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Investigation of the Possible Effect of Two Processing Methods on the Proximate and Macro Element Constituents of *Alternanthera brasiliana* (L.) O. Kuntze

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Abstract:- This research work evaluated the effect of air-drying and sun-drying (two processing methods) on the proximate and macro-elemental constituents of *Alternanthera brasiliana* (L.) O. Kuntze leaf. The proximate analysis was carried out following the method of by the Association of Official Analytical Chemists (AOAC). Individual element was estimated using Atomic Absorption Spectrometer (AAS) machine LAMOTTE Smart Spectro 2 RMN 26625 and FP 902 (Nanometer: 510NM). The results showed appreciable quantity of ash, crude fat, protein, energy, and macro minerals. All the macro mineral elements analyzed viz: Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), and Phosphorus (P) presented higher values in the air-dried than the sun-dried sample. The sun-drying method had a reduction effect on all the values of minerals analyzed but had a positive and significant effect of the increase on the crude protein. It was concluded that *A. brasiliana* was rich in ash, fat, crude protein, energy, and macro minerals. Air-drying favoured high yield of minerals while sun-drying gave a high percentage in crude protein. *A. brasiliana,* therefore, could be reckoned with as a promising candidate in leaf meal preparation for monogastric animals.

Keywords:- *Processing, Constituents, Leaf Meal, Monogastric, Alternanthera Brasiliana.*

I. INTRODUCTION

Alternanthera brasiliana (L.) O. Kuntze is a member of the family *Amaranthaceae*. This family comprises many species that are invaluable for the treatment of many diseases in folk medicine[1]. The plant is endowed with a high level of adaptability and tolerance to adverse environmental conditions[2]. It is believed to be native to Southern Mexico, South America forests (i.e., French Guiana, Guyana, Surinam, Venezuela, Brazil, Colombia, Ecuador, and eastern Peru), and that of Central America (i.e., Belize, Guatemala, and Nicaragua). The plant was reported to be abundant in Brazil and hence commonly known as Brazilian joy weed, penicillin or Terracina, calico plant, indoor clover, and Joseph's coat[3, 4, 5]. The leaves of *Alternanthera brasiliana* are reddish-purple in colour, and perhaps the most commonly cultivated and naturalized species[5]. The biological effects of the leaves of this plant such as anti-microbial, wound healing, antioxidant, anti-diabetic, etc. was reported[6, 7, 8], but less has been documented on its nutritional/elemental composition in Nigeria. The plant has appreciable nutritional constituents, great potential for animal productivity, and also a candidate for animal herbal growth promoter[9, 10]. The importance of proximate and elemental composition cannot be overemphasized in animal nutrition and health. The assessment of the nutritional importance of any vegetable or feed ingredient depends absolutely on their proximate analysis[11]. The pharmacological and nutritional importance of any medicinal plant can only be well understood after the analysis of its elements[12]. Minerals serve as structural components in the body and as cofactors during the metabolic process as well. The deficiency of minerals will make the body to suffer; symptoms may be subtle or culminated in sickness[13]. Therefore, this study was carried out to investigate the effect of air-drying and sun-drying processing methods on the proximate and elemental constituents of *Alternanthera brasiliana* leaf. This is probably the first paper to evaluate the effect of processing on the proximate and macro mineral constituents of the leaf of *A. brasiliana* (L.) O. Kuntze, in Nigeria.

II. MATERIALS AND METHODS

➢ *Plant collection*

The leaves of *A. brasiliana* were sourced around Oba-Ile Estate in Akure South Local Government, Akure, Ondo State Nigeria in September 2019 and identified. Akure has a geographical location of 5º 07′ E, 7º 19′ N; 5º 09′ E, 7º 19′ N; 7º 17′ N, 5º 07′E; 7º 17′ N, 5º 09′ E with a tropical climate of average annual temperature of 26.7ºC and rainfall of 2378mm[14].

➢ *Preparation of plant samples*

The dust particles on the leaves were rinsed with clean water and later divided into two flat plastic trays. The first part was air-dried under the shade while the second portion was sun-dried. The sun-dried sample became crispy after five days while that of the air-dried sample took eight days. The samples were ground into powder using Bajaj Twister Mixer Electric Grinder (3 Jar QC. NO: HP/14/001/0064) and well kept in an air-tight plastic containers prior to the analytical procedure.

