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YELLOW OLEANDER (*THEVETIA PERUVIANA*) SEEDS FOR HUMAN FOOD IN KENYA

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Abstract: **The Yellow oleander (*Thevetia peruviana*), is a potential oil seed and a good alternative source of nutrition for food and animal feeds. The seeds of Yellow oleander from four geographical regions (Busia, Bondo, Thika (JKUAT) and Mombasa districts) in Kenya were subjected to a nutritional value study. The oil and the defatted seed cake were analyzed for food values (fatty acids, proteins, minerals, fibre, and carbohydrates). Fatty acid characterization of the oil was done by GC. Minerals analysis was performed using AAS and flame photometer. The crude protein content of the defatted cake was determined by semi-micro Kjeldahl method. Carbohydrates values were determined by difference. Data analysis was done by SPSS program. The results showed that the nutritional values of these seeds were similar to those of other common oil seeds and did not depend on the climatic regions.**

Keywords: **Yellow oleander, food value, plant.**

1. INTRODUCTION

The plant kingdom is estimated at 500,000 species (Marjorie, 1999), which includes 250,000 species of flowering plants alone (Brown, 2002). Both man and other animal species use a relatively small amount of flowering plants (1 to 10 %) as food (Marjorie, 1999). Plants are important as an ultimate source of nutrition for animal species because they have a unique capacity of synthesizing proteins, carbohydrates and oils and absorbing minerals directly from the soil (David and Glenn, 1985). The kernels and defatted cake of many underutilized oil seeds are good sources of proteins and triglycerides (Koziol, 1992).Yellow oleander oil from seeds contains a large proportion of unsaturated fatty acids, which makes it good for nutrition yet their content is not yet known. The under exploited Yellow oleander seed oil and seed cake if found viable economically and industrially, will greatly improve the economy of the peasant farmers and the entire country of Kenya. The objective of this study is therefore to investigate the effect of change in geographical locations with nutritional properties of Yellow oleander seeds.

2. MATERIALS AND METHODOLOGY

Kenya has a great climatic diversity that goes in parallel with the different geographic regions. As an Equatorial country, there is little variation in temperatures throughout the year. However, among regions there are great differences in average rainfall. This climatologic diversity is mainly due to the winds and the altitude differences. Mature fruits of Yellow oleander were collected from different geographical zones: Coast, Central, Nyanza and Western Provinces of Kenya. In the Coastal area, from Mombasa, (Jomvu, Nov. 2005); in Central, from Thika, (JKUAT, Oct. 2005); in Nyanza, from Bondo, (Abidha Pri. School, Oct 2005) and in Western, from Busia, (Nangina Pri. School, Oct. 2005). All the samples were taken during dry season. These seeds were then air-dried and the seed kernel was manually separated from the endocarp. Grinding of the seeds was done using a blender. The ground samples were stored at -4 0C in a freezer until used.

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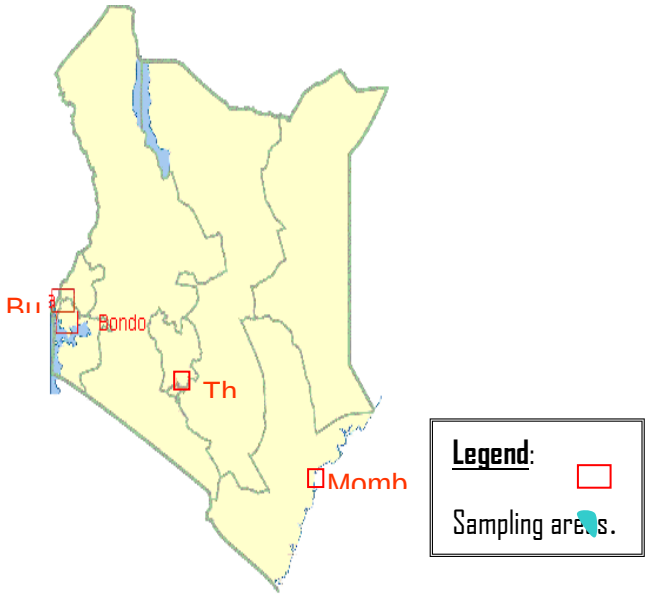

