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The potential of *Oleander (Thevetia peruviana)* in African agricultural and industrial development: a case study of Nigeria

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ABSTRACT
Objective: Studies on seed cake and seed oil of *Thevetia peruviana* were reviewed in which the potential of the plant for agricultural and industrial development was discussed. *Methodology and results:* Results of the chemical analysis and the nutritional evaluation of the raw and treated (detoxified) seed cake were reviewed. The results available from work done so far on the seed cake indicates that the nutrients in the raw seed cake compared favourably well with the nutrients in the commonly used seed such as soybean, cotton seed, rape seed, melon, despite the presence of toxins. Similarly, detoxification of the seed does not affect the seed nutrient as there is a significant increase in the nutrients of the cake, with maximum yield of 53.60% crude protein. Reductions in total carbohydrate and significantly higher quantities albumin and globulin fractions were reported in acid, alkaline and ethanol treated *T. peruviana* seed cakes than raw cake. Some of the essential amino acid required by animals and human were present in both raw and treated cakes. Feed test results revealed that up to 15% inclusion of ethanol treated cake produced no mortality and gave satisfactory growth performance based on feed intake, weight gain and nutrient retention. Acid treated cake up to 15% inclusion into the diet resulted in high mortality and poor growth performance. The results of the seed oils studied in three geographical locations of Nigeria (North, North – Central and South) were evaluated. *Conclusion and application of findings* The results of the physicochemical properties of the oil showed that it can be used for the preparation of oleo chemicals such as soap, shampoos, alkyd resin, fatty acid methyl ester (biodiesel). The products are expected to compare favorably to products from other lesser known oil seeds.
Key words: *Thevetia peruviana*, detoxification, crude protein, amino acid, oleo chemicals

INTRODUCTION
Oil seeds are major sources of vegetable proteins and oils for human and animal nutrition. They also constitute an essential part of industrial raw materials. Due to their wide application and utility oil crops are widely grown in different parts of the world. Commonly used oil seeds include soybean, cotton seed, rape seed, sunflower seed and peanut. World oil oilseed stocks were estimated at 39.8 million tons for 2003/2004 (USDA 2004).
Increased production of a small number of crops, including soybean, sunflower and rape seed, account for the increase in world production of oil. According to the Food and Agriculture Organization (FAO), traditional oil crops like

ground nut and sesame seeds continue to be important in the food supply and food security of many countries, e.g. Sudan and Myanmar (Bruisnsma, 2003). Apart from the above mentioned crops, other seeds that are used in the production of oils include linseed and sesame seed (O'Brien *et al*., 2000). When these seeds are defatted, the seed cakes are used in animal feed formulation. In Nigeria, notable among the non – edible lesser known oil seeds are Castor, *Jatropha curcas*, *Jatropha gossipifolia and Thevetia peruviana*. Akintayo (2004) reported on the nutrient contents of two Nigerian oil seed crops, *Parkia biglobossa* and *Jatropha curcas*. The crude protein content ranges from 26.52/100g for *P. biglobossa* and 47.25/100g for *J. curcas*, while the crude lipid in the *P. biglobossa* and *J. curcas* are 32.40/100g and 24.60/100g, respectively.

