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Extraction and Determination of the Concentration of Seven Water Soluble Vitamins Present in Seven Accessions of *Dioscorea, Bulbifera* Planted in Different Soil Treatments

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Abstract **Original Research Article**

The experiment on the extraction and determination of seven water soluble vitamins present in seven accessions of *Dioscorea bulbifera* was carried out at the research farm of University of Port Harcourt Rivers state Nigeria. It was laid out in a randomized complete block design (RCBD). Various treatments (Ashes amended with sandy soil (AS), Sawdust amended with sandy soil (SAW), sandy soil (SD), and garden soil as control (CNT) were used with seven accessions of *Dioscorea bulbifera* which includes; accession 3079, 3083, 3084, 3087, 3089, 3094 and 4121 were planted on each of the treatments for 8 weeks. Data was obtained by analyzing the leaves, the results shows that across the treatment level, all the seven water soluble Vitamins studied is found to be present in *Dioscorea bulbifera* and highest in the sandy soil (SD) treatment and in accession 3083 only when compared with the control (CNT). This was also replicated in all the vitamins as prove that the control (CNT) and sandy soil (SD) treatment is the best soil for planting *Dioscorea bulbifera* for optimum water soluble vitamin production. This study has also proved that there is significant amount of water soluble vitamins present in Dioscorea *bulbifera* and we can proudly say that a farmer should plant *Dioscorea bulbifera* in normal soil or sandy soil for optimum vitamins C, B1, B2, B3, B6, B9, B12, production and it is now true that all the accessions of *Discorea bulbifera* can grow well with high yield if planted on the right soil with good treatment.

Keywords: *Dioscorea Bulbifera*, Water-Soluble Vitamins, Vitamin C, B1, B2, B3, B6, B9, B12, Soil Treatments, Randomized Complete Block Design, Sandy Soil, Accession, Vitamin Extraction, Nigeria, Crop Yield.

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INTRODUCTION

Yam (Dioscorea species) constitute one of the most important food security crops for many countries especially Togo, Ghana, Bukinafaso etc (koua kou *et, al* 2010). *Dioscorea* species popularly known as aerial yam word wide is a prime staple medicinal food substitute for many people. Across different ethnic communities and geographic regions. Different species of the *Dioscorea* have been adopted within different habitation as a food source due to the high nutritional benefits and values towards treatment and cure of different health challenges Yam also provides other nutritional benefits like lipids, vitamins, proteins and minerals (lazzitity *et al* 1998). According to (IITA) the global annual consumption of yam is placed at 18 million tons, with 15 million tons only in West Africa amounting to about 61 kg per capital in the region (IITA 2020). *Dioscorea bulbifera* contain high nutritional value compared to other *Dioscorea* species with high level of calcium, vitamin B1, B3, and C. Despite the grate huge benefits derived from the dioscorea family, not much investments/ Research attention is given to them. According to Jue *et, al* , the nutritional value of *D bulbifera* is Moisture= 61.6-92.5, Crude protein=0.89-16.8, Crude fat=0.30-8.13, Crude fiber =0.61-18.2, Ash=0.05=8.15, and Starch= 12.5=62.7. (Foods 2020, 9, 1304) and Vitamin was not recorded. • Vitamins are any of several organic substances that are necessary in small quantities for normal health and growth in higher forms of animal life. They are usually designated by selected letters of the alphabet, as in vitamin C, K, E though they are also designated by chemical names like niacin, riboflavin, thiamin etc. Traditionally vitamins are separated into two groups, the water soluble and the fat soluble vitamins. The water soluble vitamins are vitamin C,B1,B2,B3,B5,B6,B7, B9, and B12 while the fat soluble once are Vitamin A,E,D and k. but in this research work, our focus is on seven water soluble vitamins which includes vitamin C, B1, B2, B3, B6, B9, and B12 to ascertain there concentration

level in each of the soil treatments and which accession has the highest .

MATERIALS AND METHODS

These research work was conducted ai the research farm of the University of PortHarcourt , PortHarcourt Rivers state NIgeria between November 2021 and September 2023 cropping season the site is located at (latitude 4º 53′ 31″ N and longitude 6º 54′ 38″ E) with temperature range of 24º C to 35º C and average rain fall of 2718MM. seven accessions of Aerial yam (*Dioscorea bulbifera*) bulbil accessio3079, 3083, 3084, 3087, 3089, 3094 and 4121 s were obtained from Genetic Resource Centre (GRC) of the International Institute of Tropical Agriculture (IITA) Ibadan Nigeria. The treatments' include Saw-dust Amended with sandy soil (SAW) Ashes Amended with sandy soil (AS), Sandy soil (SD) and Garden soil as control (CNT).The Ashes was obtained from a local fire wood cooker in Etche LGA, The sawdust was obtained from a timber sawmill along Sars road and the sandy soil from Choba River while the garden soil was obtained from the site where the research was conducted

