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Full Length Research Paper

Screening for cyanide in selected food stuffs and its possible effects on the level of Vitamin B complex in the food samples

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Food crops namely sorghum, soybean, palm kernel, melon and groundnut were randomly selected from market in Oyo and Ogun states. The samples were finely ground, labeled (AW, AR, B, C, D and E) and analyzed spectrophotometrically for cyanide (bound, free and total), thiocyanide and vitamin B-complex concentrations. From the results, it was observed that cyanide was only present in sorghum and palm kernel samples. Absence of cyanide was observed in soybean, melon and groundnut. Red sorghum was observed to have significant (p<0.05) high total cyanide concentration compared with white sorghum from both Oyo and Ogun state markets. Both the red and white sorghum species from Ogun state contained significant (p<0.05) high concentration of total cyanide and thiocyanide respectively compared to those samples purchased from Oyo state. This seems to be influenced by climatic or soil factors. It was noted that palm kernel from both states had lower concentrations of thiocyanide and total cyanide in comparison to sorghum. There was no significant difference (p > 0.05) between the concentrations of the vitamin B-complex in sorghum as compared to that of non-cyanide containing samples. This implies that the presence of cyanide might have no observable effect on vitamin B-complex synthesis in the plant samples.

Keywords: Cyanide, Thiocyanide, Vitamin B, Spectrophotometric, Food crops.

INTRODUCTION

Man's dependence on plants for food is universal. Food crops are grown in greater quantities to provide more energy worldwide and hence, constitute a major portion of man's food. In Nigeria, there are various types of food crops which are cultivated in various areas and locations. Which include melon, palm kernel, sorghum, groundnuts, cassava and many more (Vennesland et al., 1982). Considering all the phytotoxins traced in human food crops, cyanide has commanded greater attention than any other due to its toxicity. Besides, it is found in cassava, one of the most popular food crops consumed by man and live stocks in the tropical region such as tropical Africa. Cassava plays a major role in alleviating the African food crisis because of its efficient production of energy, year round availability, tolerance to extreme climatic stress conditions and suitability to present farming and food systems in Africa (Hahn and Keyser, 1985, Hahn et al., 1987). The roots and leaves contain varied amount of cyanide which is toxic to human and animal and may be in the form of linamarin or lotaustralin. This cyanogenic glucoside liberates hydrogen cyanide (HCN) upon hydrolysis by the endogenous linamarase (Dufour, 1994). Cyanogenic glycosides are phytotoxin which occur in at least 200 plant species, of which a number of species are used as food in some areas such as Zaire, Congo, Gabon, Central African Republic, Angola, Sierra Leone and Liberia. Sorghum and cassava are important staple foods known to contain cyanogenic glycosides (Oke, 1979). Consumption of food substances

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Table 1. Sample labeling by location.

Samples	Location	
	Ogun state	Oyo state
Red sorghum	AR2	AR1
White Sorghum	AW1	AW2
Soybean	B1	B2
Palm kernel	C1	C2
Melon	D1	D2
Groundnut	E1	E2

containing hydrogen cyanide (HCN) may cause death within few minutes to 3 hrs, depending on the concentration consumed in the food (Humbery et al., 2000). Death has also occurred in young children after eating food crops and other seeds containing cyanogenic glycoside (Sayre and Kamal, 2004).

The toxic action of HCN is due to the cyanide ion whose toxic properties are shared by all the soluble inorganic cyanide salts present in the food sample (Smith, 2003). The effect of cyanide in cassava has been well documented; however, not many studies have been done on other common food materials such as groundnut, melon, soybean, palm kernel and others. Since the residual cyanide ion in cassava products have been reported to be sufficiently toxic (Adeyemi et al., 2004) to cause death (Humbert et al., 2000) and considering the rate of consumption of the products of these food stuffs by our people, we therefore decided to screen for cyanide in a number of common food stuffs (melon, groundnut, sorghum, palm kernel, soybean) and assess their possible effects on the level of vitamin B complex in the food samples.

