

Table 1

Composition of *Ricinodendron heudelotii*, *Vitex doniana* and *Cleome gynandra* seeds

	<i>Ricinodendron heudelotii</i> seed				<i>Vitex doniana</i> seed				<i>Cleome gynandra</i> seed			
	min	mean	max	References	min	mean	max	References	min	mean	max	References
Macronutrients												
Moisture content (%)	8.7	41.9	45.1	(Saki <i>et al.</i> , 2005, Kouame <i>et al.</i> , 2015)		8.25		(Amah and Okogeri 2019)	1			
Carbohydrates (g/100g dw)	3.03	3.16	3.29	(Saki <i>et al.</i> , 2005)		19.23		(Amah and Okogeri 2019)				
Crude protein (g/100g dw)	24.51	25.79	27.07	(Saki <i>et al.</i> , 2005)		30.05		(Amah and Okogeri 2019)	27.9	29.65	31.4	(Mnzava 1990)
Crude lipids (g/100g dw)	44.9	51.83	58.76	(Kapseu and Tchiegang 1995, Saki <i>et al.</i> , 2005, Kouame <i>et al.</i> , 2015, Yirankinyuki <i>et al.</i> , 2018)	26.3	28.55	39.8	(Ajiwe <i>et al.</i> , 1998, Amah and Okogeri 2019, Chinweuba 2014)	25.10	27.35	29.6	(Mnzava 1990)
Crude fibre (g/100g dw)				(Saki <i>et al.</i> , 2005)		5.27		(Amah and Okogeri 2019)				
Starch (g/100g dw)	0.43	0.455	0.48	(Saki <i>et al.</i> , 2005)								
Sugars (g/100g dw)	0.08	0.09	0.1	(Saki <i>et al.</i> , 2005)								
Cellulose (g/100g dw)	2.49	2.62	2.75	(Saki <i>et al.</i> , 2005)								
pH	5.45	6.005	6.56	(Saki <i>et al.</i> , 2005)								
Titrateable acidity (meq/l)	2.8	2.95	3.1	(Saki <i>et al.</i> , 2005)								
Minerals and Vitamins												
Ash (g/100g dw)	5.84	6.635	7.43	(Saki <i>et al.</i> , 2005)		5.65		(Amah and Okogeri 2019)				
Ca ²⁺ (g/l)	0.31	0.335	0.36	(Saki <i>et al.</i> , 2005)								
Mg ²⁺ (g/l)	0.15	0.175	0.2	(Saki <i>et al.</i> , 2005)								

Cl ⁻ (g/l)	0.03	0.035	0.04	(Saki <i>et al.</i> , 2005)
P (g/100g)	1.6	1.69	1.79	(Saki <i>et al.</i> , 2005)
K (g/100g)	0.74	0.83	0.92	(Saki <i>et al.</i> , 2005)

Table 2

Amino acid composition (g/100 g crude protein) in *Ricinodendron heudelotii*, *Vitex doniana* and in **Zambian selections** of *Cleome gynandra* seeds (*Gynandropsis gynandra* L. Briq)

Amino acid	<i>Ricinodendron heudelotii</i> (Tchiegang <i>et al.</i> , 1997)	<i>Cleome gynandra</i> (Mnzava 1990b)	<i>Vitex doniana</i> (Amah and Okogeri 2019)
Glutamic acid	10.2	17.43	7.33
Arginine	5.14	10.33	4.26
Aspartic acid	4.93	8.43	5.51
Leucine	3.06	5.88	5.31
Valine	3.23	5.63	3.12
Glycine	2.56	5.33	3.48
Proline	Traces	4.93	8.64
Phenylalanine		6.48	5.28
+Tyrosine	4.17	4.15	3.95
Isoleucine	1.9		
Threonine	1.82	4.08	7.55
Alanine	2.26	3.9	2.71
Serine	2.86	3.75	3.18
Lysine	1.47	3.25	4.92
Histidine	1.63	2.33	3.25
Cysteine	-	-	1.07
Methionine	-	-	6.22
Asparagine	-	-	4.53

Table 3: Physicochemical properties of *Ricinodendron heudelotii*, *Vitex doniana* and *Cleome gynandra* seed oils.