Vitamin composition; The amount of vitamin C, B6, B9 and B12 in the sample was determined using the method describe d by (AOAC, 2010; Achikanu *et al*., 2013) Vitamin B1 and B3 were determined using the method described by Okwu and Ndu, (2006) while Vitamin B2, folate was determined using the methods described by Okwu and Josiah (2006)

RESULTS AND DISCUSSIONS

Vitamin C Concentration of all Accessions of *Dioscorea bulbifera.* Grown on the Treatments Sample

The vitamin C concentration of all the accessions of *Dioscorea bulbifera* grown on control (normal soil), SAW (saw dust), SD (Sandy Soil) and AS (Ashes) are shown in Figure 1 below. There were significant difference decrease in vitamin C concentration in accessions 3079, 3084, 3087 and 3089 of SAW, 3079, 3087, 3089, 3094 and 4121 of SD and 3079, 3083, 3084, 3087, 3089, 3094 and 4121 of AS treatments when they were compared to the control except accession 3083 of SD which experience significant difference increase. Also, there were significant difference in some of the accessions treated within control, SAW and SD.

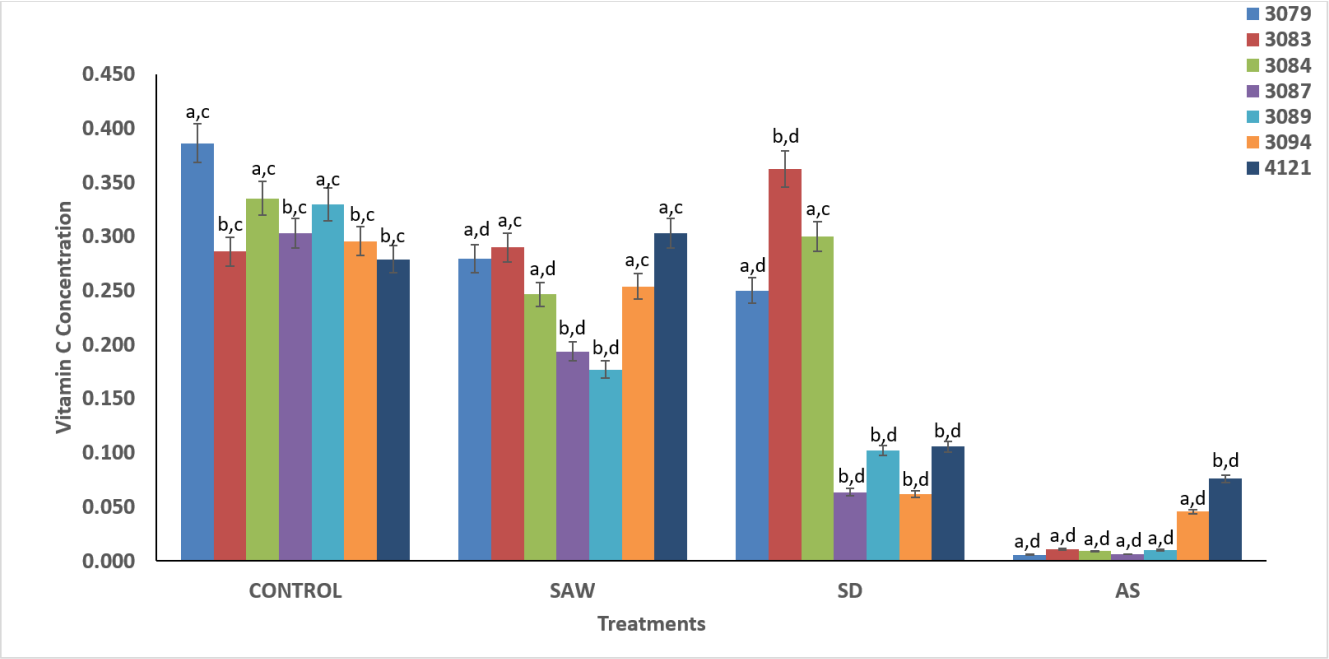

Figure 1 Vitamin C Concentrations of different accessions of *Dioscorea bulbifera* (3079, 3083, 3084, 3087, 3089, 3094 and 4121) grown on normal soil Control (CNT), Sawdust (SAW), Sandy soil (SD) and Ashes (AS). Values are means ± Standard Error Mean (SEM). Values with different superscripts are statistically different at ($p \leq 0.05$). Superscript (a,b) compares accession 3083, accession 3084, accession 3087, accession 3089, accession 3094 and accession 4121 to accession 3079 (1st letters) within the group while Superscript (c,d) compares SAW, SD and AS to Control of the same accession across the treatments (2nd letters).

