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Comparative Study of Effect of Sprouting on Water and Fat Soluble Vitamins in White *Sorghum bicolor* and *Pennisetum glaucum*

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Abstract: *White Sorghum bicolor and Pennisetum glaucum were analyzed using standard analytical techniques for vitamin composition before and after sprouting. The data showed that the vitamin content was increased after sprouting. For white Sorghum bicolor and Pennisetum glaucum, among the water soluble vitamins, the highest percentage enhancement was observed in B_9 (-39.4% and -21.0%) respectively while among the fat soluble vitamin group, the highest level of enhancement was observed in vitamin K (-10.1%) and A (-19.4%) both for Sorghum bicolor and Pennisetum glaucum respectively. However from the present study, it was concluded that Sorghum bicolor and Pennisetum glaucum contains appreciable amount of various water and fat soluble vitamins of which sprouting significantly increased their percentage composition. Comparatively, both water and fat soluble vitamins in Pennisetum glaucum are highly or more enhanced than that of white Sorghum bicolor after sprouting. Although the level recorded in all the samples in the present research could not meet up with the recommended daily allowance but could serve complementary role in nutrition.*

Keyword: *White Sorghum bicolor, Pennisetum glaucum, Sprouting, Vitamins.*

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I. Introduction

Cereal grains are grasses members of the monocot families *poaceae* or *gramineae*. Cereal grains are grown in greater quantities and provide more food energy worldwide than any other type of crop. Cereals are the most important stable food for many people in the developed and developing countries. In the developed countries, 70% of the cereal production is used as animal food while in the developing countries, like Nigeria, about 68-98% of the cereal production is used for human consumption. The principal cereal crops are millet sorghum, maize, wheat, barley, oats and rice, Adebayo *et al*., (2016).

Pennisetum glaucum (Pearl millet), is known as spiked millet, bajra (in India). Pearl millet may be considered as a single species but it includes a number of cultivated races. It almost certainly originated in tropical western Africa, where the greatest number of both wild and cultivated forms occurs. About 2000 years ago the crop was carried to eastern and- central Africa and to India, where because of its excellent tolerance to drought it became established in the drier environments (FAO, 2006).

Sorghum bicolor (Sorghum) is commonly consumed by the poor masses of many countries and it forms a major source of vitamins minerals, protein and calories in the diet of large segment of the population of India and Africa, as well as for the poultry and livestock.

Sprouting is the natural germination process by which seeds or spores put out shoots, plants produce new leaves or buds, or other newly developing parts experience further growth. In other to improve the nutritional and functional properties of plant seed. (Jirapa *et al*., 2001). Sprouting has been reported to improve digestibility and bioavailability of vitamins (Inyang *et al*., 2008).

Increase in the rate of population growth, economic crises and inflation in prices of some commonly consumed imported cereal food items coupled with increase rate of metabolic diseases especially diabetics which has gained prominence in the society which calls for an in-depth research into local cereal grains (*Sorghum bicolor* and *Pennisetum glaucum*) reported to be one of the major source of nutrient vital for human health in Nigeria(Ogunlade,*et al*.,2011).

II. Materials And Methods

In the present research work, the seed of white *S. bicolor* and *P. glaucum* were purchased from the market in Ado Ekiti, Ekiti State, Nigeria and identified in the herbarium of Department of Agronomy, Federal University of Technology, Akure, Ondo State. *White Sorghum bicolor* and *Pennisetum glaucum* seeds were properly sorted to remove the defected ones and each were divided into two portions making four samples in all.

The first portion were soaked for 24 hours, after which it was spread on trays lined with cloth and kept wet by frequent spraying of water in the morning and evening for four days.

The sprouted grains were sundried for four days and oven-dried at 60°C to constant weight and milled into flour using electric blender (VTCL Model). The second portion was processed into flour without sprouting using the same method.

The seed flours were labeled as follows: *Unsprouted Sorghum bicolor* (USb) *Sprouted Sorghum bicolor* (SSb), *Unsprouted Pennisetum glaueum* (UPg), *Sprouted Pennisetum glaucum* (SPg) following the methods described by Adeyeye (2010) in the treatment of samples.

