Assessment of Chemical Composition, Variability, Heritability and Genetic Advance in *Tetrapluera Tetraptera* Fruits

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Abstract
Fruits of six genotypes of Tetrapluera tetraptera collected from six States in Southern Nigeria were analyzed for proximate, minerals, vitamins and phytochemical composition. The aims were to determine nutrient composition as well as variations among them, estimate the proportions of heritable and non-heritable components, and expected genetic advance. The determinants were replicated 3 times in completely randomized design. Analysis of variance showed that proximate, minerals, vitamins and phytochemical were significant ($P< 0.01$). The results showed that the fruit is a good source of essential nutrients, minerals (potassium, iron, and calcium), vitamins A, B-complex; C and E. Heritable variations among the genotypes were observed in their ether, protein, crude fibre, potassium and Vitamin A contents. Selection based on these traits could lead to improvement of nutritional and phytochemical composition of T. tetraptera fruits, for more availability and consumption by average Nigerians.

Introduction

Tetrapleura tetraptera, known as Aridan (fruit) in Western Nigeria is a medicinal plant of the Fabaceae family, generally found in the lowland forest of tropical Africa. The fruit consist of pulp with small, brownish-black seeds, with a fragrant, characteristic pungent aromatic odour (Aladesanmi, 2007). It is a popular seasoning spice in Southern Nigeria (Okwu, 2003; Essien *et al*., 1994). Its fruit is used for the management of convulsions, leprosy, inflammation, rheumatism flatulence, jaundice and fevers. The anticonvulsant activity of the volatile oil from fresh fruits of *T. tetraptera* in mice has been reported (Ojewola and Adesia, 1993). Its leaves are essential for the treatment of epilepsy (Akah and Nwabie, 1993). The fruit is also used locally in the management and control of adult-onset type 2 Diabetes mellitus. The aqueous fruit extract has also been shown to possess hypoglycemic properties. It has been suggested that the plant should be used in formulating drugs (Abii and Elegalam, 2007). *T. tetraptera* is one of the most valued forest species in Nigeria that is facing ecological threat of extinction caused by deforestation as a result of timber and non timber values. Available information on the bioactive composition of *T. tetraptera* is limited to studies based on a few accessions (Abii and Elegalam

2007, Bouba *et al*,.2012). In addition, little is known about the genetic variations of the leaves of different genotypes for proximate, mineral, vitamin and phytochemical compositions which are fundamental to improvement of the crop. Improvement of any crop is dependent on the magnitude of genotypic variability and the extent to which desirable characters are heritable (Johnson et al.,1955). Thus, this research was aimed at examining the proximate, phytochemical, vitamin and mineral contents, determine the phenotypic and genotypic variations as well as estimate the heritable and non heritable components, heritability and genetic advance of dry fruits of *T. tetraptera* genotypes collected from six States in Southeastern Nigeria.

Materials and Methods

Mature pods of six genotypes of *T. tetraptera* were collected from six different States in Southern Nigeria (Umuahia, Umuahia South Local Government Area of Abia State, Abakiliki in Abakiliki Local Government Area of Ebonyi State, Urua-atu in Ikot Ekpene Local Government Area of Akwa Ibom State, New market, Aria Road in Enugu Local Government Area of Enugu State, Portharcourt in Rivers State and Onitsha in Anambra State. They were washed with distilled water and sundried for three days. The dried fruits were pulverized into fine powder using a grinder, then sieved through mesh sieves (1 mm) and stored in air tight bottles. These were then used for the various analyses.

Proximate analysis

Moisture, ash, crude protein and crude fat were determined using the methods of (Udo et al., 2009), nitrogen free extract (NFE) referred to as soluble carbohydrate was obtained by subtracting all the other components from 100%. NFE = 100- (% ash+ %crude fibre + %crude protein + %moisture).

Vitamin and mineral analysis

Vitamins A and E contents were estimated by the methods described by Pearson (1976); vitamin C was estimated as described by Kirk and Sawyer (1998), B complex vitamins (thiamine, riboflavin and niacin), zinc and iron were estimated as described by James (1995). Phosphorus, Calcium, Potassium, Sodium and Magnesium were estimated by AOAC methods (AOAC,2000).

