percentage ash, protein, crude fibre and carbohydrate content while there was a corresponding lipid content decrease. Also, moisture contents in the defatted residues were higher than in the whole seeds, except for groundnut and coconut. The high nutritional values of these defatted residues have made them to be potentially applicable in both human and animal feed formulations (Achu et al., 2005). The proximate changes of the defatted resi-

Table 2. Proximate analysis of defatted oilseeds residues stored for one month.

	Moisture content (%)	Ash (%)	Protein (%)	Ether extract (%)	Crude fibre (%)	Carbohydrate (%)
Soybean	8.0(8.3)	7.5(7.7)	38(41)	4.8(5.7)	7.0(7.1)	30.0(30.2)
Melon	9.8(10.1)	7.4(7.9)	42.1(48.1)	18.0(19.2)	4.1(4.5)	9.6(10.2)
Cashew	9.0(9.3)	4.5(4.7)	26.2(28.8)	12.0(12.5)	4.5(4.7)	36.0(40.0)
Groundnut	4.0(4.2)	3.4(3.6)	35.6(39.9)	9.9(10.8)	5.2(5.6)	35.0(36.4)
Coconut	15.6(16.0)	5.9(6.2)	19.2(19.9)	15.8(16.2)	13.0(13.1)	26.7(28.6)

Values are means of three determinations. Data in parenthesis are the values for the defatted residues at the onset of storage.

Table 3. Microbial count (log10 cfu/g) of defatted oil residues stored for one month.

Sample	Bacterial count	Fungal count
Soybean	11.61(10.32)	9.48(8.11)
Melon	12.11(10.51)	10.17(8.45)
Cashew	12.00(10.60)	10.00(8.48)
Groundnut	12.05(10.67)	10.04(8.31)
Coconut	11.48(10.41)	9.30(8.41)

Values are means of three determinations. Data in parenthesis are the values for the defatted residues at the onset of storage.

Table 4. Microbial profile of stored defatted oilseeds residues.

Sample	Bacterial Isolates	Fungal Isolates
Cashew	*Proteus vulgaris,*	*Aspergillus niger*
Melon	*P. vulgaris, Bacillus licheniformis*	*A. niger, Rhizopus spp*
Groundnut	*P. vulgaris, P. mirabilis, B. subtilis, B. Licheniformis*	*A. niger, Rhizopus spp*
Soybean	*P. vulgaris, P. mirabilis, B. subtilis, B. Licheniformis*	*A. niger, Rhizopus spp*
Coconut	*B. subtilis, B. licheniformis*	*A. niger, Rhizopus spp*

dues stored for one month is shown in Table 2. Within one month of storage, it is noteworthy that virtually all the proximate parameters decreased with storage. For instance, a decrease of between 3.52 (coconut) and 12.47% (Melon) was observed in protein content of the residue. Percentage decrease of between 2.60 (soybean) and 6.33% (Melon) was noted in ash content while the decrease in lipid content ranged from 4.00(cashew) to 15.79% (soybean). The crude fibre decrease was bet-ween 0.76% (coconut) and 8.89% (Melon). On a general note, the proximate parameters decrease was highest in the defatted melon residue while that of the defatted coconut residue witnessed a minimal proximate content decrease. This trend of decrease in proximate composition of the defatted residues is similar to that observed in the unpublished report on soybean daddawa (soyiru) (Kolapo A.L and Sanni M.O.). The general decrease of the proximate content of the stored defatted residues may be linked to the microbial activity of the organisms associated with the stored residues. The results from the present study is suggesting that the defatted residues from the oilseeds should be used in further applications as soon as possible, as a prolonged storage may negatively impact on their proximate composition, the feature that made them to be highly valued for food and feed formulations in the first place. This information would be valuable especially where these cakes are been consum-ed as snacks e.g. northern Nigeria.

On the microbiology of the stored defatted residues, the changes in the microbial counts and the identity of the isolated microorganisms are shown in Table 3 and 4 respectively. There was a significant increase ($P<0.05$) in both the bacterial and fungal counts with storage. This may be due to an increase in the moisture content of the defatted residues compared to that of the whole seeds. The microbial profile of the stored defatted residues is similar to those reported for stored soybean daddawa (Kolapo and Sanni 2006; Kolapo et al., 2007) and stored edible oil (Ilori et al., 2007). From the public health point of view, the high levels of the associated microorganisms may not be particularly frightening as the majority of these organisms are saprophytes. However, the effect of the proliferation of these isolated organisms on the storage qualities of these defatted residues may not be far

fetched as they may have been responsible for the reduction in the nutritive value of the stored residues.

Conclusion

Conclusively, results from this study have revealed that the storage quality of the defatted residues of oilseeds is time dependent an Information that would be relevant to the end users of defatted residues of oil seeds. Further works have already started in our laboratories to determine the exact shelf durations of these important oilseed cakes.

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