MATERIALS AND METHODS

All reagents used were of analytical grade and supplied by Sigma Incorporated, USA.

Samples Collection and Preparation

Twelve samples of the food crops were collected from markets in Oyo and Ogun states. The samples were prepared by grinding them into a fine powder using Hammer laboratory mill. And labeled as shown in Table 1.

Extraction of Cyanide from Samples

In determining the cyanogenic potential of a sample, an extract is made from the sample using cold orthophosphoric acid. The acid prevents linamarase from degrading cyanogenic glycosides and stabilizes the cyanohydrins. At low temperature, the evaporation of hydrogen cyanide was reduced. A weight of 1g of each collected samples was added with 100 ml of cold 0.1 M orthophosphoric acid. The mixture was properly homogenized using glass rod. The homogenate obtained was centrifuged at speed of 2000rmp for period of 5 minutes at 25°C and the supernatant was decanted, 2.5 ml aliquots of this extract were taken for determination of bound cyanide, free cyanide and thiocyanide.

Assay methods

Bound cyanide concentration was determined as described by Kruse et al., 1993. Free cyanide concentration was determined according to the methods by Bradbury et al., 1991. Thiocyanide concentration was determined as described by Kruse et al., 1993. Vitamin B complex (B1, B2, B3, B6 and B9) levels were determined as detailed by A.O.A.C. 1990.

Statistical Analysis

The values were expressed as mean ± SEM (Standard Error Measure). The statistical analysis was carried out by one way analysis of variance (ANOVA). The Pearson value ($p<0.05$) was considered significant using Statistical Package for Social Sciences (SPSS) version 18.

RESULTS

Both white and red sorghum purchased from Oyo and Ogun states showed significantly ($p<0.05$) higher concentration in total cyanide whereas there was no presence of cyanide detected in soybean, melon and groundnut. Palm kernel purchased from both states showed significant ($p<0.05$) lower total cyanide concentration compared with sorghum (Figure. 1). There is no significant difference ($p > 0.05$) in thiocyanide concentration between sorghum and palm kernel samples (Figure 2). All the tested samples showed the