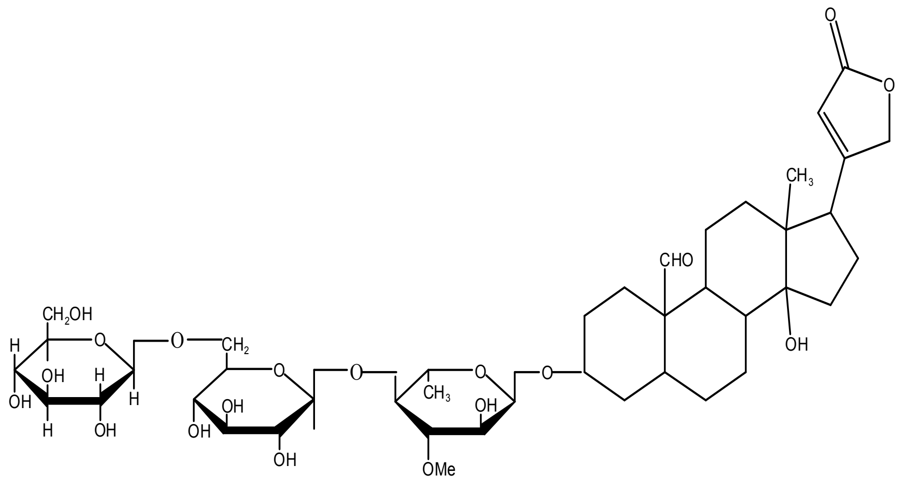
Thevetia peruviana

Thevetia peruviana is an ever – green ornamental dicotyledonous shrub that belongs to Apocyanaceae family (Dutta, 1964). It is commonly found in the tropics and sub – tropics but it is native to Central and South America. It grows to about 10 – 18 feet high, the leaves are spirally arranged, linear and about 13 – 15 cm in length. There are two varieties of the plant, one with yellow flowers, yellow oleander, and the other with purple flowers, nerium oleander. Both varieties flower and fruit all the year round providing a steady supply of seeds. Grown as hedges, they can produce between 400 – 800 fruits per annum depending on the rainfall pattern and plant age. The flowers are funnel-like with petals that are spirally twisted. The fruits are somewhat globular, with fleshy mesocarp and have a diameter of 4 – 5 cm. The fruits are usually green in colour and become black on ripening. Each fruit contains a nut which is longitudinally and transversely divided. The fruit contains between one to four seeds in its kernel, and the plants bears milky juice in all organs. In Nigeria, *T. peruviana* has been grown for over fifty years as an ornamental plant in homes, schools and churches by missionaries and explorers (Ibiyemi *et al.,* 2002). All parts of the plant are toxic, due to the presence of glycosides.

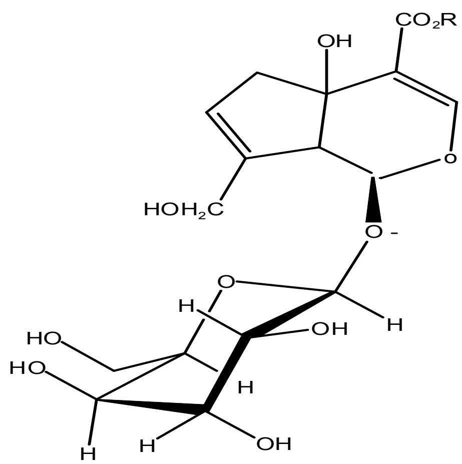
The seed contains 60 – 65% oil and the cake comprise of 30 – 37% protein. Despite the fact that there is high level of oil and protein in the seed, it remains non – edible because of the presence of cardiac glycoside (toxins). According to Atteh *et al.* (1995) and Oluwaniyi *et al.* (2007), the crude protein content of the defatted seed ranges from 42.79 – 47.50/100 g of the seed cake while crude lipid ranges from 4.40 to 4.80/100 g.

Toxic principles in *Thevetia peruviana* plants (Cardiac glycosides): All parts of *T. peruviana* plants contain toxic glycosides, the major one reported in seed being thevetin [1], a bitter principle with a powerful cardiac action (Arnold *et al.,* 1935; Huang *et al.,* 1965). Sun and Libizor (1964) reported that thevetia kernel contains between 3.6 and 4.0 % thevetin. The presence of theveridoside [2], digitoxigenin [3], cerberin [4], peruvoside [5] and theveside [6] has been established in the plant (Lang and Sun, 1964; Arora *et al.,* 1967; Sticher 1970; Perez – Amator *et al.,* 1993).