The vitamin content of the samples was analyzed by following the modified methods of AOAC (2005) [MTHD 992.03, 992.04 and 992.26].The sample was made to attain laboratory atmospheric condition on the bench after being removed from the storage chamber at less than 4°C. The sample was pressed and completely homogenized in the mortar carefully with pestle to avoid forming balls. 0.1 g of the sample was weighed into 10 ml beaker capacity. The sample was extracted in the container by the aforementioned methods. The extracted sample was concentrated to 1.0 ml for the chromatographic analysis.

III. Results And Discussions

The result of various vitamins (water and fat- soluble in mg/100g) contents of white *sorghumbicolor* and *pennisetum glaucum*) (unsprouted and sprouted) were shown in Table 1. The water soluble vitamins included ascorbic acid (vitamin C), Thiamin (B_1), riboflavin (B_2), niacin (B_3),pyriodoxamine (B_6), folacin and cobalamin (B_{12}), biotin and pantotheme acid (B_5) while the fat soluble are vitamin A, D E and K. The levels of these vitamins for unsprouted white *sorghum bicolo*r in the present report are as follows:-

Vitamin A (1.78E-06), B_1(0.19), B_2(0.04), B_3(3.93), B_5(1.15), B_6(0.48), B_9(0.01), B_{12}(1.5E-06), C(2.65E-05), D(5.61E-06), E(1.42) and K(2.27E-06) all in mg/100g respectively. The values for all the vitamins in sprouted white *sorghum bicolor* are as follows A (1.5E-06), B_1(0.20), B_2(0.05) B_3(4.15), B_5(1.26), B_6(0.49) B_9(0.007) B_{12}(1.6E-06) C(3E-05) D(4.4E-06) E(1.50) and K(2.5E-06) all in mg/100g.

Table 1: Vitamins Composition of white *Sorghum bicolor* and *Pennisetum glaucum* (sprouted and unsprouted)

S/N	NAME	UWSB			SWSB			UPG			SPG		
		Mean	SD	CV%	Mean	SD	CV%	Mean	SD	CV%	Mean	SD	CV%
1	Vitamin B3	3.92	0.16013	4.074485	4.15	0.074508	1.79515143	4.16	0.14336	3.444877	4.72	0.103685	2.19349335
2	Vitamin B6	0.47	0.00962	2.024889	0.48	0.010547	2.16281511	0.76	0.01099	1.446273	0.75	0.016215	2.14785742
3	Vitamin C	2.65E-05	6.7E-07	2.516905	3.00E-05	7.53E-07	2.54972882	4.75E-05	1.8E-06	3.835603	5.40E-05	1.15E-06	2.11901953
4	Vitamin A	1.78E-06	4.8E-07	26.78393	1.50E-06	1.86E-07	12.2712627	2.35E-06	2.6E-07	11.12812	2.80E-06	1.31E-07	4.6568996
5	Vitamin B1	0.18	0.00983	5.250868	0.19	0.004941	2.47574886	0.27	0.01436	5.278039	0.27	0.007358	2.67679546
6	Vitamin B2	0.04	0.00197	4.542559	0.04	0.000135	0.28238518	0.05	0.00187	3.742744	0.05	0.001834	3.41445145
7	Vitamin D	5.61E-06	1.9E-07	3.393603	4.40E-06	1.32E-07	3.01722827	7.92E-06	7E-08	0.886579	8.90E-06	1.29E-07	1.46137722
8	Vitamin E	1.41	0.08378	5.908948	1.49	0.017264	1.15799517	1.54	0.12017	7.781329	1.65	0.107253	6.46706635
9	Vitamin B9	0.004	0.00012	2.523922	0.006	0.000102	1.47863313	0.004	0.00026	5.719452	0.005	0.000155	2.82541539
10	Vitamin K	2.27E-06	2.1E-07	9.240696	2.50E-06	1.08E-07	4.25489237	5.70E-06	5.3E-07	9.387849	5.90E-06	1.38E-07	2.3510424
11	Vitamin B5	1.14	0.13328	11.63329	1.25	0.155744	12.3764908	1.23	0.08788	7.114714	1.38	0.19004	13.7597129
12	Vitamin B12	1.50E-06	2E-07	13.63479	1.60E-06	1.81E-07	11.0315528	1.14E-05	1.1E-06	9.765681	1.30E-05	1.63E-06	12.6261896