Vitamin B1 Concentration of all Accessions of *Dioscorea bulbifera.* Grown on the Treatments Sample

The vitamin B1 concentration of all the

accessions of *Dioscorea bulbifera* grown on control (normal soil), SAW (saw dust), SD (Sandy Soil) and AS (Ashes) are shown in Figure 2 below. There were significant difference decrease in vitamin B1 concentration in accessions 3079, 3084, 3087 and 3089 of SAW, 3079, 3087, 3089, 3094 and 4121 of SD and 3079, 3083, 3084, 3087, 3089, 3094 and 4121 of AS treatments when they were compared to the control except accession 3083 of SD which experience significant difference increase. Also, there were significant difference in some of the accessions treated within control, SAW and SD.

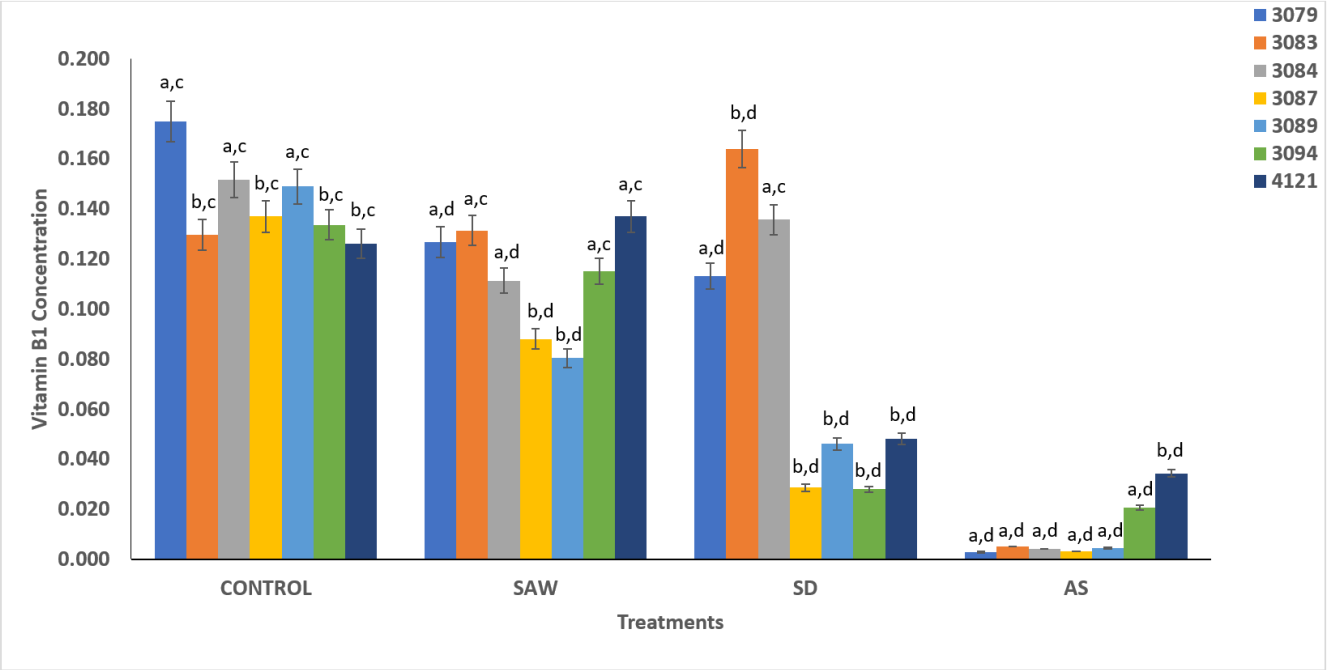

Figure 2 Vitamin B1 Concentrations of different accessions of *Dioscorea bulbifera* (3079, 3083, 3084, 3087, 3089, 3094 and 4121) grown on normal soil Control (CNT), Sawdust (SAW), Sandy soil (SD) and Ashes (AS).

Values are means ± Standard Error Mean (SEM). Values with different superscripts are statistically different at ($p \leq 0.05$). Superscript (a,b) compares accession 3083, accession 3084, accession 3087, accession 3089, accession 3094 and accession 4121 to accession 3079 (1st letters) within the group while Superscript (c,d) compares SAW, SD and AS to Control of the same accession across the treatments (2nd letters).

