Characterization of the ripe edible Sheanut (*Vitellaria paradoxa* C.F. Gaertn.) fruit pulp for dietary minerals and metabolites in Ghana

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Tshwane University of Technology
We empower people

Shea trees

Previously
Butyrospermum parkii

Now
Vitellaria paradoxa subsp. *paradoxa* C.F. Gaertn (West Africa)
Vitellaria paradoxa subsp. *nilotica* C.F. Gaertn (East Africa)

(Ferris *et al*., 2001).

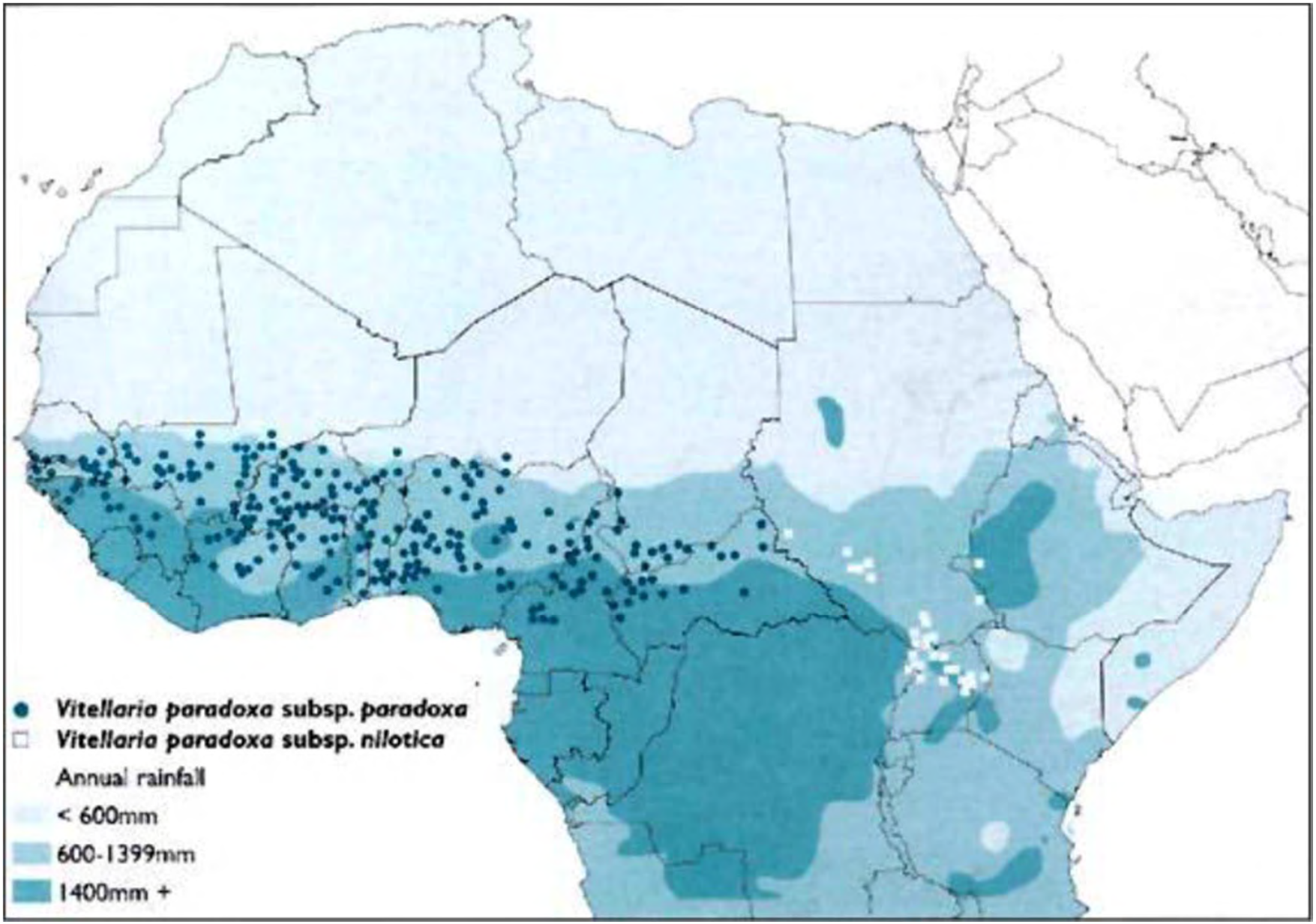
Background/Distribution

- Shea trees grow across a 5 000 km wide Savanna ("Shea belt")

- Distribution in West Africa: Senegal, Mali, Ĉote d'Ivoire, Burkina Faso, Togo, Ghana, Benin, Nigeria, Niger, Cameroon (Maranz *et al*., 2003; Masters *et al*., 2004)