UWSB-Unsprouted White *Sorghum bicolor*
SWSB-Sprouted White *Sorghum bicolor*
UPG-Unsprouted *Pennisetum glaucum*
SPG-Sprouted *Pennisetum glaucum*

The results of *Pennisetum glaucum*(unsprouted and sprouted) for vitamins were as presented as follows:

A (2.35E -06), B_1(0.27), B_2(0.05) B_3(4.16), B_5(1.25), B_6(0.76) B_9(0.004) B_{12}(1.14E-05) C(4.75E-05) D(7.92E-06) E (1.54) and K(5.77E-06) all in mg/100g respectively in the unsprouted *pennisetum glaucum.* While for the sprouted samples, the report were as follows; A (2.8E-06), B_1(0.27), B_2(0.05) B_3(4.72), B_5(1.38), B_6(0.75) B_9(0.005) B_{12}(1.3E-05) C(5.4E-05) D(8.9E-06) E(1.65) and K(5.9E-06) all in mg/100g respectively.

A new study finds out that the amount of Vitamin A present in a particular body system has effect on vision and skin health. Vitamin A deficiency can occur in people with protein deficiency, diabetes, overactive Thyroid, fever liver diseases, cystic fibrosis or an inherited disorder called abetalipoproteinemia (In *et al.,* 2012). Vitamin is possibly effective for breast cancer, cataracts, measles, pregnancy related, night blindness and reduces diarrhea after giving birth in malnourished women. (NRC, 1989). The levels (mg/100g) o0f vitamin A in this present report as shown on Table 4.21 were lower than those reported for raw and processed in a research carried out by Adesina (2015) similarly. The levels recorded in this present study for the raw and processed cencals flour samples were seriously lower than those reported for raw and processed red pepper (In et al., 2012). Thamin (B_1) function in the body in the form of thamin pyrophosphate (TPP), the (enzyme for the transfer of active aldehyde in carbohydrate metabolism and decarboxylation). Such as pyruvate (NRC, 1989). The requirement for thamins is directly correlated with carbohydrate intake and increases as the metabolic rate increases due to pregnancy, lactation or increased physical exercise (NRC, 1989).

For those whose total caloric intake is less than 2000kcal, at least 1.0mg/dy is recommended, men and women, 19-50 years of age in the 1985 survey averaged 0.70kg/1000kcal whereas, 1-5 years of age averaged 0.79mg/1000kcal (USDA, 1987). The levels in the samples were comparably lower than the recommended daily allowance (RDA). In any case, to meet up with the RDA foods rich in vitamin B_1 needs to be consumed alongside with the white sorghum bicolor and *pennisetum glaucum*. The increase in vitamin B_1 compared well with the increase trend in vitamin B_1 observed in a research work carried out on sprouted cereal by Shipard (2005). The present reports on the other hand were comparably higher than the levels reported for cosmas variety seeds (0.022-0.021mg/100g) and sassako variety seeds (0.016-0.017mg/100g) both for raw and processed samples (Gwana *et al*., 2014). deReuk *et al*., (1980) observed severe thamine deficiency (wernick's encephalopathy) in patients with tumex of the lymphoid nematopietic system.

Vitamin B_2 (Riboflavin levels in mg/100g) in present study is not too high but averagely okay. The 1980 RDA for riboflavin is 0.6mg/100day: a minimum of 1.2mg/day is recommended for those whose caloric intake is less than 20.00kcal/day. In 1985, the mean intake for men and women 19-50 years of age was 0.82mg/1000kccal and 0.88mg/1000kcal respectively (USDA, 1986, 1987): For children 1-5 years of age, t was 1.12mg/1000kcal (USDA, 1987). From the present report, meeting these requirement would require the consumption of large amount or supplementary it with other fools that are rich sources of thiamine such as dark green vegetables and milk. Ethanol consumption can reduce intestinal bioactivity of riboflavin, particularly flavin adenine dinucleotide (FAD) according to Pinto *et al.,* (1984). The accumulation of fat in the liver in

riboflavin deficient person resembles changes observed in the liver of chronic alcoholics. Riboflavin deficiency is usually encounter when there is a general lack of vitamin B intake such as in forms of malnutrition that accompany alcoholism. The level obtained for vitamin B_2 in the present study were higher than the levels reported for sassako variety seeds (0.004-0.005mg/100g) in a research work carried out by Gwana *et al.,* (2014).