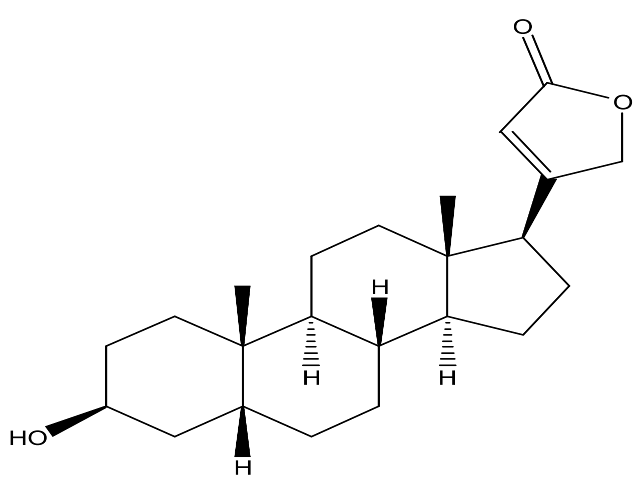
The toxicity of the glycoside is reflected in the accidental poisonings that occur among children that feed on the seed of the plants (Brewster 1965; Shaw & Pearn 1979;). Some adults have reportedly died after consuming oleander leaves in herbal teas (Haynes *et al.,* 1965). According to Saravanapavanatha (1965), the kernel of about ten fruits may be fatal to an adult while kernel of one fruit may be fatal to children. Generally, small children and livestock are at higher risk of *T. peruviana* poisoning



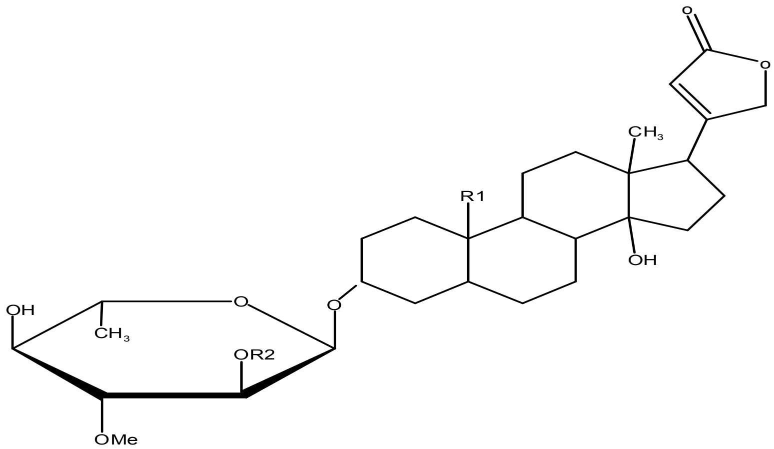
Thevetin [1]



Theveridoside [2]: R = Me
Theveside [6]: R= H



digitoxigenin [3]



Cerberin [4]: R1= Me; R2 = Ac
Peruvoside [5]: R1 = CHO; R2 = Ac

Livestock poisoning after consuming thevetia has been reported by various workers. For instance Singh and Singh (2002) reported that leaf, stem and bark extracts of the plant killed fish. These extracts together with seed kernel extract also caused poisoning symptoms and death of albino rats (Oji & Okafor, 2000). Pahwa and Chartterjee (1990) reported 80 and 90% mortality of rats that were fed on 20 and 30% kernels of thevetia seed after ten days of feeding.

Detoxification of *Thevetia peruviana* seed cake: To harness the potentials of the seed cake, efforts have been made by several workers to remove the toxins (Atteh *et al.,* 1995; Odetokun *et al.,* 1999; Usman, 1999; Oluwaniyi *et al.,* 2007). Methods employed for the detoxification of *T. peruviana* seed cakes are based on the polar nature of the toxins which enhance their extraction by polar solvents e.g. ethanol, methanol; and the susceptibility of the glycosides to hydrolysis which could give lower molecular weight sugar moiety and aglycone. Based on these properties, Atteh *et al.* (1995) employed both alkaline and acid hydrolysis to detoxify the seed cake using concentrated and dilute NaOH and HCl solutions prior to solvent (chloroform) extraction. The detoxification was monitored (through tasting) by the level of bitterness of the cake. The cake with minimum bitterness was used to compound broiler's meals containing 0, 5, 10 and 15% *T. peruviana* seed cake. Inclusion of the cake in the broiler's diet irrespective of level drastically reduced feed intake and weight gain (P<0.01) at both the starter and finisher stages. The result showed that both alkaline and acid hydrolysis methods of detoxification were not efficient.