Phytochemical analysis

Alkaloids, flavonoids, saponins, phenols, tannins, sterols, oxalate and phytate were estimated by the methods described by Harborne (1973) and Edeoga *et al*. (2005).

Data analysis

Data were analyzed by one way analysis of variance and significant means separated with the least significant difference (Snedeco and Cochran, 1989).The gross variability was partitioned into genetic and non- genetic components. Phenotypic, Genotypic and error variances were estimated using the method of Wricke and Weber (1986)

$\sigma^2 P = \frac{MSG,}{r}, \sigma^2 G = \frac{MSG-MSE}{r}, \sigma^2 E = \frac{MSE}{r}$ MSG, MSE and r are the mean squares genotypes, mean square error and number of replication respectively. $PCV = \frac{\sigma P}{mean} x \frac{100}{1}$, $GCV = \frac{\sigma G}{mean} x \frac{100}{1}$. PCV, GCV and ECV are phenotypic, genotypic and environmental coefficients of variations respectively. Broad sense heritability (h^2B) was expressed as the ratio of genotypic (σ^2G) to the phenotypic (σ^2P) variances as described by Allard (1991). Genetic advance (GA) was estimated with the method of Fehr (1987), using the formula, GA = $K(Sp)h^2B$. K is the standardized selection differential at 5% (K=2.063), sp is the phenotypic standard deviation σP; h^2B is the broad sense heritability. Genetic gain (GG) was determined from genetic advance (GA) expressed as a percentage of the population mean.

Results and Discussion

The *T.tetraptera* genotypes were significantly different (P<0.05) in proximate, vitamins, minerals and phytochemical compositions (Table 1). From Table 2, genotypes obtained from Akwa Ibom (9.18%) and Abia State (8.465%) had the highest and lowest protein contents respectively, while Enugu (88.23%) and Port Harcourt (84.63%) had the highest and lowest dry matter content respectively. Genotypes from Anambra (3.25%) and Ebonyi State (2.74%) had the highest and lowest ash content respectively, while genotypes from Abia (25.44%) and Enugu (22.74%) had the highest and lowest fibre content respectively. Genotypes from Enugu (53.73%) and Portharcourt (48.33%) had the highest and lowest carbohydrate content respectively. Genotypes from Ebonyi (11.05%) and Anambra State (9.16%) had the highest and lowest ether content, while genotypes from Port Harcourt (15.37%) and Enugu State (11.77%) had highest and lowest moisture content. Moisture content of these genotypes was slightly higher than that reported by Bouba et al. (2012) in this plant. Moisture content of any food is an index of its water activity and is used as a measure of stability and susceptibility to microbial contamination (Darey,1989, Chinatu and Ukpaka, 2016). The low moisture content of *T.tetraptera* corroborates its resistance in nature to microbial spoilage, leading to improved shelf life of the fruits. Fibre content of these genotypes was higher than that reported by Dike (2010) in Portulaceae, and Cucurbitaceae leaves and Chinatu and Ukpaka (2016) in *P.guineense* leaves. Hence, it is a good source of dietry fibre for bowel movement. Diet low in fibre could cause constipation, pile, appendicitis and cancer (Ekeanyanwu *et al*., 2010).Inclusion of *T. tetraptera* fruits in diets could prevent constipation and diseases associated with colon. They are of immense help to those suffering from elevated cholesterol level (Zhao

Table1: Variance ratio of proximate, vitamins, minerals and phytochemical composition of fruits of six genotypes of *T. tetraptera* from Nigeria.