Niacin B_3 (Nicotinic acid) is the product of the chemical oxidation of nicotine a component of NADP and NAD. In nutrition literature, the word niacin is used generally to encompass the active forms of vitamin B, nicotinic acid and nicotinamide; however, estimates of niacin as well as that obtained as equivalent (NE) in the body from tryptophon metabolism. For this purpose, it is estimated that when bony of tryptophon is consumed by an adult, enough is oxidized to produce 1mg of Niacin (NRC, 1980).Niacin is associated with a number of dyhydrogenation enzymes. Other major activities in the body include carbohydrate metabolism and circulatory system.It could be obtained in cereals, legumes, mushrooms and proteinous items like fish and lean meat. Deficiency of Niacin causes pellagra, dermatitis and dementia.The level of niacin B_3 in present report were comparably higher than the level for rosmas seed (0.006-0.009mg/100g) according to research work done by Gwana *et al.,* (2014). The level is below the RDA of 18mg for males and 13mg for females. This indicate that more of the samples may need to be consumed (if it serves as the sole source of niacin) to meet up with the RDA. A high nicotic acid intake has been associated with hepatotoxicity (NRC, 1989).Vitamin B_5 also called pantothenic acid is a water soluble vitamin. Pantothenic acid is an essential nutrient. Animals is required panthothenic acid in otherto synthesize and metabolize proteins, carbohydrates and fats. The anion is called panthothenate (NRC, 1989). It has been reported that panthonenic acid (Vitamin B_5) concentrations are several times higher in the liver than in other tissues (NRC, 1989). Vitamin B_5 (Pantothenic acid) levels in the research study were comparatively higher than those reported for rosmas variety seeds (0.035-0.036mg/100g) and sassako variety seeds (0.026-0.027mg/100g) according to Gwana *et al.,*(2014).Vitamin B_6 also known as pyriodixine is a member of vitamin B complex responsible for the cure of dermatitis other substances that make up vitamin B_6 are pyridoxial and pyridoxamine. The co-enzymes forms of which are pyroxidal phosphate and the levels of vitamin B_6 (mg/100g) in the present report were comparably higher than levels reported for rosmas variety seed (0.046-0.045mg/100g) and sassako variety seeds (0.044-0.045mg/100g) according to Gwana *et al.,* (2014) the RDA for Adult females and males are 2.0 mg/day and 2.2mg/day respectively assuming a protein intake for the female and male are 100g/day and 110g/day respectively. Vitamin B_6 dependent enzyme is needed in a wide range of reactions, most if which involve amino acid metabolism. Vitamin B_6 compositions of the flour samples were normal and within the RDA (NRC, 1984).Folacin, the coenzyme of vitamin B_9 (Folic acid), is essential in the body for the transfer of single carbon units, they are needed for the synthesis of purine, methionine and thymidylate, for conversion of serine to glycine (NRC, 1989). The metabolism of folacin and vitamin B_{12} is linked because normal activity of methyl vitamin B_{12} is needed to maintain the metabolically active form of folacin (NRC, 1989; Lee, 2000; Adesina, 2015). The levels of folic acid in the present reports as recorded in Table 4 appeared to be very low and compared well with the level of vitamin B_9 reported by Adesina (2015) in research carried out on ***Treculia Africana seeds*** of which with the following ranges raw seed flour (9.28^{-8}-$1.74e^{-7}$) processed seed floor ($8\text{-}13e^{-8}$-2.19^{-7}).

From the results, the samples could complaints meeting the RDA of folic acid because the 1980 RDA of folic acid because the 1980 RDA was set at 400mg/day (0.4g/day) for persons of 11 years of age and older women of 19 to 50 years had average intake of 189mg/day (0.189g/day). Formen 19 to 50 years of age, average 305mg/day (USDA 1986) folic acid found to inhibits tumor growth several years ago (Prentice *et al*., 1985 and Lee, 2000).

Early studies in mice by Leuchtenberger *et al*., (1945) showed inhalation of spontaneous breast tumors by Folate. Lack of folic acid cause anemia (Ogunlade,*et al.*,2011).