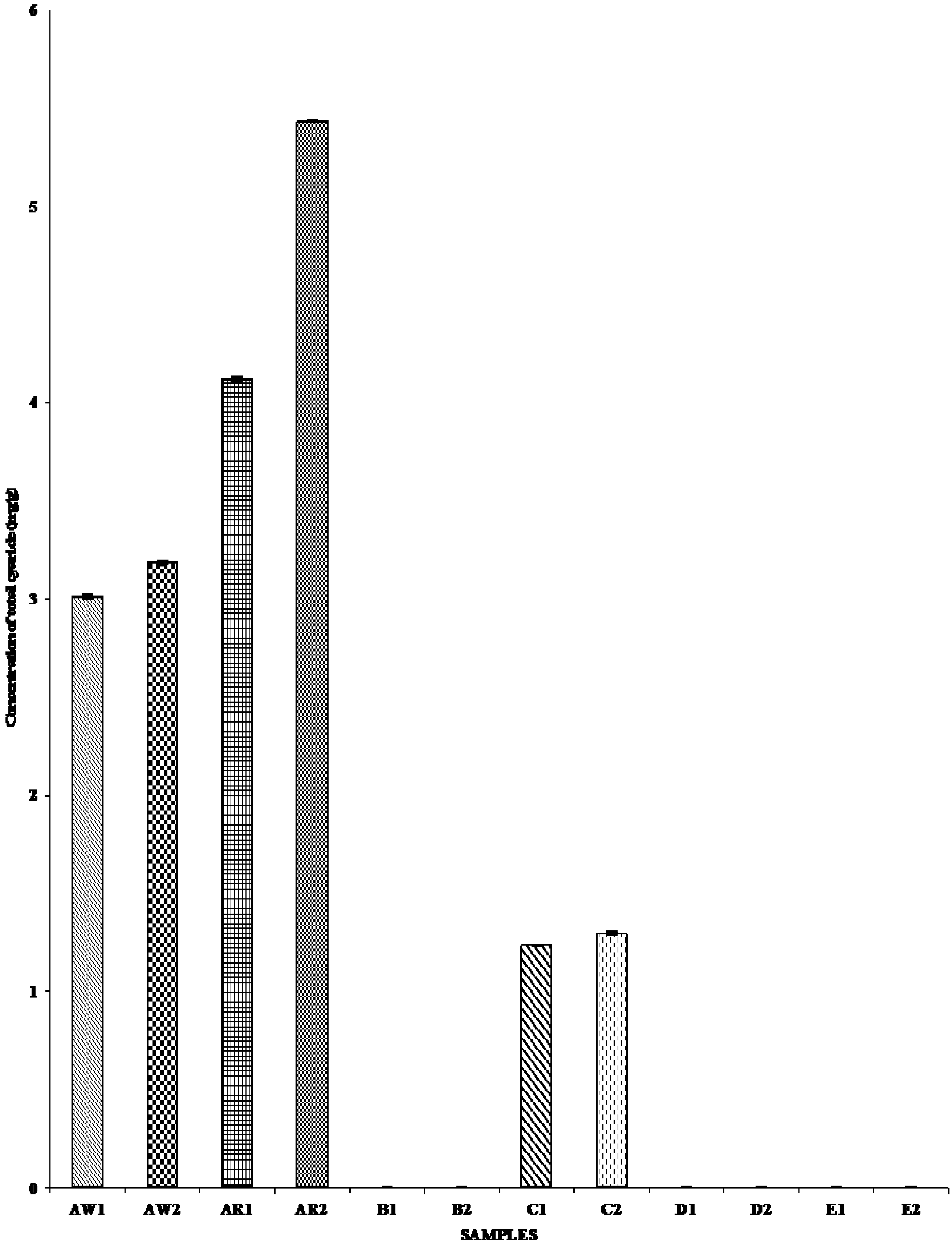

Figure 1. Total Cyanide (CN^-) Concentration.