Parameter	Mean square Genotype	Error	Variance ratio
Proximate			
Ash	0.1256	0.0006	213.2500***
Ether Extract	1.5579	0.0017	890.2500***
Crude Fibre	3.4029	0.0062	542.5400***
Dry Matter	5.1906	0.0055	932.4500***
Moisture	5.1907	0.0056	930.5200***
Content	8.7170	1.0460	8.3300***
Carbohydrate			
Protein	0.2316	0.0023	98.6900**
Vitamins			
Vitamin A	1.24320	0.00135	915.2400***

Vitamin B1	0.10470	0.00075	139.6000***
Vitamin B2	0.00493	0.00278	18.2100***
Vitamin B3	0.03677	0.00025	147.0800***
Vitamin C	0.01008	0.00236	4.2600**
Vitamin E	0.81453	0.00079	1027.0800***
Minerals			
Calcium	1.47843	0.00074	1993.3900***
Magnesium	1.02178	0.00103	987.5000***
Sodium	0.06839	0.00182	37.5600***
Potassium	1.58783	0.01137	139.5900***
Phosphorus	0.08000	0.00143	55.8100***
Iron	1.09130	0.00404	270.0100***
Zinc	0.53183	0.00182	292.0800***
Phytochemical			
Flavenoid	0.00320	0.00102	3.1500*
Alkaloids	0.06820	0.00011	64.1900***
Tannin	0.00330	0.00034	9.7600***
Saponin	0.00183	0.00039	4.6700**
Phenol	0.00199	0.00020	9.7700***
Steroid	0.00193	0.00057	3.3900*
Oxalate	0.00290	0.00029	9.9400***
Phytate	0.00383	0.00049	7.8600**

*****= Significant at 5% probability, ******= Significant at 1% probability, *******= Significant at 0.1% probability

*et a*l., 2007). Protein content of the genotypes was higher than that reported by Dike (2010) on Portulaceae (2.40%) and Cucurbitaceae (4.20%) leaves. High protein content of *T. tetraptera* fruits could have supplementary effect for the daily protein requirements of the body.

Table 2. Proximate composition of fruits of six genotypes of *T. tetraptera* from Nigeria

Genotypes	**Nutrient**						
	Moisture Content (%)	**Dry Matter (%)**	**Ash (%)**	**Crude Fibre (%)**	**Ether Extract (%)**	**CHO (%)**	**Crude Protein (%)**
Portharcourt	**15.3700**	**84.6300**	**2.8800**	**24.6800**	**9.4500**	**48.33**	**8.7400**
Akwa Ibom	**14.2700**	**85.7300**	**2.9000**	**22.8120**	**10.6600**	**50.84**	**9.1800**
Abia	**12.8400**	**87.1600**	**3.1800**	**25.4400**	**10.1900**	**49.89**	**8.4650**
Enugu	**11.7700**	**88.2300**	**3.1500**	**22.7400**	**9.8200**	**53.73**	**8.6100**
Anambra	**13.8400**	**86.1600**	**3.2533**	**23.5300**	**9.1600**	**50.34**	**9.0400**
Ebonyi	**14.7600**	**85.2400**	**2.7400**	**23.5900**	**11.0500**	**50.30**	**8.6100**
Lsd $_{0.05}$	**0.1327**	**0.1327**	**0.0413**	**0.1409**	**0.0744**	**1.820**	**0.0866**

The vitamins composition of the fruits of the genotypes is presented on Table 3. The genotypes from Enugu (12.81 ug/g) and Anambra State (10.87ug/g) had the highest and lowest Vitamin A content respectively. Genotypes from Enugu (0.0585mg/100g) and Port-Harcourt States (0.042mg/100g) had highest and lowest Vitamin B_1 content respectively. The genotypes from Abia (0.680mg/100g) and Anambra (0.530 mg/100g) had the highest and lowest Vitamin C content respectively, while Anambra (8.265mg/100g) genotype had the highest Vitamin E content. Klin-Kabari *et al*., (2011) reported that *T. tetraptera* contains large amounts of beta-caryophyllene, an anti-inflammatory agent. The Vitamin C content of these accessions compared favorably with Vitamin C content of *P. nigrum* (Nwofia *et al*., 2013). Consumption of *T.tetraptera* makes available to the body vitamins B complex and C which are good sources of antioxidants and are needed for the formation of enzymes that are essential for optimum health. Vitamin C is the primary soluble anti-oxidant which prevents damage in the aqueous environment in and outside the cells. The antioxidant properties of vitamin C stabilize folate in food and in blood plasma. A common feature of vitamin C deficiency is anaemia. It's deficiency impairs the normal formation of intercellular substances throughout the body, including collagen, bone matrix and tooth dentine. Vitamins A and C are involved in bone formation (Wright, 2002). In conjunction with other antioxidants, vitamin E provides protection from free radicals and products of oxygenation. It also inhibits lipoxygenase, an enzyme responsible for the formation of pro-inflammatory leukotrienes, (Anon. 2002). These underline the importance of the fruits for the good health of poor and average Nigerians