- Distribution in East Africa: Uganda, Sudan and Ethiopia (Chalfin, 2004; Goreja, 2004)

- Ghana and Burkina Faso are the main Shea nut exporters (Walter *et al*., 2003)


Vitellaria paradoxa subsp. paradoxa
Vitellaria paradoxa subsp. nilotica
Annual rainfall
< 600mm
600-1399mm
1400mm +

Uses of the Shea tree

- Wood used as timber
- Dead plants used as firewood
- Shea nut used for extracting butter
- Shea butter used as cooking oil
- Shea butter used in cosmetic and pharmaceutical industry
- Shea meal used as feedstuff to poultry
- Shea fruit eaten as food

Sources: Lovette and Haq (2000), Dei *et al*., (2006), Davrieux et al. (2010), Warra (2001)

Source: http://commons.wikimedia.org

AIM

- To characterise the dietary value of edible Shea fruit pulp

METHODOLOGY

- Air-dried pulp (pericarp) of ripe and unripe Shea fruit was ground to fine powder (0.85 mm)
- Sub-samples were digested and analysed for nutrient elements using inductively coupled plasma-mass spectrometry (ICP-MS)
- Sub-samples were dissolved in de-ionized water, centrifuged, and analyzed for amino acids, sugars and organic acids using HPLC technique

RESULTS

Table 1 Macronutrient concentration in ripe Shea fruits sampled from four different locations in Ghana.

Location	P	K	Ca	Mg	S	Na
			mg/kg			
Kpongu	0.60±0.05	14.58±1.05	1.92±0.16	1.04±0.16	0.44±0.04	50.00±5.59
Dandafuro	0.80±0.10	13.94±0.81	1.46±0.35	0.88±0.18	0.44±0.10	41.20±4.69
Kurikpara	0.82±0.19	14.06±1.23	2.26±0.36	0.94±0.05	0.50±0.05	56.60±9.61
Nakor	0.68±0.06	13.38±0.98	2.08±0.24	1.04±0.07	0.50±0.03	61.20±16.19
F-statistics	**0.78^{ns}**	**0.23^{ns}**	**1.39^{ns}**	**0.36^{ns}**	**0.31^{ns}**	**0.74^{ns}**

Table 2 Trace element concentration in ripe Shea fruits sampled from four different locations in Ghana.

Location	Fe	Cu	Zn	Mn	B	Al
			mg/kg			
Kpongu	117.4±26.9	1.3±0.1	9.2±0.9	7.4±0.4	9.9±0.7	76.0±14.1
Dandafuro	118.8±16.1	1.6±0.2	9.9±0.9	6.9±1.1	7.9±0.6	94.8±24.9
Kurikpara	672.1±506.6	1.4±0.2	9.2±0.6	19.3±11.2	8.6±0.7	285.4±170.6
Nakor	223.3±53.5	1.5±0.1	7.4±0.3	9.2±2.2	9.5±1.1	114.0±21.2
F-statistics	**1.07^{ns}**	**0.48^{ns}**	**2.16^{ns}**	**1.02^{ns}**	**1.36^{ns}**	**0.33^{ns}**

Table 3 A comparison of macronutrient concentration in ripe and unripe Shea fruits sampled from four different villages in Ghana.

Fruits	**P**	**K**	**Ca**	**Mg**	**S**	**Na**
			mg/kg			
Unripe fruits	0.96±0.07a	15.87±0.61a	2.11±0.16	1.18±0.09	0.52±3.1	53.6±6.4
Ripe fruits	0.73±0.06b	13.99±0.48b	1.93±0.15	0.98±0.06	0.47±2.9	52.3±4.9
Location						
Kpongu	0.75±0.08	15.37±0.86	2.19±0.15	1.28.±0.15	0.46±0.02	54.0±11.7
Dandafuro	0.90±0.09	14.84±0.75	1.56±0.24	0.96±0.14	0.49±0.07	46.6±4.0
Kurikpara	0.91±0.13	14.93±0.96	2.21±0.25	0.95±0.03	0.50±4.5	52.7±7.2
Nakor	0.80±0.07	14.57±0.81	2.12±0.18	1.11±0.07	0.53±0.03	58.4±8.0
2-WAY ANOVA (*F-statistics*)						
Fruits	**6.4***	**5.0***	**0.7^{ns}**	**3.5^{ns}**	**1.2^{ns}**	**0.1^{ns}**
Village	**0.7^{ns}**	**0.2^{ns}**	**2.0^{ns}**	**2.1^{ns}**	**0.4^{ns}**	**0.3^{ns}**
Fruit*Village	**0.1^{ns}**	**0.1^{ns}**	**0.4^{ns}**	**0.8^{ns}**	**0.2^{ns}**	**0.3^{ns}**

Table 4 A comparison of trace element concentration in ripe and unripe Shea fruits sampled from four different villages in Ghana.