Normally not only the cardiac glycosides in the cake are prone to hydrolysis, other constituents like carbohydrates and proteins are also susceptible to hydrolysis. It is on this basis that Usman (1999) used 0.1 – 0.5 M solutions of hydrolyzing agents (NaOH, $Ca(OH)_2$ and HCl) to detoxify the seed cake and also monitored the effects of each detoxicants on the quantity of crude protein. The detoxification was also monitored by the level of the bitterness (through tasting) of the cake after the extraction of the hydrolytic product with chloroform. Effects of the detoxification on the quantity of albumin and globulin in the seed cake were subsequently monitored by Usman *et al.* (2003). The treated cakes obtained from NaOH and HCl hydrolysis, irrespective of the concentration, were devoid of bitter taste, but blackened which indicated strong hydrolytic effect of the chemicals used, and potential complete removal of all bitter principles that account for the toxicity of the seed cake. With $Ca(OH)_2$, only the cake treated with 0.4 and 0.5 M concentrations were free of bitter principles. The bitter taste was retained in the cake treated with lower concentrations of $Ca(OH)_2$ solutions.

Increased crude protein content has been widely reported in detoxified seed cake (Kujawa *et al.,* 1990; El – Adawy 1992; Sotelo *et al.,* 1993). Table 1 shows the effect of the concentrations of HCl, NaOH and $Ca(OH)_2$ on the quantity of crude protein in *T. peruviana* seed cake as reported by Usman (1999)

Table 1: Effect of different concentrations of HCl, NaOH and $Ca(OH)_2$ detoxification on the quantity of crude protein in *Thevetia peruviana* seed cake

Concentration of solution (M)	Percentage crude protein in detoxified seed cake		
	HCl	NaOH	$Ca(OH)_2$
0.1	46.26	46.03	44.72
0.2	46.56	44.28	52.16
0.3	46.87	43.28	51.28
0.4	57.31	39.91	49.75
0.5	48.43	35.09	42.75

According to this researcher there were no appreciable increases in the quantity of crude protein at lower concentration of HCl. However, significant increase occurs at 0.4M but subsequently reduced at 0.5 M concentration. The yields range from 46.26 – 57.31%, in the treated cakes as against 43.19 % in the untreated cake. Decrease in quantity of crude protein was observed in NaOH treated cake as the concentration of the solution increases. This was attributed to the strong alkaline hydrolytic effect of the hydrolyzing agent on the crude protein. The quantity of the crude protein in NaOH treated cake ranges from 35.09 – 46.03%/ 100 g of the seed cake.

For the Ca $(OH)_2$ treated cake, the quantity of crude protein increased as the concentrations of the solution increases from 0.1 to 0.3 M. There was a significant reduction in the quantity of crude protein obtained when the seed cake was treated with 0.5 M compared to that of 0.4 M $Ca(OH)_2$ solution. The quantity of albumin and globulin has been a measure of the quality of proteins in oil seeds (Bajaj *et al*., 1971; Tella & Ojehomon, 1980). Usman *et al.* (2003) monitored the effect of detoxification by alkaline and acid hydrolysis on the quantity of these valuable proteins. The results obtained are presented in Table 2. The quantities of albumin and globulin fractions in untreated cake were 1.1 and 2.9 g/Kg of seed cake respectively.