Vitamin B_{12} also known as Cobalamin appeared to have a very low level in the sample as observed from Table 4.8. vitamin B_{12} substances are physiologically active Cobalamins. The coenzyme (St deoxyadenosy) and methyl forms of this vitamin are essential for the recycling of the active folate coenzyme, foor the metylaton of homocysteine to form methionine and for metabolism of proplenate. Vitamin B_{12} is also essential in the metabolism of fatty acids and aliphatic amino acids through its protein isomerization of methylmalonyl-COA to Succinyl-COA (NRC, 1989; Lee, 2000). Although vitamin B_{12} is synthesized by bacteria and is only found in animal foods such as meats, milk products and egg. Both white sorghum bicolor and Pennisetum glaucum in unsprouted and sprouted form contained vitamin B_{12} although in low quantity. The level in the present report could easily meet the RDA of 3.0mg/day for individual of 7 years of age and older (NRC, 1989 and USDA, 1987).

Vitamin C is ascorbic acid, isolated as a crystalline vitamin with molecular formular $C_6H_8O_6$. It takes part in hydroxylation of collagen. Wound healing and bone formation antioxidant, healthy sex organs and adnenal glands, tooth formation, enhance iron absorption infection fighter and mental health. Lack of vitamin C causes scurvy and capillary fragility, bleeding gums and loose teeth, skin lesions and bruises. Increase in vitamin C content of all four samples after sprouting was remarkably significant as shown in Table 1Actually,

the levels of vitamin C in unsprouted and sprouted *pennisetum glaucum* samples are comparatively higher than that of unsprouted and sprouted sorghum bicolor as shown in Table 1. The result of the cereal sample flows generally is comparatively lower than the result of cowpea and mungbeans in a research done Sangroms and Machads (2005). Similarly, the values for the vitamin in this research report is very low compared with the values observed by Masood and Zeb (2014) in a research carried by them on sprouted mungbeans and chickpeaseeds. Generally, an observation was made that during germination Vitamin C are synthesized (Bibi *et al.,* 2008) as a consequence of the reactivation of vitamin C. biosynthesis undergone in the seeds (Mao *et al.,* 2005). This may be the reason for the increase in vitamin C level in all flour samples. Even soaking in water yields greatly increased amount of B vitamins as well as C sprouting can yield vitamin contents 30 times higher. Vitamin D represents a group of substances that deals with the proper utilization of calcium and phosphorus. It is a secondary alcohol that has a molecular formula of $C_{28}H_{44}O$. It is primary effect on calcium metabolism. Vitamin D increases the absorption of calcium from intestinal tracts. Making vitamin D necessary for various forms of Vitamin D. vitamin D_1 and D_2 are of vegetable origin Vitamin D_3 is of animal origin. Vitamin D promotes calcium and phosphate absorption and mobilization, other major activity in the body include nerve healthy and regulation of heartbeat. Lack of vitamin D causes rickets in children, pliable bones osteomalacis in adults and fragile bones recommended daily intake is 10mg and exposure to sunlight. Vitamin D are soluble in organic solvent and are absorbed and transported in a manner similar to that of fats (NRC, 1989; Lees, 2000). The levels mg/100g of D vitamins were presented in table 4.8 and they were apparently low and compared well with the values obtained for raw and processed Treculia Africana in a research study carried out by Adesina (2015).Vitamin E (Apha-Tocopherol) is one of the most vulnerable of vitamins during food processing. Vitamin E is found in green leafy vegetables, whole cereals, nuts, beef, liver egg yolk and vegetable oils. It serves an antioxidant. It dissolves fibrin, reduces throubin formation and it is involved in red blood cell health. Lack of vitamin E causes anemia (premature infants), fat absorption defeats metabolic disfuntion in the muscles. Vitamin E activity in foods is due to the presence of tocophherols and tocotrienol compounds of plant origin. The most important of these is a-tocophenol; less active b–tocophenol, g-tocophenol and a¯tocotrienol (NRC, 1989). The levels (mg/100g) of vitamin E were presented in table 4.8 to meet RDA for vitamin E. 8mg a-tocophenol equivalent or 12mg for females age 11 and older and 10mg of a-tocophenol for male aged 15 or older (NRC; 1989)but could act as a complementary. Sources of Vitamin E in human diets (NRC, 1989).vitamin K was isolated form alfafa concentrate and from fish known as vitamin K_1 and K_2 respectively. Vitamin K_1 is 2 methyl-1-3 plytyl1-1-4- naphthoquinone and the sources are green leafy vegetables beef liver, egg yolk and tomatoes and also dot low level in cereals. it functions in blood clothing or co-agulation. Lack of vitamin K causes uncontrolled bleeding especially in newborn infants, haemorrgging and delayed blood congulation. In this present results the level of vitamin K in (mg/100g) were low as presented in table 1 and it is as well compared favourable with the level of Vitamin K in raw and processed T. Africana in a research study carried out by Adesina (2015).The human body obtain intake from dietary sources as well as though synthesis by the gut microflora. Larger amounts of vitamin K are present in dark-green leafy vegetables lower levels are found in cereals, diary product, meals and fruits (a class to which the samples belong). A committee of the food and nutrition board estimated the safe and adequate intake range for adults to be 70 to 140mg/day (NRC, 1989).

