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Comparative Evaluation of the Proximate Composition of Raw and Fermented Seeds of Zarmarkee, *Sesbaniaspp*

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Abstract : *Characterization of a seed determines its functionality. This study was conducted to evaluate the proximate composition of Raw and Fermented Zármarkéé seeds, sesbaniasppand established possible variance in their composition. Raw and fermented seeds of Zarmarkee, sesbaniasppwere analyzed for their nutritive components to assess their dietary value for humans and animals. Proximate composition of the raw flour sample prepared by grinding the dried seeds gave the following results: (*6.92 ± 0.01)*% moisture; (*32.50 ± 0.00) *% protein; (*9.60 ± 0.01)*%, Crude fat; (*20.44 ± 0.01)*% crude fiber; (*4.10 ± 0.00)*% ash; (*26.40 ± 0.02)*% carbohydrates; Correspondingly, proximate analysis of the sample of the flour prepared from the fermented seed resulted in the following: (*7.01 ± 0.01)*% moisture; (*36.05 ± 0.01)*% protein; (*8.67 ± 0.02)*% crude fat; (*18.24 ± 0.01)*% crude fiber; (*5.08 ± 0.01)*% ash; (*24.93 ± 0.00)*% carbohydrates. The calculated calorific values and Comparison of the proximate analysis results of both the raw and fermented sample showed some disparity in their percentage value, but altogether, both revealed good sources of healthy foods and dietary supplements. The investigation further revealed that the fermented sample flour had a better nutritional profile in terms of protein and ash content which signals a viable alternative natural protein and mineral supplementation source that can be employed in combating the menace of malnutrition both in infants and lactating mothers as well as in food composite formulation. Hence, both raw and fermented sample would contribute immensely to good nutritional status and improve health for both man and livestock when consumed, but mineral concentration and anti-nutritional status of the grain is considered to be understudied next to strengthen the claims.*

Keywords:-*Sesbania spp; Zarmarkéé seeds; Proximate analysis; Raw and fermented Flour;Caloric value.*

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I. Introduction

The seed of Zarmarkéé is one of the non-popular legumes in the world which is scientifically called *Sesbaniaspp*, natively known as zarmarkéé in Hausa, is an important agroforestry species. The Genus is within the family Leguminosea and therefore they have the ability to improve soil through the fixation of atmospheric nitrogen. Though known to Hausa and Kanuri peoples, no usage is recorded as reported by the Royal Botanic Gardens, Kew (K). *Sesbansppis* very common throughout the northern part of Nigeria where it is commonly seen growing on the dikes between moringa plantations, along roadsides and in backyard vegetable gardens. Members of the genus *Sesbaniaspp* can be described as soft, semi or slightly woody, 1-8 m tall perennial nitrogen fixing trees(Evans and Rotor, 1987).*Sesbaniaspp* can grow up to 8 metre and obtain a diameter of up to 12cm. Growth is extremely rapid, on the right sites it can reach 4-5 m in just 6 months. (suttie, 1983; Topark,1989; Evans, 2001).Zarmarkéé is believed to be potent in improving crop yields and provides fuel wood and has been also reported to be planted primarily as a green manure**,** leaves mixed with shear butter oil to cure arthritis and a source of cut and carry forage in Kano State, the North Eastern part of Nigeria(MallamHaruna;personal communication, 2014). Characterization of a seed determines its functionality by revealing its nutritional profiles as well as its possible utilizations. Zarmarkee seed species obtained in Kano had no known officially stated nutritional and anti-nutritional profile that can authoritatively validate the claims made of its properties. Therefore, the need to comparatively investigate and determine the nutritional profile for this unpopular legume, starting with the proximate composition of the raw and fermented form which informed this research work.

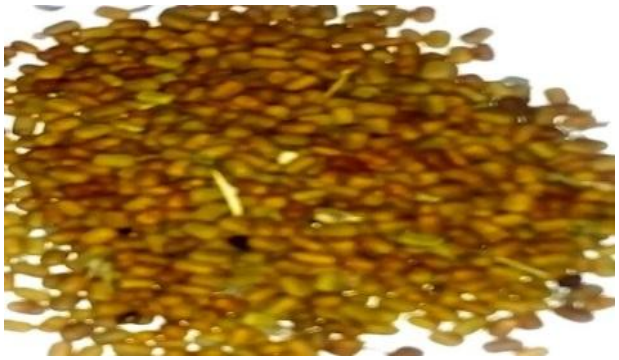
Origin

The exact origin of ***Sesbaniaspp*** is unclear, but it is widely distributed on a self-note and scarcely cultivated throughout northern part of Nigeria. It has also been reported to have been introduced in tropical America (Heering and Gutteridge, 1992).