Table 2: Effect of different concentrations of HCl, NaOH and $Ca(OH)_2$ on the quantity of extractable albumin and globulin in *Thevetia peruviana* seed cake

Concentration of solution (M)	Quantity of extractable Albumin and Globulin in detoxified seed cake					
	HCl		NaOH		$Ca(OH)_2$	
	Albumin (g/Kg)	Globulin (g/Kg)	Albumin (g/Kg)	Globulin (g/Kg)	Albumin (g/Kg)	Globulin (g/Kg)
0.1	2.9	2.9	1.2	0.5	20.8	23.6
0.2	3.6	3.1	2.6	2.1	22.7	24.1
0.3	4.2	3.6	3.9	3.1	24.7	25.1
0.4	4.8	4.3	5.5	4.5	25.6	25.6
0.5	6.0	5.0	9.8	7.6	26.3	26.1

Source: Usman *et al.* (2003)

Acid hydrolysis did not increase the quantity of the albumin and globulin fractions in the cake treated with 0.1 M HCl, however, significant increase ($p<0.05$) in the quantity of both fractions were observed from the samples treated with 0.2 – 0.5 M HCl solutions. The quantity of albumin in the acid treated cake ranges from 2.9 – 6.0 g/Kg of the seed cake while that of globulin ranges from 2.9 – 5.0 g/Kg of the seed cake.

Hydrolysis of protein fractions by alkaline solutions have been reported by various workers (Marcone & Yada 1992; Marcone *et al.,* 1994). For the NaOH treated cake, the quantities of albumin and globulin increase steadily but not as high as those detoxified using 0.1 – 0.3 M HCl. This might be due to the strong hydrolytic property of NaOH. Hydrolytic products are low molecular weight peptides and amino acid that are loss through washing of the residue with water and dialysis of the fractions . Higher quantities of the albumin and globulin in the cake treated with 0.4 – 0.5 M NaOH indicated that there are conjugated forms of the fractions which were hydrolyzed at those concentrations. Thus free albumin and globulin which consequently compensated for the loss during hydrolysis were produced.

Hydrolysis by alkaline – pH using $Ca(OH)_2$ did not significantly affect the quantities of albumin and globulin in the treated cake. The quantities of albumin and globulin were higher in these ($Ca(OH)_2$ treated) cakes than in the cakes treated with HCl or NaOH solutions. Compared to the quantity of the protein fractions obtained from the $Ca(OH)_2$ treated cake it is likely that there was hydrolysis induced by acidic pH in both fractions in the cake, treated with hydrochloric acid solutions. Higher quantities of albumin and globulin recorded in the cake treated with $Ca(OH)_2$ solutions suggests it has a mild hydrolytic effect on the protein fractions.

Odetokun *et al.* (1999) detoxified *T. peruviana* seed by heat treatment and then feed tested the heat treated cake to establish its nutritional quality. The test indicated that the replacement of soybean component of the feed up to 30% with treated *T. peruviana* cake gave satisfactory performance of 90% of the test animals with 10% mortality. However, 40% replacement in the basal feed meal led to marked reduction in body weight of the chicks, poor feed consumption and efficiency and a high mortality rate. These results showed that detoxification of the cake were not achieved by mere heat treatment.

Taiwo *et al.* (2004) detoxified *T. peruviana* cake by oven drying and autoclaving prior to formulating feed for rabbits. Although the treatment removed some of the toxin and antinutrients, the feed could still not support productive growth. Rabbits fed on the autoclaved diet did not record any mortality but looked unthrifty and did not gain weight. The animals recorded reduction in feed intake, and they suffered from diarrhea and rough and dry coat.

Oluwaniyi *et al.* (2007) adopted two methods to detoxify *T. peruviana* seed cake, they are; solvent extraction using 80% aqueous solution of ethanol adapted from the method of Finningan and Lewis (1989). The second method was adapted from Usman *et al.* (2003).

Glycoside content in the untreated cake was 4.27 g/Kg of the seed cake, while the content in ethanol and acid treated cake were 2.15 and 0.83 g/Kg of seed cake, respectively. The results showed that acid detoxification resulted in 95% reduction in the cardiac glycoside while ethanol treatment gave 98% reduction of the glycoside. The higher content with ethanol could be attributed to the presence of quantifiable insoluble aglycones in acid treated cake which were estimated along with the remaining glycoside in the cake. Nutrient contents of the detoxified cake were as shown in Table 3

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Table 3: Proximate composition of detoxified *Thevetia peruviana* seed meal (TSC)