	<i>Ricinodendron heudelotii</i>				<i>Vitex doniana</i>				<i>Cleome gynandra</i>			
	min	mean	max	References	min	mean	max	References	min	mean	max	References
Saponification value (mg KOH/g)	104.20	147.35	190.50	(Kapseu and Tchiegang, 1995, Tchiegang et al., 1997, Ekam 2003, Kouame et al., 2015, Assanvo et al., 2015, Olasehinde et al., 2016, Yirankinyuki et al., 2018)	14.50	35.50	56.50	(Ajiwe et al., 1998, Chinweuba 2014)	192.00			(Mnzava 1990)
Iodine value (mg I ₂ /100g)	10.01	88.41	166.80	(Kapseu and Tchiegang 1995, Tchiegang et al., 1997, Ekam 2003, Ketaona et al., 2013, Kouame et al., 2015, Assanvo et al., 2015, Olasehinde et al., 2016, Yirankinyuki et al., 2018)	110.70	113.15	114.60	(Ajiwe et al., 1998, Chinweuba 2014)	120	122.5	125	(Mnzava1990)
Acid value (mg KOH/g fat)	0.39	6.34	12.29	(Ekam 2003, Keaton et al., 2013, Kouame et al., 2015, Assanvo et al., 2015, Olasehinde et al., 2016, Yirankinyuki et al., 2018)	51.80	54.20	56.60	(Ajiwe et al., 1998, Chinweuba 2014)				
Peroxide index (meq/kg)	5.87	25.91	45.95	(Ketaona et al., 2013, Kouame et al., 2015, Olasehinde et al., 2016, Yirankinyuki et al., 2018)								
Unsaponifiable content (%)	1.40	1.50	1.60	(Kapseu and Tchiegang 1995)								
Free fatty acids (%)	0.94	1.24	1.53	(Ekam 2003, Olasehinde et al., 2016)	25.80	27.00	28.20	(Ajiwe et al., 1998, Chinweuba 2014)				
Saponification equivalent (g fat mg/KOH)	485.00	500.00	515.00	(Ekam 2003)								
Ester value (mg KOH/g fat)	103.94	140.28	176.62	(Ekam 2003, Olasehinde et al., 2016)								

Specific gravity (28 °C)	0.9124		0.93	(Assanvo <i>et al.</i> , 2015, Yirankinyuki <i>et al.</i> , 2018)	0.84	0.86	0.88	(Ajiwe <i>et al.</i> , 1998, Chinweuba 2014)
Mean molecular mass					10001.80			(Ajiwe <i>et al.</i> , 1998)
pH	6.62		6.7	(Yirankinyuki <i>et al.</i> , 2018)				
Lipid colour	yellow		Brownish yellow	(Ekam 2003, Yirankinyuki <i>et al.</i> , 2018)				
Heat of combustion (Kcal/g)	28.80	32.80	36.80	(Ekam 2003)				
Refractive index (40 °C)	1.4542	1.4545	1.4549	(Ekam 2003, Olasehinde <i>et al.</i> , 2016)				
Refractive index (30 °C)		1.49		(Assanvo <i>et al.</i> , 2015)				
Boiling point (°C)	134.00	177.00	220.00	(Ekam, 2003, Olasehinde <i>et al.</i> , 2016)				
Smoke point (°C)	240.00	260.00	280.00	(Ekam 2003)				
Flash point (°C)	330.00	350.00	370.00	(Ekam 2003)				
Melting point (°C)	2.00	3.00	4.00	(Ekam 2003, Ketaona <i>et al.</i> , 2013)				
Slip point (°C)	2.00	3.00	4.00	(Ekam 2003)				
Relative density (25 °C) g dm ⁻³	0.84000	0.85	0.86	(Ekam 2003, Olasehinde <i>et al.</i> , 2016)				
Cloud point		0.50		(Olasehinde <i>et al.</i> , 2016)				
K232	1.19	1.19	1.19	(Ketaona <i>et al.</i> , 2013)				
K270	0.35	0.35	0.35	(Ketaona <i>et al.</i> , 2013)				
Viscosity (mPa.s)	60.32	62.87	65.42	(Ketaona <i>et al.</i> , 2013)				
Crystallisation temperature (°C)	-16.09	-16.18	-16.28	(Ketaona <i>et al.</i> , 2013, Yirankinyuki <i>et al.</i> , 2018)				