Local names

Sesbaniaspp is known by different vernacular names such as Zarmarkéé native to Hausa's, Egyptian sesban ,sesban or sesbania (English); dien-dien (Vietnamese) (Dande et al., 2010).

Pictorial Representation of Zarmarkee seeds



A close-up of dried Zarmarkee, sesbanspseed.Photo credit Ishola, D.T.

Limitation of the study

Zarmarkéé is a seasonal plant and therefore must be preserved till the next planting season.

II. Materials and Methods

2.1 Collection of samples

Zarmarkéégrainswere self-grown and harvested from the premises of Nigerian stored products Research Institute, (NSPRI) Kano Zonal Office, Hadejia Road in Kano State, Nigeria.

2.2 Methods

The grains were properly dried after harvested and mixed together before is prepared for the analysis proper.

2.2.1 Preparation of dry milled flour from Raw Zarmarkee grain.

Zarmarkee grains were washed by mixing the sample with distilled water at a ratio of 1:2 w/v, drained and were allowed to dry. The dried grains were milled, sieved and packaged.

2.2.2 Preparation of dry milled flour from fermented* Zarmarkéé *grains:

Fermentation of the *Sesbaniaspp*:

Natural fermentation was carried out by mixing the sample with distilled water at a ratio of 1:2 w/v. The sample was withdrawn at period of 72 h. After the fermentation period each sample was transferred to an aluminum dish and air dried under shield for 1hr. Dried samples were finely ground, sieved and stored in polyethylene bags at 4ºC for subsequent analysis .

2.2.3 Proximate analysis of raw and fermented* Zarmarkéé *flour.

2.2.4 Proximate Analysis

Proximate composition of the samples including the moisture, protein, crude fat, ash and carbohydrate contents for the raw and fermented Zarmarkéé seeds, *sesbaniaspp* were determined following the methods of The Association of Analytical Chemists Official Method of Analysis (AOAC, 2002).

Moisture content determination

Moisture content of the sample was determined by the method described by AOAC (2002) using the conventional Oven. Clean and well labeled petri dishes were washed, oven dried at 105^0C for 30 minutes to get rid of moisture and cooled. The weight of the petri dishes was recorded as W_1. 5 grams of each sample was weighed into the petri dish and the weight was taken as W_2, the sample was oven dried at 105^oC for 3hours. It

was transferred into the desiccators, cooled for an hour and the weight was observed until constant weight was attained as W_3.

$$\% \text{ Moisture Content (MC)} = \frac{\text{Loss of weight}}{\text{Weight of sample before drying}} \times 100$$

$$\%MC = \frac{W_2 - W_3}{W_2 - W_1} X\ 100$$

Where; W_1= weight of petri dish
W_2= weight of petri dish and sample before drying
W_3 = weight of petri dish and sample after drying

Crude protein determination

The total crude protein content was determined using the micro kjeldahl method (AOAC, 2002). 0.5g of the sample was weighed to an accuracy of 0.1mg into a 250ml digestion tube. One Kjeltab Cu catalyst was added, followed by 10ml of concentrated sulphuric acid. The mixture was digested at 420^0C for 1hours to obtain a clear solution. The digest was cooled and 75ml distilled water was added followed by 50ml of sodium hydroxide solution. The ammonia formed in the mixture was subsequently distilled into 25ml, 2% boric acid solution containing 0.5ml of indicator methyl red. The distillate collected was then titrated against 0.1M of HCl. Blank titration was also carried out on the reagent and the nitrogen in the sample was calculated. The nitrogen content was multiplied by 6.25 to obtain crude protein content.

$$\textbf{\%Nitrogen} = \frac{\text{Titrate value} \times M \times 0.014}{\text{Weight of sample}} \times 100$$

Crude protein = % Nitrogen × 6.25
N is the total Nitrogen, 6.25 is the conversion factor.