Vitamin B2 Concentration of all Accessions of *Dioscorea bulbifera.* Grown on the Treatments Sample

The vitamin B2 concentration of all the accessions of *Dioscorea bulbifera* grown on control (normal soil), SAW (saw dust), SD (Sandy Soil) and AS (Ashes) are shown in Figure 3 below. There were significant difference decrease in vitamin B2 concentration in accessions 3079, 3084, 3087 and 3089 of SAW, 3079, 3087, 3089, 3094 and 4121 of SD and 3079, 3083, 3084, 3087, 3089, 3094 and 4121 of AS treatments when they were compared to the control except accession 3083 of SD which experience significant difference increase. Also, there were significant difference in some of the accessions treated within control, SAW and SD.

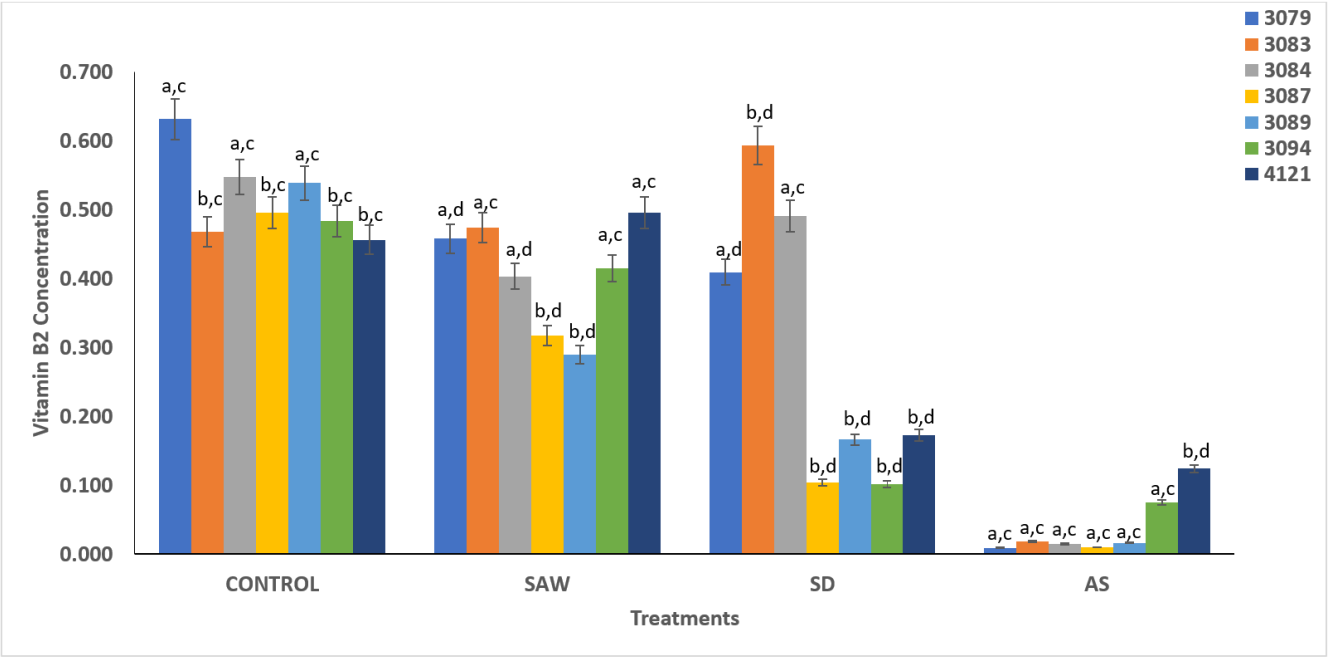

Figure 3 Vitamin B2 Concentrations of different accessions of *Dioscorea bulbifera* (3079, 3083, 3084, 3087, 3089, 3094 and 4121) grown on normal soil Control (CNT), Sawdust (SAW), Sandy soil (SD) and Ashes (AS).

Values are means ± Standard Error Mean (SEM). Values with different superscripts are statistically different at ($p \leq 0.05$). Superscript (a,b) compares accession 3083, accession 3084, accession 3087, accession 3089, accession 3094 and accession 4121 to acccssion 3079 (1st letters) within the group while Superscript (c,d) compares SAW, SD and AS to Control of the same accession across the treatments (2nd letters).

Vitamin B3 Concentration of all Accessions of *Dioscorea bulbifera.* Grown on the Treatments Sample

The vitamin B3 concentration of all the accessions of *Dioscorea bulbifera* grown on control (normal soil), SAW (saw dust), SD (Sandy Soil) and AS (Ashes) are shown in Figure 4 below. There were significant difference decrease in vitamin B3 concentration in accessions 3079, 3084, 3087 and 3089 of SAW, 3079, 3087, 3089, 3094 and 4121 of SD and 3079, 3083, 3084, 3087, 3089, 3094 and 4121 of AS treatments when they were compared to the control except accession 3083 of SD which experience significant difference increase. Also, there were significant difference in some of the accessions treated within control, SAW and SD.