Fig. 2.1 Map of Kenya showing sampling areas

The fatty acid composition was analyzed using a Shimadzu GC–14 B after esterification. Fatty acid methyl esters were prepared as follows: About 10 mg of oil was pipetted into a flask. 10 ml of 95 % acidic methanol (5 % HCl in 95 % methanol) was added and the mixture heated under reflux for 1 hr. After cooling the sample, the fatty acid methyl esters were extracted with three portions (1 ml) of *n*-hexane. The *n*-hexane layer was washed with one portion (3 ml) distilled water and the solvent evaporated. The residue was dissolved with a little *n*-hexane ready for GC analysis. Separation of constituent fatty acids by GC was done under the following conditions. Glass packed column; 3 m x 3mm id, carrier gas; Nitrogen, detector**;** FID (Flame ionization detector) Column temp**;** 170 0C, injector temp**;** 250 0C and detector temp**;** 250 0C. 1.0 □l of the sample was injected (Bligh and Dye, 1959). This was done three times as stated (Craske and Bannon, 1987). The Yellow oleander seed oil from all the four regions, hydrolyzed to yield five prevalent fatty acids. These were oleic acid, palmitic acid, linoleic acid, arachidonic acid and stearic acid. Shimadzu Gas Chromatography analyzed the fatty acid composition. Three injections were done per sample. Identification of the constituents was based on the computer matching against the library spectra built up from pure substances and compounds of known fatty acids (fatty acid standards). Mineral elements iron, zinc, calcium, magnesium, copper, potassium and sodium content were measured after sample mineralization; this was done according to AOAC (1984). About 2 g sample was accurately weighed ashed in the muffle furnace at a temperature of 5500C for 2 hrs. 5 ml of 50 % Nitric acid was added and the sample was heated on a hot plate to dryness. The sample was ashed again for 6 hrs at a temperature of 5500C. After cooling, 20 ml of 50 % HCl was used to transfer it to a 100 ml volumetric flask and 1 % HCl used to dilute to the mark. A Shimadzu Atomic Absorption Spectrophotometer (Shimadzu Corp, Kyoto, Japan, and Model AA-6200) was used to determine the mineral content of each of the elements. The appropriate hollow cathode lamps were used. The readings from the spectrophotometer were used to calculate the total content of the mineral elements using the standard curves obtained by running appropriate standard solutions as described by Meyer and Keliher (1992).

The mineral elements potassium and sodium were analyzed by Flame Photometer model 410. Moisture determination of all the samples was done using an Isuzu hot air rapid drying oven Soyokaze type ASF-113S (AOAC, 1984). This was done by weighing about 2 g of sample, drying it in the oven, cooling and weighing it again. This process was repeated until a constant weight was obtained. The difference between initial and final weight was taken and expressed as a percentage. Crude fibre content was determined by gravimetric method (AOAC, 1978) No. 978.10. About 2 g of sample was weighed accurately (wo) and transferred into a 500 ml conical flask and boiled in the presence of 200 ml of 1.25 % H_2SO_4 for about 30 minutes under reflux condenser. It was filtered under slight vacuum. After addition of 200 ml of 1.25 % NaOH, it was again heated for about 30 minutes under reflux condenser.

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The residues were dried at 100 0C for one hr cooled to room temperature and weighed to get constant weight (w1). It was then incinerated at 500 ^{0}C for about an hr. The temperature was decreased to 200 0C and the sample was transferred to a desiccators. It was cooled to room temperature and weighed to get constant weight (w2). The crude fibre content was then calculated. as shown in Eq 3. 4 Fibre content (%) = (w1) – (w2) x 100 Wo Where W1= weight of sample after alkali hydrolysis W2= weight of sample after acid hydrolysis W0= weight of sample Total carbohydrates were determined by the difference as stated by Horace (1982). The carbohydrates value was then calculated as indicated in Eq 3.5. Carbohydrates % = 100 % - moisture % - protein % - oil % - fibre % - ash %.