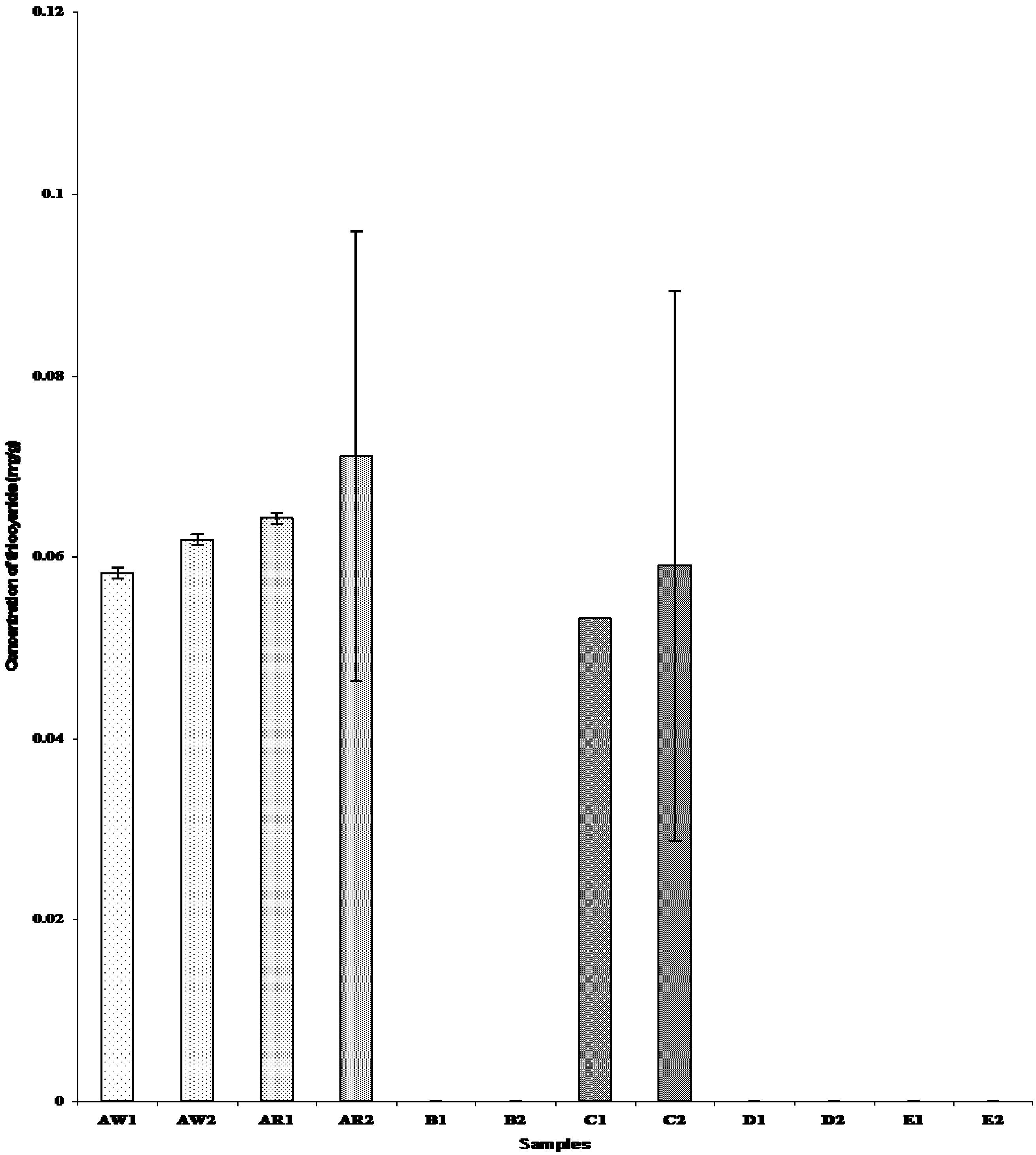

Figure 2. Concentration of Thiocyanide (SCN)

presence of Vitamin B-complex at varying concentration. All samples showed significant ($p<0.05$) higher vitamin B9 concentration in comparison with other vitamin Bs, the samples showed non-significant ($p>0.05$) lower concentration of vitamin B2 compared to other vitamin Bs (Table 2). Table 2 showed combined representation of total cyanide, thiocyanide and vitamin B-complex concentrations in the tested samples. It was observed that, the concentration of total cyanide and thiocyanide showed non-significant ($p>0.05$) difference in the concentration of vitamins in the tested samples (Table 2).

Table 2. Combine Representation of Total cyanide, Thiocyanide and Vitamin B-complex Concentration in the Samples (mg/g).

Samples	Total cyanide	Thiocyanide	Vit. B_1	Vit. B_2	Vit. B_3	Vit. B_6	Vit. B_9
AW1	3.0116 ±0.0101	0.0582 ±0.0006	1.9200 ±0.1280	0.0300 ±0.0050	0.9360 ±0.0780	0.7155 ±0.0265	5.0074 ±0.3129
AW2	3.1865 ±0.0101	0.0619 ±0.0006	3.0720 ±0.2560	0.0375 ±0.0025	1.3260 ±0.0780	0.9010 ±0.0000	6.8852 ±0.3129
AR1	4.1218 ±0.0101	0.0643 ±0.0006	3.5840 ±0.2560	0.0525 ±0.0025	1.4040 ±0.0780	1.0865 ±0.0265	5.4769 ±0.1565
AR2	5.4368 ±0.0028	0.0711 ±0.0248	4.6080 ±0.0000	0.0875 ±0.0025	1.870 ±0.0780	1.3780 ±0.0000	7.9806 ±0.1565
B1	0.0000 ±0.0000	0.0000 ±0.0000	3.8400 ±0.2560	0.0350 ±0.0050	0.6250 ±0.0780	0.7155 ±0.0265	5.0074 ±0.0000
B2	0.0000 ±0.0000	0.0000 ±0.0000	5.3760 ±0.0000	0.0500 ±0.0050	1.0140 ±0.0780	1.2455 ±0.0265	8.6065 ±0.1565
C1	1.2367 ±0.0036	0.0533 ±0.0000	0.8960 ±0.1280	0.0125 ±0.0025	0.2340 ±0.0780	0.2385 ±0.0265	2.0343 ±0.4694
C2	1.2949 ±0.0087	0.0591 ±0.0303	0.3840 ±0.1280	0.0250 ±0.0000	0.5460 ±0.0780	0.4770 ±0.0000	4.0685 ±0.0000
D1	0.0000 ±0.0000	0.0000 ±0.0000	3.9680 ±0.1280	0.0700 ±0.0050	0.6240 ±0.0780	0.5565 ±0.0265	5.1639 ±0.1565
D2	0.0000 ±0.0000	0.0000 ±0.0000	4.6080 ±0.2560	0.0850 ±0.0850	1.0920 ±0.0780	0.8480 ±0.0000	9.0760 ±0.0000
E1	0.0000 ±0.0000	0.0000 ±0.0000	3.5840 ±0.2560	0.0650 ±0.0650	1.3260 ±0.0780	0.8215 ±0.0265	3.9120 ±0.1565
E2	0.0000 ±0.0000	0.0000 ±0.0000	4.3520 ±0.2560	0.0800 ±0.0050	1.9450 ±0.0700	1.1130 ±0.0000	5.6333 ±0.3130