Table 4: Minerals composition of fruits of six genotypes of *T. tetraptera* from Nigeria.

Genotype	**Minerals**						
	Calcium	**Magnesium**	**Sodium**	**Potassium**	**Phosphorus**	**Iron**	**Zinc**
	mg/100g						
Portharcourt	**4.7500**	**2.1700**	**3.1800**	**8.6650**	**1.2600**	**5.5750**	**2.2600**
Akwa Ibom	**3.8800**	**2.6200**	**3.0400**	**8.1050**	**0.9400**	**6.1000**	**3.2200**
Abia	**4.1350**	**3.0750**	**2.8450**	**7.6400**	**0.8700**	**5.1950**	**2.7400**
Enugu	**5.2800**	**2.5400**	**2.8700**	**7.1600**	**1.1400**	**4.8400**	**3.1600**
Anambra	**5.7700**	**3.6817**	**2.8700**	**6.9300**	**0.9300**	**6.4500**	**3.2500**
Ebonyi	**4.6650**	**2.1650**	**3.1500**	**8.5750**	**1.2000**	**5.2700**	**2.4850**
Lsd $_{0.05}$	**0.0484**	**0.0572**	**0.0759**	**0.1897**	**0.0673**	**0.1131**	**0.0759**

Table 3. Vitamins composition of fruits of six genotypes of *T. tetraptera* from Nigeria.

Genotype	**Vitamin**					
	A (ug/g)	**B_1 (mg/100g)**	**B_2 (mg/100g)**	**B_3 (mg/100g)**	**C (mg/100g)**	**E(mg/100g)**
Portharcourt	**11.675**	**0.0420**	**0.0330**	**1.6800**	**0.540**	**6.7500**
Akwa Ibom	**11.390**	**0.0530**	**0.0250**	**1.8400**	**0.630**	**7.8733**
Abia	**11.465**	**0.0480**	**0.0225**	**1.5300**	**0.680**	**7.2500**
Enugu	**12.810**	**0.0450**	**0.0250**	**1.6200**	**0.560**	**7.4100**
Anambra	**10.870**	**0.0475**	**0.0310**	**1.5800**	**0.530**	**8.2650**
Ebonyi	**11.780**	**0.0585**	**0.0290**	**1.7200**	**0.600**	**7.4900**
Lsd $_{0.05}$	**0.0656**	**0.001541**	**0.002928**	**0.02813**	**0.0865**	**0.05010**