3. DATA ANALYSIS

Statistical analyses of data were done using Analysis of Variance (ANOVA) at 5% ($\alpha = 0.05$) level of significance. The statistical package used was the Statistical Package for Social Sciences (SPSS) version 11.1. One-way ANOVA enabled the determination of significant differences between the treatments and a two-tailed t test was used to locate the differences.

4. RESULTS AND DISCUSSION

The oil content of these seeds ranged from 60.0 % (Mombasa) to 64.4 % (Busia) as shown in Table 4.3. One-way analysis of variance showed no significant difference ($p > 0.05$) in oil content of the seeds. The lipid contents obtained for Yellow oleander seeds in Kenya was similar in value to that of Yellow oleander seeds obtained from Nigeria (Ibiyemi *et al.*, 2002). The Yellow oleander seed oil content is higher than that reported for various soyabean varieties (14 to 22 %) and that of other oil seeds such as peanut (44 to 54 %), castor bean (48 %) rapeseed (44 to 50 %) and sunflower (45 to 47 %) (Leffel and Rhodes, 1995). The results of analyses are presented in Tables 4. 1, 4.3, 4.4 and 4.5. The results of analyses are presented in Table 4.1.

Table 4.1 Fatty acid composition of yellow oleander oil

Region/fatty acid	Linoleic acid **%**	Palmitic **%**	Oleic acid**%**	Stearic acid **%**	Arachdonic **%**
Busia	21.5 ± 0.3	7.8 ± 0.2	50.5 ± 0.8	19.8 ± 0.6	0.4 ±.0.1
Bondo	21.0 ± 0.2	7.2 ± 0.5	50.2 ± 1.2	17.7 ± 0.4	0.4 ±.0.1
JKUAT	21.6 ± 0.7	10.2 ± 0.3	55.6 ± 0.7	11.1 ± 0.4	0.6 ± 0.2
Mombasa	21.2 ± 0.6	8.2 ± 0.2	50.7 ± 1.3	18.0 ± 0.4	0.5 ± 0.1

The values are means ± SD, n = 3

The oleic acid **[CH3 (CH2) 7 CH □□CH (CH2) 7 COOH]** content studied ranged from 50.2 % (Bondo) to 50.7 % (Mombasa) as presented in table 4.1. One-way analysis of variance showed no significant difference ($p > 0.05$) in oleic acid content. The palmitic acid **[CH3 (CH2)14 COOH]** content studied ranged from 7.2 % (Bondo) to 10.2 % (JKUAT) as presented in Table 4:1. One-way analysis of variance showed no significant difference ($p > 0.05$) in palmitic acid content of the oil from all of the four locations. The linoleic acid **[CH3 (CH2) 4 CH □□CH CH2 CH □□CH (CH2) 7 COOH]** content of the oil studied ranged from 21.0 % (Bondo) to 21.6 % (JKUAT), as presented in Table 4.1. One-way analysis of variance showed a significant difference in linoleic acid content of the oil ($P < 0.05$). A t test showed that the linoleic acid from JKUAT was less than that from the other regions. The arachidonic acid **[CH3 (CH2)3 (CH2CH□CH)4 (CH2)3 COOH]** content of the oil studied ranged from 0.35 % (Busia) to 0.6 % (JKUAT) as presented in Table 4.1. One-way analysis of variance showed no significant difference ($p > 0.05$) in arachidonic acid content of the oil from all the four locations. Stearic acid **[CH3 (CH2) 16 COOH]** is a saturated fatty acid (18:0). The stearic acid content of the oil studied ranged from 11.1 % (Busia) to 19.8 % (JKUAT), as presented in Table 4.1. One-way analysis of variance showed significant difference ($p < 0.05$) in stearic acid content of the oil from different regions. The fatty acid composition of Yellow oleander seeds oil is slightly higher in unsaturated fatty acid oleic than other fatty acids. This high level of unsaturated fatty acids in this oil can be very useful in reducing the level of cardiovascular diseases if consumed instead of using the saturated fat in the market for cooking. The protein contents of the Yellow oleander seeds studied ranged from 28.2 % (JKUAT) to 30 % (Bondo) based on fresh weight as shown in Table 4.2 One-way analysis of variance showed no significant difference in the protein content of these seeds from different regions ($p > 0.05$). The