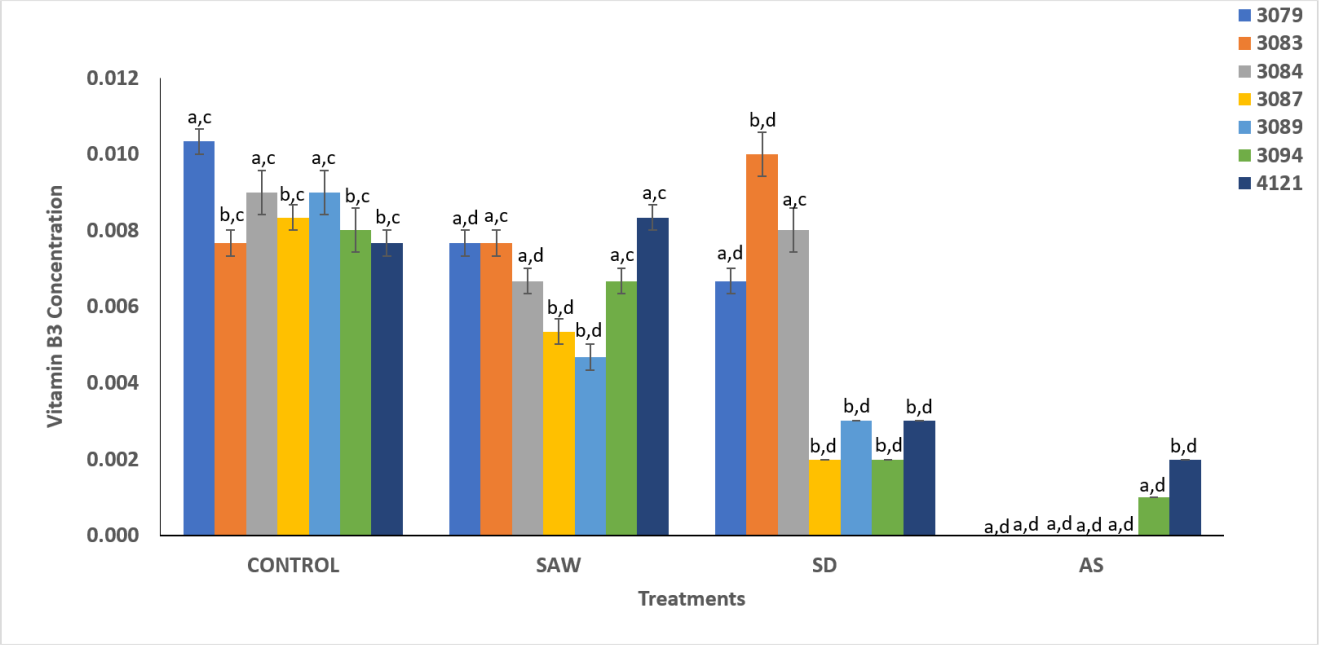

Figure4 Vitamin B3 Concentrations of different accessions of *Dioscorea bulbifera* (3079, 3083, 3084, 3087, 3089, 3094 and 4121) grown on normal soil Control (CNT), Sawdust (SAW), Sandy soil (SD) and Ashes (AS).

Values are means ± Standard Error Mean (SEM). Values with different superscripts are statistically different at ($p \leq 0.05$). Superscript (a,b) compares assession 3083, accession 3084, accession 3087, accession 3089, accession 3094 and accession 4121 to accession 3079 (1st letters) within the group while Superscript (c,d) compares SAW, SD and AS to Control of the same accession across the treatments (2nd letters).

Vitamin B6 Concentration of all Accessions of *Dioscorea b.* Grown on the Treatments Sample

The vitamin B6 concentration of all the accessions of *Dioscorea bulbifera* grown on control (normal soil), SAW (saw dust), SD (Sandy Soil) and AS (Ashes) are shown in Figure 5 below. There were significant difference decrease in vitamin B6 concentration in accessions 3079, 3084, 3087 and 3089 of SAW, 3079, 3087, 3089, 3094 and 4121 of SD and 3079, 3083, 3084, 3087, 3089, 3094 and 4121 of AS treatments when they were compared to the control except accession 3083 of SD which experience significant difference increase. Also, there were significant difference in some of the accessions treated within control, SAW and SD.