➢ *Proximate analysis of the leaf sample of A. brasiliana*

The proximate constituents (moisture, ash, crude fat, crude protein, and crude fibre) both in the air-dried and sun-dried leaf samples of *A. brasiliana* determination was carried out in Department of Chemistry Laboratory, School of Sciences, Federal University of Technology Akure. The standard procedure on a dry weight basis was employed in the analysis[15]. Percentage carbohydrate was determined by difference[16] thus, 100 – (% Crude protein + % Ash + % Crude fiber + % Moisture + % Crude fat) while metabolizable energy was obtained using Janssen formula[17].

➢ *Determination of the elemental composition of A. brasiliana samples*

Analysis of the elements in both air-dried and sun-dried samples of *A. brasiliana* was done at Sustainable Laboratory Services Limited Akure. Exactly 2 g of the dried samples were dry-ash in a muffle furnace at 550^{o}C for six and half hours after which the ashes were dissolved in 10 % HCL acid in a conical flask. The solutions were filtered into a 100ml standard flask and made up to the mark with distilled water. The individual element was estimated from the solution using Atomic Absorption Spectrometer (AAS) machine LAMOTTE Smart Spectro 2 RMN 26625 and FP 902 (Nanometer: 510NM) Laboratory equipment with Sample reference number SL01974657AB.

➢ *Statistical analysis*

All the duplicate data results for the proximate composition were subjected to statistical analysis using IBM SPSS computer software package[18] version 23 (2015) and presented as ± standard deviation (SD).

III. RESULTS AND DISCUSSION

The results of the proximate and elemental analyses are shown in Tables 1 and 2, respectively. The moisture content ranges between 13.36 ± 0.53 and 13.40 ± 0.29 for air-dried and sun-dried leaf sample *A. brasiliana,* respectively. This range agrees with the recommended 14 % moisture content for storage samples[19]. High moisture content will prevent crude drugs from storing for longer period. The plant samples in this study can therefore stay long on the shelf without the risk of deterioration from microbes[20]. Values for the ash and crude fibre of the tested samples in this study increase with the air-drying method, which also agrees with previously documented report[21]. The ash content in the two samples was higher appreciably than that reported in some selected vegetables in Nigeria[22]. Air-dried sample of *A. brasiliana* had higher values for Fat (10.07 ± 0.35 against 9.50 ± 0.16), Carbohydrate (50.33 ± 0.40 against 40.26 ± 0.75), Dry matter (87.64 ± 0.89 against 86.60 ± 0.29) and Metabolizable energy (3202.68 ± 6.61 against 3105.39 ± 10.61) than the Sun-dried sample. However, ash, crude protein (CP), and crude fibre (CF) in the Sun-dried sample were higher than the air-dried counterpart. Worthy of note is the high crude protein 17.14 ± 0.49 observed in the air-dried sample as against 8.60 ± 0.35 found in the air-dried sample. This observation agrees with other researchers who reported the crude protein of 3.04 ± 0.32 in fresh and 10.76 ± 0.70 in sun-dried samples of *Bombax buonopozense* sepals, respectively[21]. This indicates that the crude protein of plant samples may probably increase with sun drying. However, carbohydrate, crude fat, and metabolizable energy in air-dried *A. brasiliana* were higher than that of the sun-dried sample. Comparing the proximate results of this study with the report of the sun-dried *Aspilia Africana* and *Tithonia diversifolia* [23], *A. brasiliana* had higher crude protein (17.4 %), than *A. Africana* (7.87 %) and *T. diversifolia* (9.62 %). However, crude fibre (0.72 %) and carbohydrate (40.26 %) in *A. brasiliana* were lower than that of *A. africana* (crude fiber 12.30 % and carbohydrate 79.97 %) and *T. diversifolia* (crude fiber 15.82 % and carbohydrate 70.35 %). This shows that *A. brasiliana* is a good source of carbohydrates. Carbohydrate is a major source of energy to the body[24]. It is needed in the body for fats to be effectively oxidized and in the prevention of ketosis. Certain beneficial organic compounds are also embedded in carbohydrates for plants and animals' health[25]. The substantial quantity of crude fibre in *A. brasiliana* will promote better digestion in monogastric animals like pigs when fed directly or when used as leaf meal in poultry diets. Fibre is pivotal in speeding up the rate at which waste and toxins are excreted from the body system[26]. The crude protein of *A. brasiliana* both air-dried (8.60 ± 0.35) and sun-dried (17.14 ± 0.49) in this study is far higher than the percent crude protein (5 %) earlier reported for *A. brasiliana*[27] and also for all the selected vegetables in Nigeria[22] Viz: *Daucus carota* leaf, 2.4, *Sesamum Indicum* leaf, 1.54, *Hibiscus asper* leaf, 0.26, *Manihot esculenta*, 0.18, *Lactuca capensis*, 0.23, *Helianthus tuberosus*, 0.63, *Colocasia esculenta*, 1.58, *Telfaria occidentalis*, 0.15, *Amaranthus hybridus*, 1.02, *Ocimum gratissimum*, 2.43, *Chromoleana odoratum*, 0.31, *Talinum triangulare* 1.58, *Corchorus olitorus* 0.80, *Adansonia digitata*, 1.54, *Brassica oleraceae*, 1.80, *Murraya koenihii*, 0.26, *Abelmoschus esculentus*, 0.40, *Allium cepa* 0.83, *Basel alba*, 0.71, *Phaseolus vulgaris*, 2.67 *Vernonia amygdalina*, 2.27 and *Piper ganiensea*, 0.57. The high crude protein in *A. brasiliana* will make the plant to be very useful in building and repairing of body tissues, production of enzymes, hormones, and fighting off infections through antibodies production. It will be a good source of fat, as shown in Table 1. The crude fat value ranges between 10.07 ± 0.35 and 9.50 ± 0.16 for air-dried and sun-dried leaf samples, respectively. The values here were at variance with an author who reported 0.7 % crude fat in the air-dried leaf of *A. brasiliana*[27]. This high variation may be due to geographical location, nature of the soil, climate, etc. among others. Fats are indispensable in energy production, joint mobilization and brain wellness. The absorption of vitamins A and E (fat-soluble vitamins) is made possible by the availability of fats in the diet. When fat is completely oxidized, energy is made available to body cells in large quantities[28]. The mineral composition of the air-dried and sun-dried samples of *A. brasiliana* (Table 2) showed-case the plant to be very rich in minerals, and this agrees with several authors that had worked on this plant[27, 29, 30]. The analyzed minerals in this study (Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), and Phosphorus (P)) had higher values in the air-dried sample