Constituents	**Acid treated TSC (%)**	**Alcohol treated TSC (%)**
Moisture	8.40 ± 0.28	8.83 ± 0.20
Dry matter	91.60 ± 0.28	91.17 ± 0.20
Total ash	4.90 ± 0.40	7.85 ± 0.17
Crude protein	44.45 ± 0.05	53.60 ± 0.22
Crude fat	4.68 ± 0.10	4.07 ± 0.43
Crude fiber	3.92 ± 0.20	2.55 ± 0.30
Carbohydrate	33.65 ± 0.44	23.09 ± 0.26
Calorific value (kcal 100 g^{-1} sample)	355	343

Source: Oluwaniyi *et al.* (2007).

Detoxification increased the crude protein, crude fat and crude fiber in acid treated cake but these as well as the total carbohydrates were significantly decreased in ethanol treated cake. Due to this reduction, the calorific value of the cake also reduced significantly. Low value of ash content in acid treated cake may be attributed to the loss of some minerals resulting from acid treatment. Meanwhile, the nutrients in the cake compared favorably to the nutrient content in Nigerian grown groundnut cake (Table 4).

Table 4: Nutrient composition of groundnut seed cake

Nutrients	Cake (%)
Protein	56.4
Fat	10.2
Carbohydrate	28.3
Crude fibre	4.6
Ash	5.5

Source: Elegbede (1998)

Protein quality of Nigerian grown *Thevetia peruviana* seed cake: The quality of any protein relates to its amino acid composition, digestibility, bioavailability and ability to supply the essential amino acid in the amount required by the organism consuming it. Based on these facts there are two methods of assessing the quality of protein, i.e. amino acid analysis and feed test. Both methods were used by Oluwaniyi (2007) to establish the quality of *T. peruviana* seed protein (Table 5).

Table 5: Amino acid analysis of *Thevetia peruviana* seed cake

Amino acid	Raw cake	Acid treated	Ethanol treated
Lysine	4.47	3.97	5.65
Histidine	1.62	1.39	1.65
Arginine	4.48	4.25	5.19
Aspartic acid	19.85	21.86	20.34
Threonine	2.61	2.04	2.67
Serine	3.9.	3.12	4.00
Glutamic acid	14.21	20.10	15.67
Proline	4.24	3.85	4.49
Glycine	3.63	2.24	3.70
Alanine	4.49	3.04	4.56
Cysteine	1.69	1.65	1.69
Valine	4.01	3.57	4.01
Methionine	0.88	0.64	0.90
Isoleucine	2.94	2.09	2.97
Leucine	5.49	4.88	5.59
Tyrosine	2.49	1.94	2.49
Phenylalanine	3.38	3.22	3.70

The results showed that all the essential amino acids required in human and animal diet were present in both treated and untreated seed cake, except tryptophan which could not be quantified.

According to WHO/FAO (1985) standard of daily requirements of essential amino acid (Table 6), the leucine, lysine and phenylalanine contents in the untreated and ethanol treated cake were found to be adequate. The acid treated cake contain significant amount of lysine while both treated and untreated cakes are low in the sulphur containing amino acid methionine. The quantity of cysteine, threonine and valine in all the samples compared favourably to the WHO/FAO standard. However all the samples were low in isoleucine.

It has been established that utilization of lysine and isoleucine in protein is affected by the amount of leucine present (Okoh *et al.,* 1985). A leucine to lysine ratio greater than 4.6 will hinder the utilization of lysine. According to Oluwaniyi (2007), the leucine to lysine ratio of the untreated, ethanol treated and acid treated *T. peruviana* seed cake are 1.23, 0.99, and 1.23 respectively (Table 6). The values are lower than that of Nigerian grown cereals. Hence the lower ratio will no doubt make them to be nutritionally superior to commonly grown Nigerian cereals. The value of cysteine in all the samples of *T. peruviana* are higher than that of soya bean. Table 6 shows the essential amino acids in the treated and untreated *T. peruviana* seed cake compared to commonly grown legumes and cereals in Nigeria.