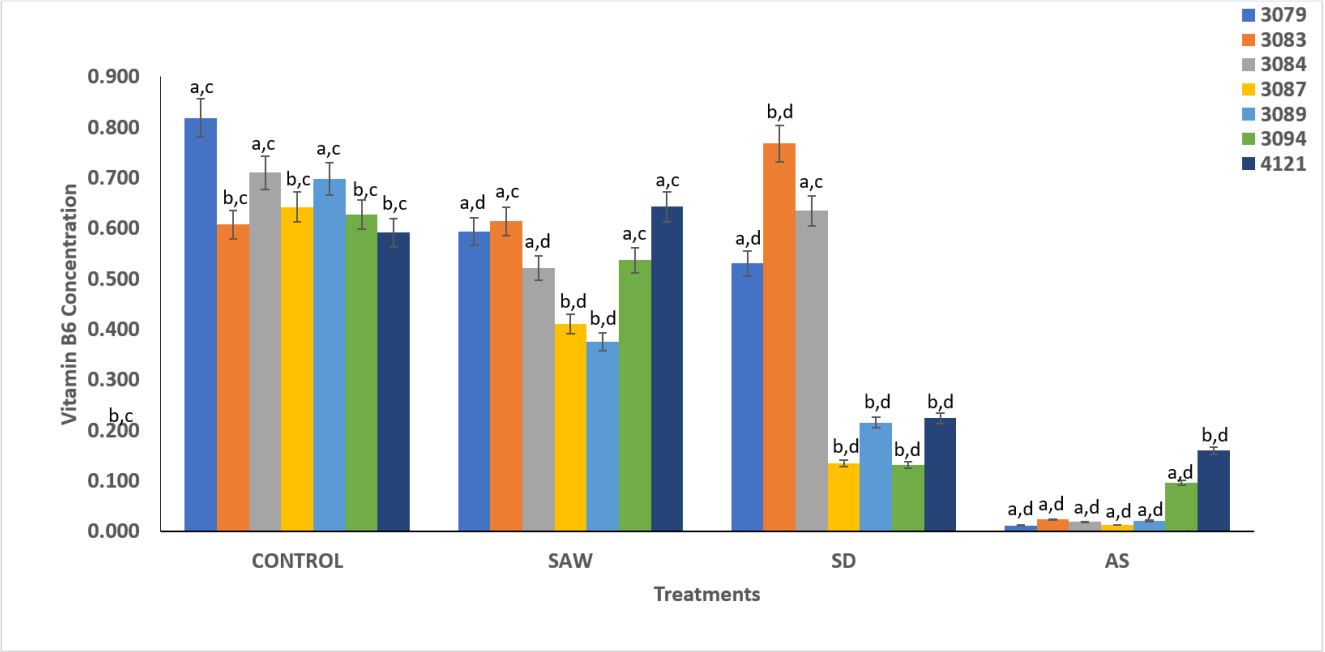

Figure 5 Vitamin B6 Concentrations of different accessions of *Dioscorea bulbifera* (3079, 3083, 3084, 3087, 3089, 3094 and 4121) grown on normal soil Control (CNT), Sawdust (SAW), Sandy soil (SD) and Ashes (AS).

Values are means ± Standard Error Mean (SEM). Values with different superscripts are statistically different at ($p \leq 0.05$). Superscript (a,b) compares accession 3083, accession 3084, accession 3087, accession 3089, accession 3094 and accession 4121 to accession 3079 (1st letters) within the group while Superscript (c,d) compares SAW, SD and AS to Control of the same accession across the treatments (2nd letters).

Vitamin B9 Concentration of all Accessions of *Dioscorea bulbifera.* Grown on the Treatments Sample

The vitamin B9 concentration of all the accessions of *Dioscorea bulbifera* grown on control (normal soil), SAW (saw dust), SD (Sandy Soil) and AS (Ashes) are shown in Figure 6 below. There were significant difference decrease in vitamin B9 concentration in accessions 3079, 3084, 3087 and 3089 of SAW, 3079, 3087, 3089, 3094 and 4121 of SD and 3079, 3083, 3084, 3087, 3089, 3094 and 4121 of AS treatments when they were compared to the control except accession 3083 of SD which experience significant difference increase. Also, there were significant difference in some of the accessions treated within control, SAW and SD.