than the sun-dried sample. Calcium and phosphorus are indispensable elements in bone formation[28]. Calcium plays significant role in exocytosis, muscle contractions, and release of neurotransmitters[31]. Sodium in conjunction with chlorine (sodium chloride) also plays a significant role in protein absorption[28]. Cellular homeostasis in the body is a process that is constantly maintained by sodium and potassium[32]. Magnesium is necessary for the transmission of signals across neuromuscular junctions and in the metabolism of calcium[33]. Magnesium is very crucial for several numbers of biosynthetic processes in the body from glycolysis to transmission of the genetic code[34]. The sodium (Na) content in air-dried sample of *A. brasiliana* (29.200 ppm) is higher than the sun-dried sample (25.700 ppm) and also higher (range of 0.71 ± 1.16 – 77.81 ± 2.01 ppm) that twenty-two (22) out of the twenty-seven (27) selected vegetables[22], showing that *A. brasiliana* is far richer in mineral constituents than many of the vegetables being consumed by humans in Nigeria.

Parameters (%)	Air-dried sample	Sun-dried sample
Moisture	13.36 ± 0.53	13.40 ± 0.29
Ash	17.44 ± 0.25	18.97 ± 0.26
Crude fat	10.07 ± 0.35	9.50 ± 0.16
Crude protein	8.60 ± 0.35	17.14 ± 0.49
Crude fibre	0.20 ± 0.03	0.72 ± 0.13
Carbohydrate	50.33 ± 0.40	40.26 ± 0.75
Dry matter	87.64 ± 0.89	86.60 ± 0.29
ME (Kcal/Kg)	3202.68 ± 6.61	3105.39 ± 10.61

Table 1:- Proximate analysis of the leaf samples of *A. brasiliana*
Values are means ± Standard deviation (SD) of duplicate determinations. ME = Metabolizable energy

Minerals	Air-dried sample	Sun-dried sample	SD
Sodium (Na)	29.200	25.700	± 2.475
Potassium (K)	71.100	64.700	± 4.525
Calcium (Ca)	10.870	10.340	± 0.375
Magnesium (Mg)	14.050	8.950	± 3.606
Phosphorus (P)	2.010	1.438	± 0.404

Table 2:- Macro minerals composition (ppm) of the leaf samples of *A. brasiliana*
SD = Standard deviation

IV. CONCLUSION

Based on the results from this research, it can be concluded that the leaf of *A. brasiliana* (L.) Kuntze is a rich source of ash, fat, protein, energy, minerals and beneficial macro minerals. The low values obtained for crude fat in the two samples are plus for monogastric animals as they require less fibre in their diet, unlike the ruminants. Air-drying had a positive (increase) effect on the quantities of minerals, while the sun-drying method favoured crude protein. The findings in this study have indicated that *A. brasiliana* (L.) Kuntze could make a significant contribution to the recommended dietary allowances for the nutrients needed by monogastric animals; poultry birds inclusive.