Fruit	**Fe**	**Cu**	**Zn**	**Mn**	**B**	**Al**
			mg/kg			
Unripe fruits	100.8±8.9	1.5±0.1	10.8±0.8a	7.7±0.5	8.8±0.4	80.2±7.1
Ripe fruits	282.9±128.3	1.4±0.1	8.9±0b	10.7±2.9	9.0±0.4	142.6±44.3
Location						
Kpongu	100.4±15.5	1.4±0.1	9.8±0.7	7.6±0.4	10.0±0.6	76.6±12.4
Dandafuro	100.6±10.4	1.5±0.1	10.2±0.5	7.4±0.9	7.7±0.5	80.1±13.6
Kurikpara	390.3±256.7	1.3±0.1	10.6±1.5	13.4±5.7	8.4±0.4	182.2±87.6
Nakor	176.1±32.2	1.6±0.1	8.7±0.6	8.4±1.1	9.4±0.6	106.5±12.0
2-WAY ANOVA (*F-statistics*)						
Fruits	**2.0^{ns}**	**0.1^{ns}**	**4.5***	**1.1^{ns}**	**0.1^{ns}**	**1.2^{ns}**
Village	**1.1^{ns}**	**1.4^{ns}**	**0.9^{ns}**	**0.9^{ns}**	**3.2***	**1.2^{ns}**
Fruit*Village	**1.0^{ns}**	**0.9^{ns}**	**0.4^{ns}**	**1.1^{ns}**	**0.1^{ns}**	**1.2^{ns}**

Table 5 Concentration of amino acids in Shea fruits sampled from four different locations in Ghana.

Location	Aspartic acid	Histidine	Arginine	Threonine	Alanine	Proline
	mg/kg					
Dandafura	74±22	47±16	81±25	16±2	59±6	1189±324
Kurikpara	172±68	82±16	174±66	23±5	120±31	1168±158
Kpongu	66±20	48±17	66±9	15±5	52±2	1076±201
Nakor	91±35	70±29	174±76	19±4	96±49	877±157

Table 6 Concentration of amino acids concentration in Shea fruits sampled from four different locations in Ghana.

Location	Tyrosine	Valine	Iso-leucine	Leucine	Phenylalanine	Serine	Asparagine
	mg/kg						
Dandafura	14±4	23±4	16±2	25±5	8±0	74±29	128±49
Kurikpara	25±5	53±15	30±6	47±10.11	15±3	187±87	322±150
Kpongu	11±0	18±2	12±2	21±2	7±0	80±23	137±40
Nakor	11±3	31±15	20±8	32±14	10±3	60±27	102±46

Table 7 Concentration of organic acids in Shea fruits sampled from four different locations.

Location	Organic acids		
	Lactic	Fumaric	Oxalic
	mg/kg		
Dandafura	16.28±1	0.07±0	0.94±0
Kurikpara	15.37±2	0.02±0	1.34±0
Kpongu	14.05±4	0.17±0	1.22±0
Nakor	22.40±1	0.04±0	1.24±0
F-Statistics	1.27^{ns}	0.87^{ns}	1.10^{ns}

Table 8 Concentration of sugars in Shea fruits sampled from four different locations in Ghana.

Location	Sugars			
	Fructose	Mannitol	Glucose	Sucrose
	mg/kg			
Dandafura	145±10a	138±7a	157±9a	151±12a
Kurikpara	60±6c	89±10b	82±13b	94±9b
Kpongu	104±14b	89±13b	121±12a	100±11b
Nakor	40±11c	47±31b	51±31b	38±2c
F-Statistics	**14.88*** **	**6.72** **	**9.10*** **	**11.66*** **

CONCLUSIONS

- Concentrations of macronutrients in ripe Shea fruit were generally similar between locations
- Fe concentration was high in edible Shea fruits at all locations
- There were no differences between ripe and unripe Shea fruits
- Organic acid concentrations were similar in Shea fruits from different locations

CONCLUSIONS

- Sugars differed in concentration between locations
- Amino acid concentrations also differed between locations
- Proline and asparagine had the highest concentrations
- Shea pulp has potential for use as jam

POLICY IMPLICATIONS

- Ripe Shea fruit is eaten during the Shea season, and has food security value.
- Ripe Shea fruit is rich in Fe and therefore important nutritional security.
- Ripe Shea fruit has potential for making “Shea jam”.


Conical Flasks & Beakers

THANK YOU!!!!!!!!!

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of Technology
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