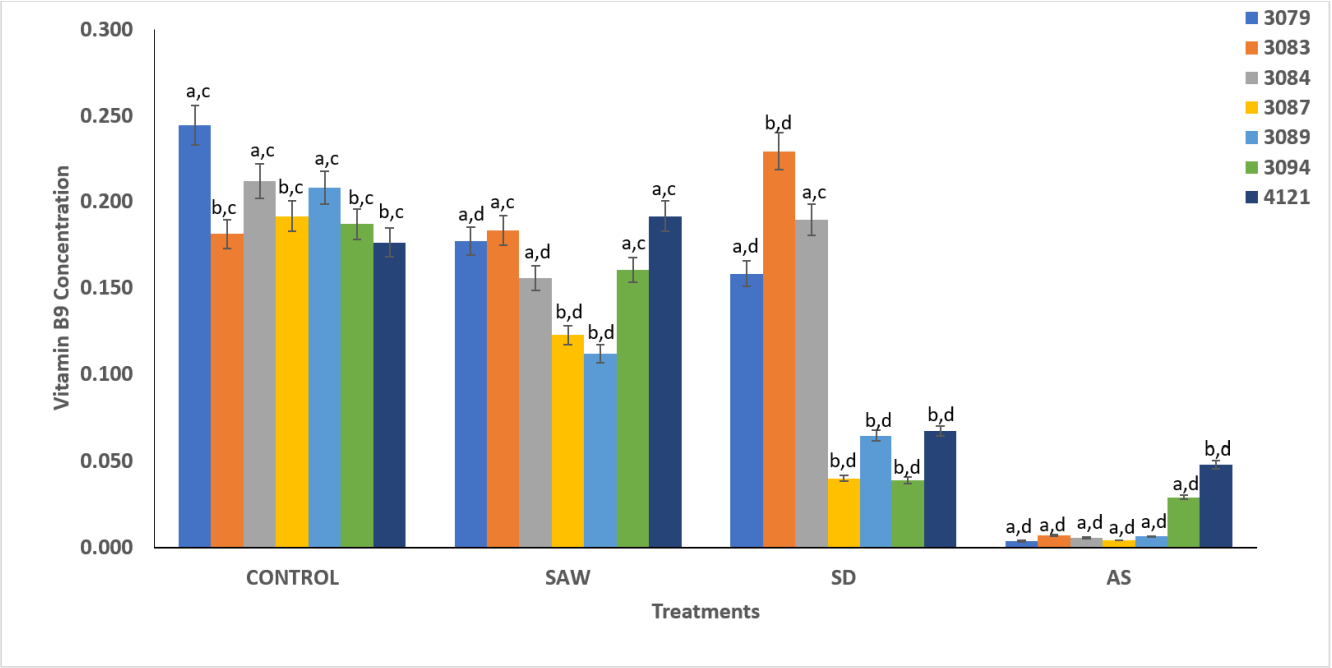

Figure 6 Vitamin B9 Concentrations of different accessions of *Dioscorea bulbifera* (3079, 3083, 3084, 3087, 3089, 3094 and 4121) grown on normal soil Control (CNT), Sawdust (SAW), Sandy soil (SD) and Ashes (AS).

Values are means ± Standard Error Mean (SEM). Values with different superscripts are statistically different at ($p \leq 0.05$). Superscript (a,b) compares accession 3083, accession 3084, accession 3087, accession 3089, accession 3094 and accession 4121 to accession 3079 (1st letters) within the group while Superscript (c,d) compares SAW, SD and AS to Control of the same accession across the treatments (2nd letters).

Vitamin B12 Concentration of all Accessions of *Dioscorea bulbifera.* Grown on the Treatments Sample

The vitamin B12 concentration of all the accessions of *Dioscorea bulbifera* grown on control (normal soil), SAW (saw dust), SD (Sandy Soil) and AS (Ashes) are shown in Figure 7 below. There were significant difference decrease in vitamin B12 concentration in accessions 3079, 3084, 3087 and 3089 of SAW, 3079, 3087, 3089, 3094 and 4121 of SD and 3079, 3083, 3084, 3087, 3089, 3094 and 4121 of AS treatments when they were compared to the control except accession 3083 of SD which experience significant difference increase. Also, there were significant difference in some of the accessions treated within control, SAW and SD.