Crude fat determination

Crude fat was determined by method described by (AOAC, 2002). Crude fat was determined by using soxhlet apparatus. Approximately 3g of sample was put into a thimble and extracted with n-hexane for about 6hours. The solvent was removed from the extracted oil by evaporation. The oil was further dried in hot air oven at 100^0C for 30minutes to remove residual organic solvent and moisture. This was cooled in dessicators and re-weighed. The quantity of the oil was expressed as percentage of the original sample used.

$$\textbf{\%Crude fat} = \frac{W_4 - W_3}{W_2 - W_1} \times 100$$

W_1 = weight of thimble
W_2 = weight of thimble and sample
W_3 = weight of round bottom flask, W_4 = weight of round bottom flask and residual oil

Total Ash Content determination

The total ash content was determined by using the procedure of AOAC (2002). 2g of the sample was weighed into clean crucible of weighed W_1 and together weighed as W_2. The crucible was then placed into a muffle furnace chambers at 600^oC until the samples turned into ashes. The crucible were removed from the furnace, cooled in desiccators and allowed to cool to room temperature and reweighed as W_3. Calculation:

$$\textbf{\%Ash} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

% Organic matter = 100-%Ash
W_1 = weight of crucible
W_2 = weight of crucible and sample before drying
W_3 = weight of crucible and sample after drying

Crude Fibre Content determination

Crude Fibre content was determined using Fibertec 2010 according to AOAC 978.10, AACC 32 – 10 and AOCS Ba 6 - 84. Fritted crucible was pre dry at 130 +/-2^0C for 30minutes. 1.000g of the sample was weighed into the crucible and placed into the Fibertec hot extraction unit. 150ml of 1.25%H_2S0_4 (reagent1) was added into each column containing sample. 2 drops of n-octanol was added to prevent foaming. Heater was turned on fully. When the reagent starts to boil, the heater was adjusted for moderate boiling of the reagent. After boiling for about 30minutes, heater was turned off and the heated sample was washed three times with hot deionised water. After washing, 150ml of preheated 1.25% NaOH solution was added (reagent2) and the sample was boiled for another 30minutes. It was again washed with hot deionised water. The crucible was transferred into

the cold extraction unit where 25ml of Acetone was added. The acetone was filtered by placing the extraction unit in the vacuum position. This was repeated three times. Crucible was removed and transfer to a crucible stand and left at room temperature until the acetone had evaporated. Crucible was dried for 2hours at 130^0C; cooled to room temperature in a desiccator and weighed to an accuracy of 0.1mg. The sample was Ash in the crucible for at least 3hours at 525 +/-15^0C and then cooled in a desiccator and weighed accurate to 0.1mg.

% CRUDE FIBER = $\frac{W_2 - (W_3 + C)}{W1} \times 100$

W_1= Sample Weight (g)
W_2 = Crucible + residue weight after drying (g)
W_3 = Crucible + residue weight after ashing (g) ,
C = Blank

Determination of Carbohydrate
Carbohydrate was determined by the difference method (A.O.A.C, 2002)

Statistical Analysis

Determinations were carried out in triplicates and the results obtained from the proximate analysis was subjected to statistical analysis using one way analysis of variance (ANOVA) and the least significant differences were calculated by Duncan multiple range test using SPSS version 16.00 Software. Significance was accepted at $p < 0.05$ levels.

III. Results and Discussion

Table1. Proximate composition of raw and fermented samples in percentage (%)

PARAMETERS	SAMPLES (%)	
	RAW SAMPLE	FERMENTED SAMPLE
Moisture Content (%)	6.92 ± 0.01	7.01 ± 0.01
Crude Protein (%)	32.50 ± 0.00	36.05 ± 0.01
Crude Fat (%)	9.60 ± 0.01	8.67 ± 0.02
Crude Fibre (%)	20.44 ± 0.01	18.24 ± 0.01
Ash (%)	4.10 ± 0.00	5.08 ± 0.01
Carbohydrate(%CHO)	26.40 ± 0.02	24.93 ± 0.00

All data were mean ± standard deviation of triplicate determinations

Proximate Analysis of the flours:

The result of the proximate composition of raw and fermented Zarmarkee, *Sesbaniaspp*seed flour subjected to natural fermentation process for 72hrs is shown in Table 1. The Crude protein, ash content and moisture

contents of *Sesbaniaspp*flour was observed to increase with fermentation process whereas crude fibre, crude fat and carbohydrate was not favored by the fermentation process.