Table 6: Essential amino acid in raw and treated seed cake of *Thevetia peruviana*

Amino acid	WHO/FAO	Wheat[1]	*Thevetia peruviana*[2]			Soybean[3]
			Untreated[a]	Acid treated[b]	Ethanol treated[c]	
Isoleucine	4.2	3.66	2.94	2.09	2.97	4.8
Leucine	4.2	7.52	5.49	4.88	5.59	8.0
Lysine	4.2	4.30	4.47	3.97	5.65	6.4
Phenylalanine	2.8	4.74	3.38	3.22	3.70	4.8

Tyrosine	2.8	3.10	2.49	1.94	2.49	3.2
Cysteine	2.0	-----	1.69	1.65	1.69	0.8
Methionine	2.22	1.23	0.88	0.64	0.90	0.9
Threonine	2.8	3.40	2.61	2.04	2.67	4.0
Tryptophan	1.4	-----	Nd	Nd	Nd	1.3
Valine	4.2	4.29	4.01	3.57	4.01	4.8

Source: Temple *et al.* (1991)[1] ; Oluwaniyi (2007)[2]; Okoh *et al.* (1985)[3]

The estimated minerals (Na, Mg and Ca) were higher in soya bean than in *T. peruviana* seed cake. Based on the knowledge that seed cake proteins bear all the essential amino acids required by chicken, Oluwaniyi (2007) conducted a feed test on cockerels using 0, 5, 10 and 15% of acid detoxified and aqueous alcohol detoxified *T. peruviana* seed cake. The results showed that up to 15% inclusion of alcohol detoxified seed cake (equivalent to 50% replacement of soybean meal) produced no mortality and gave satisfactory growth performance based on feed intake, weight gain and nutrient retention. However, diets formulated with acid detoxified seed cake gave a satisfactory performance only at the 5% inclusion level. The 10 and 15% diet formulated meal of acid detoxified seed cake resulted in high mortality and poor growth performance.

Utilization of vegetable oils for diet and oleochemicals depends on the oils physicochemical properties, e.g. acid value, saponification value, iodine value, hydroxyl value, acetyl value, free fatty acid, unsaponifiable matter, refractive index and viscosity. Above parameters favoured the use of *Jatropha curcas* seed oil for the production of oleochemicals as reported by Akintayo (2004).

Physicochemical properties of *Thevetia peruviana* seed oil: Ibiyemi *et al.* (2002) investigated the physicochemical properties *of T. peruviana* seed oil from three geographical locations, i.e. North, North – Central and Southern in Nigeria. The oil yields from the seeds from the North, the North – central and the South were 64.7, 63.4 and 61.8% respectively (Table 7). The iodine values ranged from 79 – 82.1, which indicates that the oils are semi drying oils. These values suggest the potential of the oils in the production of alkyd resin, shoe polish and varnishe among others. The saponification value of the oils range from 123.1 – 127.3 which may make the oils useful in the production of liquid soaps and shampoos. In general the high saponification value and low unsaponifiable matter in the oils suggest that they contain triglycerides. The oils have low free fatty acid values (0.61 – 0.63), which suggests their potentials as edible oil after detoxification. The viscosity of the oils is considerably lower than that reported and tested at 30^o C. Such oils include soybean (31 cst); cotton seed (36 cst); sunflower (43 cst) and *Jatropha curcas* (17.1 cst). Akintayo (2004) hence suggested the oils as potential material for the production of biodiesel. Physicochemical properties of the oils from purple and yellow flowered varieties of the plant were also investigated by Ibiyemi *et al.* (2002), the results are presented in Table 8.