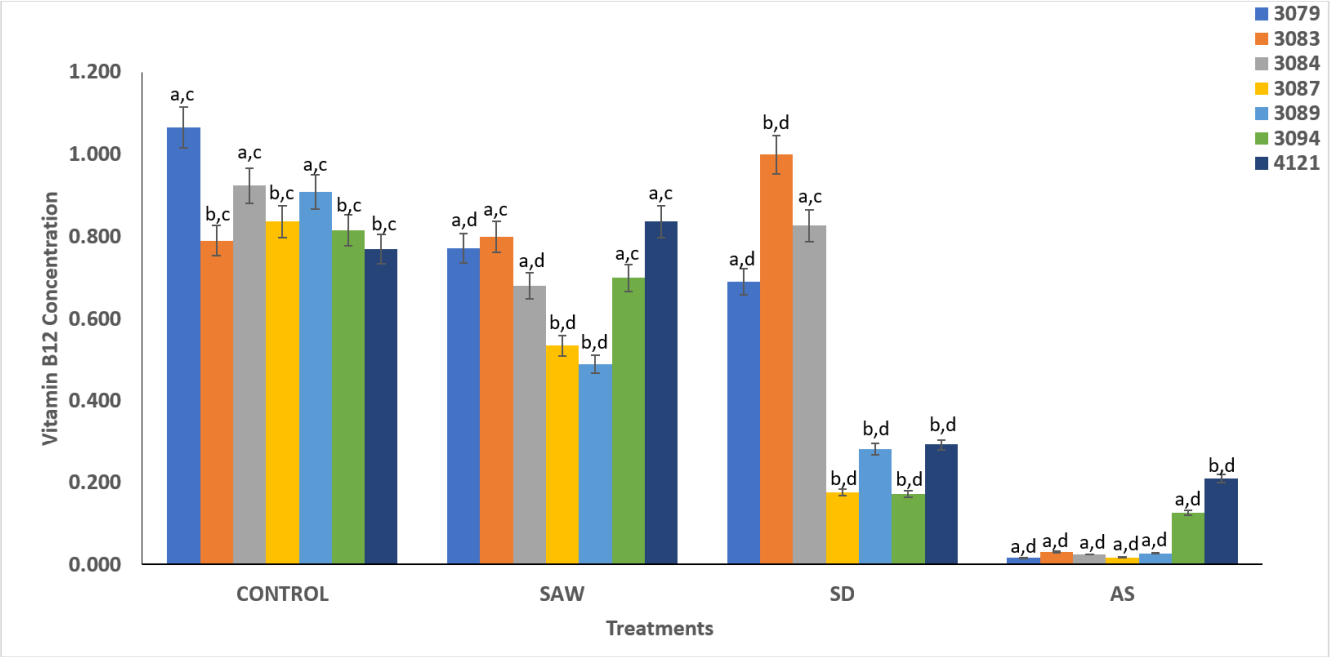

Figure 7 Vitamin B12 Concentrations of different accessions of *Dioscorea bulbifera* (3079, 3083, 3084, 3087, 3089, 3094 and 4121) grown on normal soil Control (CNT), Sawdust (SAW), Sandy soil (SD) and Ashes (AS).

Values are means ± Standard Error Mean (SEM). Values with different superscripts are statistically different at ($p \leq 0.05$). Superscript (a,b) compares accession 3083, accession 3084, accession 3087, accession 3089, accession 3094 and accession 4121 to accession 3079 (1st letters) within the group while Superscript (c,d) compares SAW, SD and AS to Control of the same accession across the treatments (2nd letters).

DISCUSSION/CONCLUSION

Figure 1 There was a decrease in Vitamin C concentration in most of the treatments when compared to the control with the Ashes (AS) treatment as the lowest. But for the accession level we experienced a significant difference decrease in accession 3079, 3084, 3087 and 3089 of sawdust (SAW), 3079, 30887, 3089 and 4121 of sandy soil (SD). There was also a significant difference decrease in all the accessions of AS treatments when they were compared to the control. Accession 3083 of sandy soil stand out in all with a significant difference increase when compared to the control

(a) This result also correlate with the result of Nwachukwu and Okoroafor 2019 that shows the presence of some vitamins especially water soluble vitamins in *Dioscorea bulbifera*

(b) As observed from the results, across the treatment level, it is now proved that all the seven water soluble Vitamins studied is found to be present in *Dioscorea bulbifera* and highest in the sandy soil (SD) treatment.

(c) The result has also shown that accession 3083 is the only accession where we have a significant difference increase consistently in all the seven water soluble vitamins studied when compared with the control (CNT).

(d) This study has also proved that the control (CNT) and sandy soil (SD) treatment is the best soil for planting *Dioscorea bulbifera* for optimum water soluble vitamin production.

(e) This study has also proved that there is significant amount of water soluble vitamins present in *Dioscorea bulbifera* .

(f) We can proudly say that a farmer should plant *Dioscorea bulbifera* in normal soil or sandy soil for optimum vitamins C, B1, B2, B3, B6, B9and B12 production.

(g) This experiment has shown that all the accessions of *Discorea bulbifera* can grow well with high yield if planted on the right soil with good treatment

(h) The results shows that there was significant increase in all the vitamins observed or seen in *Dioscorea bulbifera* in accession 3083 grown on SD, it simply shows that when vitamins are needed, *Dioscorea bulbifera* grown on SD can supply all the basic needed water soluble vitamins. According to Chaniad *et al.* (2020)

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