DISCUSSION

Cyanide is known to bind and inactivate enzymes in the body, it is thought to exert its ultimate lethal effect of histotoxic anozia by binding to the active site of cytochrome oxidase thereby stopping aerobic cell metabolism (Sayre and Kamal, 2004). The binding appears to occur on neuronal transmission, cyanide is readily diffusible through the epithelium. The most important route of cyanide excretion is by formation of a thiocyanate (SCN¬-), which is subsequently excreted in the urine (Vennesland et al., 1982). From the result of the experiment, it was observed that the concentration of total cyanide of white and red sorghum collected from Oyo state is significantly ($p<0.05$) increased compared with the concentration of sorghum collected from Ogun state. These suggest that cyanide content of white and red sorghum from Oyo state contains an apparent safer cyanide concentration compared with their counterpart from Ogun state. This difference might have resulted from different in the climatic, edaphic or environmental factors.

The results also showed no detectable level of cyanide in soybean, melon and groundnut samples purchased from both states. This suggests apparent cyanide safety in the consumption of these plant materials from either state. The result showed low thiocyanide concentration in sorghum and palm kernel samples from both states. However, the concentration of thiocyanate in red sorghum from Oyo state was significantly ($p<0.05$) lower compared with those from Ogun state. Similar trend was also observed in white sorghum. The kernel sample from Ogun state also contains significantly ($p<0.05$) higher concentration in thiocyanate compared with those from Oyo state.

Vitamin B complex is a large group of water soluble vitamins that are found in grains, cereals and peas. The members of the groups are very vital for several biochemical reactions in the living system (Sethi et al., 2005). Both white and red sorghum from Oyo state showed significant ($P<0.05$) reduction in vitamin B1 concentration compared with their counterpart from Ogun state. The same result was observed in the presence of vitamin B2, B3, B6 and B9 in sorghum and other tested samples from Ogun state. Following similar trend, the concentration of vitamin B complex in melon, palm kernel, soybean and groundnut purchased from Ogun state were found to be significantly ($p<0.05$) higher in comparison with same samples from Oyo state. The concentration of vitamin B complex estimated in this study showed slight variation from the value estimated by Symolon et al., 2003. This slight variation might be as a result of environmental or edaphic factors. It was also observed that, the concentration of cyanogens compounds in the samples does not influence the synthesis of vitamin B complex in the plant samples studied.

CONCLUSION

From the study, it was observed that, the presence of cyanide or thiocyanide might not have any definite influence on the concentration of vitamin B complex in the studied samples. Furthermore, the differences observed in parameters analyzed among the samples from the two states might be as a result of climatic, edaphic, environmental factor or species variation.

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