Table 2 shows the summary of the effects of sprouting on the vitamin's concentration of *sorghum bicolor* and *pennisetum glaucum* (raw and processed). In table 2 it was so evident that sprouting enhanced the levels of water soluble and fat-soluble vitamins when compared the unsprouted whole flour samples both for *sorghum bicolor* and *pennisetum glaucum*. The observation were as follows: for white sorghum *bicolor*, among the water soluble vitamins, the highest percentage enhancement was observed in B_9 (–39.4) while the other enhanced vitamins were observed as follows B_2 (–10.2%) B_3 (–5.60%), B_6 (–2.70%) B_1 (–6.60) and B_5 (–9.80) and C (–13.2%).

Table 2: Summary of the differences in Vitamin Composition of white *Sorghum bicolor* and *Pennisetum glaucum* (sprouted and unsprouted)

Vitamins	UWSB-SWSB (%)	UPG-SPG(%)	UWSB-UPG(%)	SWSB-SPG(%)
Vitamin B3	-0.2(-5.60%)	-0.6(-13.6%)	-0.2(-5.90%)	-0.6(-13.9%)
Vitamin B6	-0.01(-2.70%)	0.005(0.70%)	-0.3(-60.0%)	-0.3(-54.8%)
Vitamin C	-0.000004(-13.2%)	-0.000007(-13.7%)	-0.00002(-81.1%)	-0.00003(-83.1%)
Vitamin A	0.0000003(15.7%)	-0.0000005(-19.1%)	-0.0000005(-29.2%)	-0.000001(-84.2%)
Vitamin B1	-0.01(-6.60%)	-0.003(-1.00%)	-0.08(-45.4%)	-0.08(-37.7%)
Vitamin B2	-0.004(-10.2%)	-0.004(-7.40%)	-0.007(-15.2%)	-0.006(-12.3%)
Vitamin D	0.000001(21.6%)	-0.000001(-12.4%) -0.1(-7.40%)	-0.000002(-40.8%)	-0.000005(-103.2%)
Vitamin E	-0.07(-5.10%)		-0.1(-8.90%)	-0.2(-11.2%)
Vitamin B9	-0.002(-39.4%)	-0.001(-21.4%)	0.0004(8.10%)	0.001(19.9%)

Vitamin K	-0.0000002(-10.10%)	-0.0000002(-3.50%)	-0.000003(-151.1%)	-0.000003(-132.3%)
Vitamin B5	-0.1(-9.80%)	-0.1(-11.8%)	-0.09(-7.80%)	-0.1(-9.80%)
Vitamin B12	-0.0000001(-6.70%)	-0.000002(-14.0%)	-0.00001(-633.3%)	-0.00001(-687.9%)

-ve – Enhancenment
+ve – Reduction

However, in the fat-soluble vitamin group, the highest level of enhancement was observed among the samples as follows; vitamin K(–10.1) while the least enhancement was found in vitamin E (–5.10).