RECOMMENDATIONS

The purpose for which the plant is to be used will determine to a great extent, the choice of processing as clearly seen in this study. However, because of the appreciable quantity of ash, crude fat, crude protein, and energy in *A. brasiliana*, the plant is highly recommended as fodder additive and in the preparation of leaf meal for poultry and other monogastric animals as a partial substitution for some costly and scarce animal feed ingredients. Further research is hereby strongly recommended to be carried out on the vitamin composition and amino acid profile of *A. brasiliana* for better, higher, productive, and profitable utilization in animal husbandry.

➢ *Competing Interest*

There is no conflict of interest to be declared by the authors of this publication.

REFERENCES

[1]. Susarla. S., Medina, V. F., McCutcheon, S. C. Phytoremediation: an ecological solution to organic chemical contamination. *Ecol. Eng*. 2002, **18**, 647 – 658.
[2]. Ager, F. J., Ynsa, J. R., Domínguez-solís, J. R., Romero, L. C. Cadmium localization and quantification in plant *Arabidopsis thaliana* using micro-PIXE. Nucl. Instrum. Meth. *Phys. Res.* 2002, **189**: 494 – 498.
[3]. Duarte, M. R. and Debur, M. C. Characters of the leaf and stem morpho-anatomy of *Alternanthera brasiliana* (L.) O. Kuntz *Amaranthaceae*. *Braz J Pharm Sci*. 2004, **40** (1): 85 – 92.
[4]. Macedo, A. F., Lage, C. L., Esquibel, M. A., de souza, M. M., da Silva, K. L,. Niero, R and Cechinel-Filho, V. *Acta Farm*. Bonaerense 2009, **23** (4): 515 – 519.
[5]. Wikipedia. The free encyclopedia. https://ee.wikipedia.org. Accessed on 07/01/2020.

[6]. Barua, C. C., Begum, S. A., Talukdar, A., Datta, R. J., Buragohain, B., Chandra, P. D., Kumar, S. D., Saikia, B. R. and Gupta, A. Influence of *Alternanthera brasiliana* (L.) Kuntze on altered antioxidant enzyme profile during cutaneous wound healing in immunocompromised rats. *Int.Scholars. Res. Network-Pharmacol* **8.** 2012.

[7]. Pereira, D. F., Zanon, R., Santos, M. D., Boligon, A. and Athayade, M. Antioxidant activities and triterpenoids isolated from *Alternanthera brasiliana (L)* Kuntze leaves. *Nut. Prod. Res*. 2013, **27**, 1660 – 1663.

[8]. Tan, K. K. and Kim, K. H. *Alternanthera sessilis* red ethyl acetate fraction exhibits antidiabetic potential on obese Type 2 diabetic rats. *Evid. Bare Compl. Altern. Med* **8.** 2013.

[9]. Dingman, S. L. Water in soils: Infiltration and redistribution. (2nd edn). Physical Hydrology, Upper saddle river, Prentice-hall, New Jersy, USA. 2002.

[10]. Macedo, A. F., Lage, C. L., Esquibel, M. A., Souza, M. M and Silva, K. L. Preliminary phytochemical and pharmacological studies on plantlets of *Alternanthera brasiliana* cultured under different spectral quality of lights. *Acta Farm bonaerense* **23** (4): 515 – 519. 2004.

[11]. Pandey, M., Abidi, A. B., Singh, S. and Singh, R. P. Nutritional Evaluation of Leafy Vegetable paratha. *J. Hum. Ecol.* 2006, **19** (2): 155 – 156.

[12]. Mohammed, M. I. and Sulaiman, M. A. Analysis of some metals in some brands of tea sold in kano, Nigeria. Bayero. *J. Pure Appl Sci*. 2009, **2**(2): 34 - 39.

[13]. Getty, T. A. The Importance of Good Nutrition, Herbs and Phytochemicals for Your Health, Good Looks and Longevity. Falcon Press International, 1997. P. O. Box 4113 Mountain View, CA 94040. ISBN 1-884459-02-1. Pp 60 – 70.