Analysis of the mineral contents of the genotypes showed high contents of potassium, Iron and calcium, with moderate magnesium, sodium, zinc and little phosphorus in the fruits, Table 4. Similar results were reported by Bouba *et al*. (2012) in the same plant. Genotypes from Port-harcourt (5.77mg/100g) and Akwa Ibom (3.88mg/100g) had the highest and lowest calcium contents respectively. Genotypes from Anambra (3.6817mg/100g) and Ebonyi (2.165mg/100g) had the highest and lowest magnesium content respectively, while genotypes from Portharcourt (3.18mg/100g) and Abia (2.845mg/100g) had highest and lowest sodium content respectively. Genotype from Anambra (6.93mg/100) and Portharcourt (8.665mg/100) had highest and lowest potassium content respectively, while phosphorus concentration was highest and lowest in genotypes from Portharcourt (1.26mg/100g) and Abia (0.87mg/100g) respectively. Genotype from Anambra had the highest Iron (6.45mg/100g) and Zinc (3.25mg/100) contents, while genotypes from Enugu (4.80mg/100g) and Portharcourt (2.26mg/100g) had the lowest Iron and Zinc contents respectively. High calcium and magnesium are useful in blood maintenance of electrical conductivity in nerve cells, and enzymes activation in metabolic processes and absorption of vitamin B12 (Ekeanyanwu *et al*., 2010). Potassium functions to maintain the normal balance and distribution of fluids throughout the body. The electrolytes, including potassium, are involved in the maintenance of normal pH balance, and work in conjunction with calcium and magnesium in the maintenance of normal muscle contraction and relaxation, and nerve transmission (Akpabio and Akpakpan 2012). Due to the high concentrations of potassium and calcium in *T. tetraptera*, it is administered to people suffering from deficiency of such minerals; hence, it is often given to nursing mothers. Iron, magnesium and zinc strengthen the immune system as antioxidants. Zinc provides natural protective mechanism against viruses that cause respiratory tract infections (Sadler 2004). Iron is important in regeneration of lost blood. Abii and Elegalam (2007) also reported high iron and zinc contents in fruits of *T. tetraptera*.

The result of phytochemical composition of *T. tetraptera* fruits are presented on Table 5. Genotypes from Enugu had the highest concentration of alkaloids and phytate, while genotypes from Abia had the highest concentration of flavonoids, Tannin, Saponin and phenol. Alkaloids, tannins and oxalates content of the fruits were lower than the reports of Dike, (2010) for *P. guineense* while flavonoids content was slightly higher in these genotypes. Tannin and oxalate contents were also lower in this study than those reported by Echo et al. (2012) in *Aframomum melegueta* and Chinatu and Ukpaka (2016) in *P. guineense*. Low phytochemical content normally, lead to better bioavailability and absorption of minerals. High tannin content reduce feed intake, growth rate and protein digestibility in animals (Emebu and Anyika, 2011).

Table 5: Phytochemical composition of fruits of six genotypes of *T*. tetraptera from Nigeria.

Genotypes	Phytochemical							
	Flavenoid	Alkaoid	Tannin	Saponin	Phenol	Sterol	Oxalate	Phytate
	Mg/100g							
Portharcourt	**0.1900**	**1.2350**	**0.2950**	**0.1200**	**0.0870**	**0.1700**	**0.2500**	**0.3900**
Akwa Ibom	**0.2500**	**1.3000**	**0.2600**	**0.1400**	**0.1200**	**0.2000**	**0.1800**	**0.4200**
Abia	**0.2600**	**1.4350**	**0.2600**	**0.1850**	**0.1500**	**0.1800**	**0.2000**	**0.3650**

Enugu	**0.2000**	**1.6600**	**0.2300**	**0.1500**	**0.0940**	**0.1300**	**0.2350**	**0.4600**
Anambra	**0.1800**	**1.4650**	**0.3000**	**0.1800**	**0.1000**	**0.1550**	**0.1750**	**0.4200**
Ebonyi	**0.2200**	**1.3400**	**0.3200**	**0.1467**	**0.1400**	**0.1900**	**0.2300**	**0.4500**
Lsd $_{0.05}$	**0.0567**	**0.0579**	**0.0327**	**0.0353**	**0.0254**	**0.0425**	**0.0304**	**0.0393**

Low tannin content in these genotypes indicated high nutritional value. Alkaloids are beneficial to plants as they repel parasites, but affect glycogen and inhibit some enzyme activities in mammals (Igwe *et al*., 2010). Flavonoids act as anti-oxidants and have been implicated in anti-microbial, anti-inflammatory and anti-viral activities (Nwaogu *et al*., 2008). The moderate levels of flavonoids indicate usefulness of *T. tetraptera* in diets. Oxalate, an anti-nutritional factor interferes with calcium absorption by forming insoluble salts of calcium. The very low level of oxalate showed that the nutrient quality of these genotypes is high, and could improve the diet of Nigerians. The presence of sterols (phytosterols) in a plant is an indication that the plant is a good source of steroidal compounds which are potent precursors for the synthesis of sex hormones (Edeoga *et al*., 2005). Phenolic compounds are potent water soluble antioxidants and free radical scavengers which prevent oxidative cell damage, and have strong anti-cancer activity (Okwu 2004). Saponins act as a deterrent mechanism (stop attacks) by foreign pathogens, making them natural antimicrobials. They are bitter, bind with cholesterol and exhibit haemolytic activity in aqueous solutions (Sodipo *et al*,. 2000).