The result have shown that Zarmarkee seeds in the raw and fermented forms have enough nutrients to satisfy protein requirements of populations in the developing countries that rely much on starchy staples.

The slight increase in crude protein values from (32.50 ± 0.00 to 36.05 ± 0.01)% for raw and fermented sample respectively could be attributed to increase in microbial mass during fermentation causing extensive hydrolysis of the protein molecules to amino acids and other simple or lower molecular weight peptides. It may be due to the structural proteins that are integral part of the microbial cells (Tortora*et al.*, 2002). The increase in crude protein in fermented Zarmarkee seed flour is an indication that *sesbaniaspp* could be a source of high quality plant protein for animal and man that cannot afford animal protein in their diets.

The fat content decreased from (9.60 ± 0.01 to 8.67 ± 0.02)% for raw and fermented sample respectively. The decrease in crude fat could be a result of poor or in extensive breakdown of large molecules of fat into simple fatty acids. This observation could also be due to the utilization of oxidized lipids to generate energy for the growth and cellular activities (Sanni and Ogbonna, 1991; Achi and Okereka, 1999)

The decreased levels of dietary fibre content in fermented *Sesbaniaspp* agreed with the result of (Eka, 1980; Oboh, 2006; Butt and Batool, 2010) that fermented foods such as legumes has lower fibre content. This observation could be due to the utilization of oxidized lipids to generate energy for the growth and the cellular activities (Sanni and Ogbonna, 1991). It therefore signals possible presence of anti-nutrient and consumption of these legumes will require processes that will reduce their anti-nutritional factors. Fermentation of *sesbaniaspp* led to the significant increase in ash content of fermented sample compared with the raw sample as shown in table 1 above. The increase in ash content may be due to poor leaching of soluble minerals into the processing water during the fermentation period or the fermenting microorganisms might not be able to use it for metabolic activities.

Also, as shown in Table 1 above, the carbohydrate value evidently decreased with fermentation. The result agreed with the result of Oladunmoye (2007) regarding effect of fermentation on the carbohydrate content of legumes.

The decrease in carbohydrate content could be attributed to the conversion of oligosaccharides to simple sugars or the utilization of the carbohydrate nutrient as source of energy by the fermenting microorganisms for growth, metabolism and as carbon source in order to synthesize cell biomass (Madigan *et al*., 2002).

Of note is the elevated carbohydrate value of both raw and fermented sample. This then revealed another possible source of calories intake as Carbohydrate (CHO) which fuels exercise and influences liver as well as muscle glycogen stores.

IV. Conclusion

The results obtained from this study revealed that fermentation process had a significant effect on the proximate content of fermented sample in relation to the raw sample of Zármarkéé seeds evaluated. In the fermented sample the level is relatively high compared to the raw samples especially in crude protein, ash content and moisture content. The research suggested that the fermented sample flour has a better nutritional profile which could serve as a reliable supplement to improve the nutritive value of other diet. Hence, fermented sample compared to raw sample would at an appreciable degree contribute immensely to good nutritional status and good health for both man and livestock when consumed. Though Zármarkéé grain is rich in essential nutrients, Worthy of note is the Calorie- protein value of both the raw and fermented flour which signal a possible staple in confronting the menace of calorie-protein deficiency that spread across the third world countries, only that much work has not been done on the grain to validate the safety of the seeds for human consumption. Further research to understudy the anti-nutritional factors in the grain is envisaged soon in a bid to prevent possible poisoning and soon incorporation of the grain as one of the regular staples immediately when certified save for consumption.

V. Recommendation

Although, the calorie-protein value of both the raw and fermented sample of the flour is greatly encouraging, but the decrease in crude fat and fibre post a signal or implies that there are possibility of the presence of anti-nutrients and consumption of these legumes will require further processes that will reduce their anti-nutritional factors, therefore, the need to further analyze the mineral and anti-nutritional factors of the grains and other parts of the grain plants is of high important. Also, further evaluation of the effect of time and methods of fermentation should be examined on the proximate composition, mineral composition, and functional properties of the grains flours before and during storage in other to generate data on its storability and possible post-harvest nutrient loss.

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