[14]. Kareem, W. A. Geological Map of Federal University of Technology, Akure. Unpublished M. Thesis, Department of Applied Geology, The Federal University of Technology Akure. Pp 109. 1997.

[15]. AOAC. Association of Official Analytical Chemists, Official Methods of Analysis of the AOAC. In: Horwitiz, W. (Ed.). 18th Edition. Association of Official Analytical Chemists, Washington D.C., USA., 2006.

[16]. James, C. S. Analytic chemistry of Foods, 1st Edition, Chapman and Hall, New York, 1995

[17]. Janssen, W. M. M. A. European tables of energy values for poultry feed stuffs. 3rd ed. Beekbergen Netherlands. (Spelderholt Centre for Poultry Research and Information Services) 1989, pp: 84.

[18]. SPSS Statistics. IBM Corporation computer software package version 23. 2015.

[19]. African Pharmacopoeia *Dau./strc*. Scientific Publication, 1986. 140 – 150.

[20]. Ibrahim, J., Ajaegbu, V. C. and Egharevba, H. O. Pharmacognostic and Phytochemical analysis of *Commelina benghalensis* L.B. saunders Company. Journal of ethnobotanical Leaflets, 2010. **14**:610 – 615.

[21]. Danso, J., Alemawor, F., Boateng, R., Barimah, J. and Kumah, D. B. Effect of drying on the nutrient and anti-nutrient composition of *Bombax buonopozense* sepals. *African Journal of Food Science* 2019. **13**(1): 21 – 29.

[22]. Omale, J. and Ugwu, C. E. Comparative studies on the protein and mineral composition of some selected Nigerian vegetables. African *Journal of Food Science,* 2011. **5**(1): 22 – 25.

[23]. Uduak, E. and Emana, A. Proximate Composition and Phytochemical Constituents of *Aspilia Africana* (Pers) C. D. Adams & *Tithonia diversifolia* (Hemsl) A. Gray Stems (Asteraceae). *Indian Journal of Pharmaceutical and Biological Research*, 2013. **1**(1):23 – 30.

[24]. Hassan, L. G. and Umar, K. J. Nutritional value of Balsam Apple (*Momordica balsamina* L.) leaves, *Pakistan Journal of Nutrition,* 2006. **5**(6): 522 – 529.

[25]. Omoyeni, O. A and Adeyeye, E. I. Chemical composition, calcium, zinc and phytate inter relationships in *Aerva lanata* (Linn) juss Ex schult Leaves. *Orient J Chem,* 2009. **25**(3); 485 – 488.

[26]. Hunt, S., Groff, I. L., and Holbrook, J. *Nutrition, Principles and Chemical Practice*. John wiley and Sons, New York, 49-52; 459- 462. 1980.

[27]. Pratap, C. R. Analysis of Proximate, Phytochemical, Elemental Compositions and Antioxidant Property of Leaf of Alternanthera brasiliana (L.) Kuntze. *MOJ Food Process Technol* **4**(3): 1 – 7. 2017.

[28]. Saxena, H. C. Poultry Feed Technology (*Feed Formulation and Manufacturing*). International Book Distribution Company (Publishing Division) India, 1999. Pp 13 – 135.

[29]. Susarla. S., Medina, V. F., McCutcheon, S. C. Phytoremediation: an ecological solution to organic chemical contamination. *Ecol. Eng*. 2002. **18**, 647 – 658.

[30]. Saawan, K., Pradeep, S., Garima, M., Saurabh, S., Jha, K. K. and Khosa, R. L. Phytopharmacological review of *Alternanthera brasiliana* (Amaranthaceae). Asian *Journal of Plant Science and Research* 2011. **1**(1): 41 – 47.

[31]. Toyoshima, C., Nakasako, M., Nomura, H. and Ogawa, H. Crystal structure of the calcium pump of sarcoplasmic reticulum at 2.6 A resolutions, 2000. *Nature* **405**(6787): 674 – 655.

[32]. Pohl, H. R., Wheeler, J. S. and Murray, H. E. Sodium and potassium in health and disease. Sigel A, Sigel H, Sigel RKO (Eds.), 2013. Interrelations between essential metal ions and human diseases, pp 29 – 47.

[33]. FAO/WHO. Report of a joint FAO/WHO Expert Consultation Bankok, Thailand expert consultation on human vitamin and mineral requirements, 2002. Pp 223 – 229.

[34]. Payandeh, J., Pfoh, R and Pai, E. F. The structure and regulation of magnesium selective ion channels. Biochin Biophys *Acta,* 2013. **1828**(11): 2778 – 2792.