Table 4

Triglyceride composition (%) of *Ricinodendron heudelotii* seed oil

Triacylglycerol (TG)	Partition number (PN)	Number of double bonds	Kapseu and Tchiegang (1995)		Kapseu (2009)
			Seed Type 1	Seed Type 2	
EEE	36	9	15.9	13.1	15.9
EEL	38	8	33.1	29.7	33.1
LEL	40	7	7.7	8.9	7.7
EEO	40	7	6.1	4.9	6.1
EEP	40	6	6.1	5.7	6.1
EES	42	6	5.9	5.8	5.9
OEL	42	6	7.3	7.3	7.3
LLL	42	6			7.3
PEL	42	5	5.4	2.1	3.75
OEO	44	5	0.3	1.9	1.1
OLL	44	5			10.1
PLL	44	4			-
OEP	44	4	10.1	8.4	-
PEP	44	3			-
POO	44	2			-
PEO	46	4	0.4	0.4	0.8
OES	46	4	0.9	1.6	1.5
SOLn	46	4	-	-	0.9
SLL	46	4	1.8	1.8	1.8
SLO	48	3	1.4	1.4	1.4
SLP	48	2	1.6	1.6	0.9

Abbreviations O = oleic acid; P = palmitic acid; L = linoleic acid; Ln = linolenic acid; S = stearic acid; E = α -elaeostearic acid

Table 5

Fatty acid content (%) of *Ricinodendron heudelotii*, *Vitex doniana* and *Cleome gynandra* seed oil

	<i>Ricinodendron heudelotii</i>				<i>Cleome gynandra</i>				<i>Vitex doniana</i>			
	min	mean	max	References	min	mean	max	References	min	mean	max	References
Palmitic 16:0	5.5	5.75	6	(Kapseu and Tchiegang 1995, Tchiegang <i>et al.</i> , 1997)	10.7	11.2	11.7	(Mnzava 1990)		34.24		(Amah and Okogeri 2019)
Palmitoleic 16:1					0.3	0.35	0.4	(Mnzava 1990)				
Stearic 18:0	6.4	6.5	6.6	(Kapseu and Tchiegang 1995, Tchiegang <i>et al.</i> , 1997)	6.1	6.85	7.6	(Mnzava 1990)		7.22		(Amah and Okogeri 2019)
Oleic 18:1	7.2	7.3	7.4	(Kapseu and Tchiegang 1995, Tchiegang <i>et al.</i> , 1997, Assanvo <i>et al.</i> , 2015)	19.6	21.75	23.9	(Mnzava 1990)		58.54		(Amah and Okogeri 2019)
Linoleic 18:2	28.3	39.7	51.1	(Kapseu and Tchiegang 1995, Tchiegang <i>et al.</i> , 1997, Kapseu 2009, Assanvo <i>et al.</i> , 2015)	56.3	58.7	61.1	(Mnzava 1990)				
Linolenic 18:3												
Arachidic 20:0					0.1	0.15	0.2	(Mnzava 1990)				
Eicosenoic 20:1		0.1		(Kapseu and Tchiegang 1995,		0.1		(Mnzava 1990)				

Tchiegang *et al.*, 1997)

Lignoceric 24:0		1.2		(Kapseu and Tchiegang 1995, Tchiegang <i>et al.</i> , 1997)
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α -eleostearic acid 24:3	49.3	50.2	51.1	(Kapseu and Tchiegang 1995, Tchiegang <i>et al.</i> , 1997, Assanvo <i>et al.</i> , 2015)
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Table 6

Qualitative phytochemical properties of crude oil extract of *Ricinodendron heudelotii* seeds

Component	Results	
	Olasehinde <i>et al.</i> , (2016)	Odinga <i>et al.</i> , (2016)
Tannins		positive
Phlobatannins	negative	negative
Flavonoid	negative	positive
Alkaloid	negative	positive
Cardiac glycoside	negative	positive
Terpenoids	positive	positive
Saponin frothing	positive	positive
Saponin emulsifying	positive	positive
Combined		
anthraquinone		positive
Free anthraquinone	negative	negative
Carotenoid		positive
Reducing compound		negative
Steroids	positive	
Volatile	positive	

Table 7

Quantitative phytochemical composition (mg/100 g wet weight) of *Ricinodendron heudelotii* and *Vitex doniana* seeds

Component	Subclass	Concentration	
		<i>Ricinodendron heudelotii</i> Odinga <i>et al.</i> , (2016)	<i>Vitex doniana</i> (Amah and Okogeri 2019)
Phenol		22.357	170
Tannin		399.463	
Oxalate		11.581	
Phytate		2.946	
Alkaloid	Lumamarine	79.079	
	Ribalidine	56.08	11.40
	Sparteine	0.002	
Saponin	Sapogenin	142.632	
Flavonoid	Catechin	115.693	
	Epicatechin	19.145	
	Rutin	59.573	3.75
	Kaempferol	31.418	
	Naringenin	187.939	
	Anthocyanin	24.412	