Table 7: Physicochemical properties of *Thevetia peruviana* seed oil from three geographical locations in Nigeria

Parameter	North	North central	South
Free fatty acid	0.63 ± 0.017	0.625 ± 0.017	0.61 ± 0.02
Oil yield	64.7 ± 0.52	63.4 ± 0.97	61.8 ± 0.82
Saponification value	127.3 ± 0.72	123.3 ± 0.40	124.7 ± 0.56
Unsaponifiable matter	0.30 ± 0.02	0.365 ± 0.022	0.31 ± 0.01
Iodine value	82.1 ± 1.44	79.4 ± 0.26	79.0 ± 1.14
Peroxide value	3.9 ± 0.36	3.4 ± 0.25	3.1 ± 0.66
Refractive index	0.93 ± 0.002	1.461 ± 0.0025	0.93 ± 0.001
Specific gravity	0.930 ± 0.002	0.929± 0.0035	0.930 ± 0.001
Viscosity (centripose)	20.14 ± 0.003	20.11± 0.002	21.36 ± 0.002

Source: Ibiyemi *et al.* (2002).

Table 8: Physicochemical properties of two varieties of *Thevetia peruviana* seed oil

Parameter	Yellow flower variety	Purple flower variety
Free fatty acid	0.62 ± 0.02	0.61 ± 0.05
Oil yield	63.3 ± 0.70	61.3 ± 0.51
Saponification value	124.3 ± 0.37	121.7 ± 0.50
Unsaponifiable matter	0.37 ± 0.03	0.41 ±0.07
Iodine value	79.4 ± 0.27	79.5 ± 0.41
Peroxide value	3.8 ±0.31	3.7 ± 0.24
Refractive index	1.461 ± 0.001	1.461 ± 0.002
Specific gravity	0.929 ± 0.002	0.928 ± 0.002
Viscosity (centripose)	20.11 ± 0.22	20.13 ± 0.18

Source: Ibiyemi *et al.* (2002).

The oil yield varied considerably being 63.3 and 61.3% for the yellow and purple flower variety, respectively. However there was no significant variation in the physicochemical properties of the oil from both varieties, hence oil from both varieties has the same potential for use in diets and preparation of oleochemicals.The fatty acids compositions of the oils from the three geographical locations as reported by Ibiyemi (2002) are shown in Table 9.

Table 9: The fatty acid compositions of *thevetia* seed oils from three different locations in Nigeria

Fatty acid compositions	Location		
	North	North central	South
Myristic acid 14:0	0.247	0.306	0.407
Palmitic acid 16:.0	20.173	18.123	20.212
Palmitoleic acid 16:1	0.257	0.234	0.255
Stearic acid 18:0	7.697	6.368	6.395
Oleic acid 18:1	46.097	39.908	42.207
Linoleic acid 18:2	15.893	12.461	10.828
Linolenic acid 18:3	0.407	0.744	0.468
Total saturated	28.303	24.97	27.113
Total unsaturated	59.900	50.971	52.932

Source: Ibiyemi *et al.* (2002).

The results indicate the presence of two essential fatty acids (linoleic and linolenic acids) in the oils. The quantity of linoleic acid ranges from 10.8 – 18.8 %, while that of linolenic acid ranges from 0.40 – 0.744 %. With its low linolenic acid the oil compared favorably with sunflower oil (0.7%). Consequently, the oils will be less prone to auto oxidation and rancidity, hence would be suitable for use in human and animal diet. The percentage of unsaturated fatty acid in the detoxified oil ranges from 50.91 – 52.93 %, while those of saturated acids ranges from 24.97 – 28.30 %. The high percentage of unsaturated fatty acid in the oils favors their use for the preparation of oleochemicals as further reflected in their physicochemical properties.

CONCLUSION

It is obvious that the world has shifted sourcing protein for animal diets and oils for industrial raw material to oil seeds. Notable among the oil seeds are *Jatropha curcas*, *J. gosipifolia*, neem seed, and rape seed. From the researches done so far on Nigerian grown *Thevetia peruviana* seed, the seed has nutritional potential that compares favorably to conventional oil seeds and protein source (soybean and groundnut). The plant can thus be used as an alternative protein source in animal feed formulation. If well processed, it would reduce competition between man and livestock for the conventional sources of proteins. The oil could also be useful in the production of oleochemicals such as liquid soap, shampoos, alkyd resin, and biodiesel. Thus, African countries are encouraged to invest in the cultivation of this potentially rich plant .in order to reduce over-dependence on the currently limited sources of protein and oil.

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