For *pennisetum glaucum* sample among the water-soluble vitamins, the highest enhancement was observed in B_9 (–21.0) while other enhanced vitamins were observed as B_5 (–11.8); B_{12} (– 140) B_3 (– 13.6) and C (– 13.7), B_6 (– 0.7), B_1 (– 1.0) and B_2 (– 7.4). However, in fat-soluble vitamins group, the highest enhancement were found in A (–19.4%), average enhancement was find in vitamin D (– 12.4) while the least enhanced vitamins were vitamin k (– 3.50) and E (– 7.40). The various levels of enhancements noticed in the sprouted samples might be due to the fact that the vitamins were not concentrated in the embryo (Rickman et al., 2007a). Rickman et al., 2007ab reported that processing charges the colour, texture, flavor and nutritional qualities of many fresh seed and vegetables. On a general note, the results have shown that for maximum access to these vitamins, during consumption, it is more advantageous to sprout the sorghum bicolor and pennisetum glaucum seeds prior nutritional application.

The result of the statistical analysis (linear correlation at r=0.05) Rxy, CA and IFE of data, from Table 2 are shown in Table 3 below.

In table 3, the rx levels were positively high (0.99816-0.99992) whereas the Rxy ranged from 0.88164 to 0.94550. as the rxy were significant at r=0.05 and n-2 degree of freedom. The coefficient of alienation (CA) ranged from 0.01-0.06% whereas the corresponding index of forecasting efficiency (IFE) ranged from 94.4 to 98.7%.

Table 3 Statistical analysis (linear correlation and regression) of Data from table 1

Groups	Correl (rxy)	Determ. (Rxy^2)	Regress (Rxy)	CA	IFE	Critical Table value (Tv)	REMARK
UWSB/SWSB	0.99992	0.99984	0.94550	1.22	98.7	0.5341	S
UPG/SPG	0.99961	0.99922	0.88399	2.77	97.2	0.5341	S
UWSB/UPG	0.99816	0.99632	0.94193	6.05	93.8	0.5341	S
SWSB/SPG	0.99896	0.99793	0.88164	4.54	95.4	0.5341	S

C_A= coefficient of alienation, IFE = index of forecasting efficiency,
TV = critical (table) value at r =0.05, S = significant.

Taking UWSB/SWSB (row1) as example, a high IFE (98.7%) and a corresponding low CA (0.01%) indicated that there is a reduction of 98.7% ini the error of prediction of relationship between the unsprouted and sprouted white *sorghum bicolor* flour vitamin contents. Furthermore, the high IFE is an indication that the unsprouted (UWSB) can easily replace the sprouted (SWSB) in the biochemical activities vice versa. The result of the *Pennisetum glaucum* follow these trends.

Generally, water-soluble vitamins as C and B and the polyphenols are degraded by processing treatments and maybe leached into water times. Fat soluble nutrients such as A and E and the carotenoids may be released from their cellular matrices by thermal, freezing and high pressure treatments.

In this research work all, the water-soluble vitamins were enhanced at various degrees and percentage by sprouting except B_6 in white *Sorghum bicolor* while in all the fat soluble vitamins for all the samples, there were enhancement except for that of vitamin A and D in white *sorghum bicolor*.

The result of this research compares favourably with that of research done on effect of sprouting time on biochemical and nutritional qualities of mungbean varieties. (Sayed *et al.*, 2011).

IV. Conclusions And Recommendations

In all the samples the levels of vitamins were enhanced by sprouting vitamin B_9 was the most concentrated or enhanced water-soluble vitamins in both sprouted white *Sorghum bicolor* and *Pennisetum glaucum*. comparatively for the fat soluble vitamins, white sorghum bicolor experienced enhancement and the highest level in vitamin K while *Pennisetum glaucum* experienced the highest enhancement level in vitamin A. Conclusively with critical observation both water and fat soluble vitamins in *Pennisetum glaucum* are highly or more enhanced than that of white *Sorghum bicolor*. Both unsprouted and sprouted samples (white *Sorghum*

bicolor and *Pennisetum glaucum*) contained both fat and water-soluble vitamins with the most concentrated being vitamin A. Although the levels recorded in all the samples in the present research could not meet up meet up with the recommended daily allowance but could serve complementary role nutrition. On the basis of these conclusions, the following recommendations were made. Sprouted white *Sorghum bicolor* and *Pennisetum glaucum* seed flowers could be relied upon as a good cheap for supplement for fat and water soluble vitamins.

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