The estimates of variance components for all the traits showed that the differences between genotypic and phenotypic components were very small, indicating that genotypic component contributed most to the total variance for these traits (Table 6). The variability observed in the proximate, mineral, phytochemical and vitamin composition may be attributed to genetic factor, offering opportunity for selection among these genotypes. Similar results were reported by Baye (2002) on *Venonia galamensis*, Nwofia and Adikibe (2012) in *O. gratissinum* and Chinatu and Ukpaka (2016) in *P. guineense*. Phenotypic, genotypic and environmental coefficients of variability, h_2B, GA and GG were estimated for proximate, mineral, phytochemical and vitamin content (Table7). Phenotypic coefficient of variation (PCV) was slightly higher than genotypic

Table 6: Phenotypic, genotypic and error variances for Proximate, Minerals, Vitamins and Phytochemical composition of fruits of T. *tetrapluera* genotypes from Nigeria.

Parameter	σ^2ph	σ^2g	σ^2e
Proximate			
Ash	**0.0420**	**0.0417**	**0.0006**
Ether Extract	**0.5193**	**0.5187**	**0.0017**
Crude Fibre	**1.1343**	**1.1322**	**0.0063**
Dry Matter	**1.7302**	**1.7265**	**0.0056**
Moisture	**1.7302**	**1.7283**	**0.0055**
Content Carbohydrate	**2.9057**	**2.5570**	**1.0460**
Protein	**0.0772**	**0.0764**	**0.0023**
Vitamins			

Vitamin A	**0.4144**	**0.4139**	**0.0014**
Vitamin B1	**0.0349**	**0.0347**	**0.0007**
Vitamin B2	**0.1644**	**0.1554**	**0.0271**
Vitamin B3	**0.0123**	**0.0122**	**0.0003**
Vitamin C	**0.0034**	**0.0026**	**0.0024**
Vitamin E	**0.2715**	**0.2712**	**0.0008**
Minerals			
Calcium	**0.4928**	**0.4925**	**0.0007**
Magnesium	**0.3406**	**0.3402**	**0.0011**
Sodium	**0.0228**	**0.0222**	**0.0018**
Potassium	**0.5293**	**0.5255**	**0.0114**
Phosphorus	**0.0267**	**0.0262**	**0.0014**
Iron	**0.3637**	**0.3644**	**0.0040**
Zinc	**0.1773**	**0.1766**	**0.0018**
Phytochemical			
Flavenoids	**0.00160**	**0.00073**	**0.00101**
Alkaloids	**0.02273**	**0.02238**	**0.00106**
Tannin	**0.00109**	**0.00098**	**0.00034**
Saponin	**0.00061**	**0.00048**	**0.00039**
Phenol	**0.00067**	**0.00059**	**0.00020**
Steroid	**0.00064**	**0.00045**	**0.00057**
Oxalate	**0.00097**	**0.00087**	**0.00029**
Phytate	**0.00128**	**0.00112**	**0.00049**

Coefficient of variation (GCV), GCV was far higher than environmental coefficient of variation (ECV). This confirmed that heritable variation is present in quantitative traits of the genotypes. The amount of heritable variations and improvement efficiency is related to the magnitude of GCV, h_2 B and GA (Johnson *et al*., 1955).Traits with high GCV, h_2 B and GA could be improved through selection. Such traits include ether extract, crude fibre and Vitamin A.

Conclusion

The high protein, ether extract, crude fibre, potassium, iron, calcium and Vitamin A contents of the dry fruit could have supplementary effect for the daily nutrient and energy requirements of an average Nigerian. There was considerable variability among the genotypes as shown by genetic component analysis. This implies that there exist enough potential for the improvement of the nutritional, mineral and vitamin A content of *T. tetraptera* fruit by selection based on ether extract, crude fibre, potassium and vitamin A content. Such Improvement and increased availability of *T. tetraptera* may contribute meaningfully to improvement in health status of Nigerians.

Table 7: Phenotypic, genotype and environmental coefficients of variations, broad sense heritability and genetic advance of proximate, mineral, vitamin and phytochemical composition of fruits of *T. tetraptera.*

Parameter	Mean	PCV	GCV	H_2B	GA	GG
Proximate						
Ash	**2.5172**	**1.6685**	**1.6567**	**0.9929**	**2.65**	**105.22**

Ether Extract	**10.0550**	**5.1645**	**5.1586**	**0.9989**	**24.16**	**240.37**
Crude Fibre	**23.7990**	**4.7661**	**4.7573**	**0.9981**	**10.37**	**43.56**
Dry Matter	**86.1920**	**2.0071**	**2.0031**	**0.9980**	**5.84**	**6.79**
Moisture	**13.8080**	**12.5304**	**12.5167**	**0.9989**	**7.29**	**52.83**
Content	**50.5667**	**5.7463**	**5.0567**	**0.8800**	**3.16**	**6.26**
Carbohydrate						
Protein	**8.7740**	**0.8798**	**0.8708**	**0.9897**	**1.78**	**20.26**
Vitamins						
Vitamin A	**11.6650**	**3.5525**	**3.5482**	**0.9988**	**13.78**	**118.13**
Vitamin B1	**0.0490**	**71.2244**	**70.8163**	**0.9942**	**0.383**	**95.80**
Vitamin B2	**0.0276**	**596.0841**	**563.0434**	**0.9445**	**0.79**	**197.50**
Vitamin B3	**1.6617**	**0.7402**	**0.7341**	**0.9919**	**0.72**	**43.18**
Vitamin C	**0.5900**	**0.5762**	**0.4407**	**0.7648**	**0.27**	**45.76**
Vitamin E	**7.5064**	**3.6169**	**3.6129**	**0.9988**	**1.13**	**15.04**
Minerals						
Calcium	**4.7500**	**10.3747**	**10.3684**	**0.9993**	**1.45**	**30.47**
Magnesium	**2.7086**	**12.5747**	**12.5600**	**0.9988**	**1.20**	**44.38**
Sodium	**2.9920**	**0.7620**	**0.7420**	**0.7420**	**0.73**	**24.43**
Potassium	**7.8530**	**6.7401**	**6.6917**	**0.9928**	**1.50**	**18.96**
Phosphorus	**1.0567**	**2.5267**	**2.4794**	**0.9813**	**1.05**	**98.99**
Iron	**5.5720**	**6.5990**	**6.5398**	**0.9910**	**1.24**	**22.25**
Zinc	**2.8530**	**6.2145**	**6.1900**	**0.9961**	**0.87**	**30.33**
Phytochemical						
Flavenoids	**0.2167**	**0.73835**	**0.3369**	**0.4562**	**0.38**	**175.36**
Alkaloids	**1.4058**	**1.6169**	**1.5920**	**0.9846**	**0.31**	**21.78**
Tannin	**0.2775**	**0.3928**	**0.3532**	**0.8991**	**0.06**	**22.07**
Saponin	**0.1536**	**0.3971**	**0.3125**	**0.7870**	**0.04**	**26.10**
Phenol	**0.1152**	**0.5816**	**0.5121**	**0.8806**	**0.05**	**40.82**
Steroid	**0.1708**	**0.3747**	**0.2635**	**0.7031**	**0.04**	**21.48**
Oxalate	**0.2117**	**0.4582**	**0.4110**	**0.8969**	**0.06**	**27.22**
Phytate	**0.4175**	**0.3066**	**0.2683**	**0.8750**	**0.06**	**14.62**

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