protein content of these seeds (28–30 %) compared well with those obtained for Yellow oleander seeds as 37 % in Nigeria (Ibiyemi *et al*., 2002). These values are higher than those of other oil seeds such as cashew nuts (23 %) and cotton (22 %) (FAO, 1983). The protein content of Yellow oleander seeds is lower than that of Soyabean (40 %) (Valnet, 1985). Table 4.3 shows that the seed protein content based on fresh matter weight of Yellow oleander seeds are higher than those reported for important grain legumes and cereals, which contain, in general, 18 % dry matter and 8 to 22 % dry matter, respectively (Singh and Singh, 1992). Thus, these seeds are a potential source of proteins irrespective of their geographical origin.

4.2 shows proximate analysis results (Fwt basis)

Table 4.2 proximate analysis results. The values are means ± SD, n = 3

Region	Oil %	Proteins %	Moisture %	Ash %	Fibre %	Carbohydrates %
Busia	64.47 ± 0.40	29.94±1.20	1.71 ±0.11	2.18 ±1.20	1.80 ±0.70	1.80 ±0.70
Bondo	60.71± 0 .76	30.00±1.00	1.72±0.60	1.18 ±0.30	2.06±0.13	4.30±0.40
JKUAT	63.55± 1.51	28.23±0.30	1.98±0.20	1.61 ±1.00	1.61±0.30	2.70±0.80
MOMBASA	60.00±1.22	29.92±0.80	3.19±1.40	5.46 ±1.00	1.61±0.40	0.73±0.50

The ash content studied ranged from 1.18 % (Bondo), 1.61 % (JKUAT), and 2.18 % (Busia) to 5.40 % (Mombasa) based on fresh weight in Table 4:3. A one-way analysis of variance showed a significant difference $p < 0.05$ in ash content of the seeds from the four locations (appendix 6). A t test showed that the ash value of Mombasa was higher than the other regions. These ash values are not different from those of other oil seeds such as peanuts (2.79 %) Soya bean (5.06%) cotton seed (4 %) and the sunflower seed (4.1 %) (FAO, 1983). The fibre values of these seeds ranged from 1.61 % (JKUAT) to 2.06 % (Bondo) based on dry weight as given in Table 4.3. One-way analysis of variance showed no significant difference ($p > 0.05$) in crude fibre content of the seeds from different regions. These values are close to those of oil seeds such as peanuts (2.79 %) but lower than those of soybean (5.06 %) cottonseeds (4 %) and the sunflower seeds (4.1 %) (FAO, 1983).

Total Carbohydrates were determined by difference (wwt basis). Carbohydrates % = 100 % - moisture % - protein % - oil % - fibre % - ash %. The level of carbohydrates in Yellow oleander seed cake ranged from 0.40 % (Busia) to 4.30 % (Bondo) Table 4.3. One-way analysis of variance showed a significant difference ($p < 0.05$) in carbohydrates content of the seeds. A t test showed that the carbohydrate content of Bondo was higher than the other regions. The carbohydrate levels in the seeds were dependent on the region of cultivation. The Yellow oleander seeds carbohydrates content are similar to those of pumpkin seeds (5.05 %) (Health Notes, 2001). They were lower than those of peanuts (18.6 %) (Oyenuga,1968). Cashew nuts (26.2 %), coconuts (32.7%), cotton seeds (46.7%), sesame (20.2%) and sunflower seeds (26 %) (FAO, 1983). The moisture content of the seeds studied ranged from 1.71 % (Busia) to 3.19 % (Mombasa) based on fresh weight, as presented in Table 4.3. One-way ANOVA showed no significant difference ($p > 0.05$) for moisture content of the seed cake from different regions. The moisture content of Yellow oleander seeds was lower than those of the other seeds such as coconut seeds (14.3 %) (FAO, 1983). The minerals studied in Yellow oleander seeds were divided into the macro (Ca, Mg and K) and the micro (Na, Cu, Fe, Zn and Mn). The results of the mineral analyses are presented in Table 4.3 and 4.4, respectively. One-way ANOVA showed no significant difference ($p > 0.05$) in the contents of the macro elements.

Table 4.3 shows the macro mineral content (fwt basis).

Region /element	Ca (%)	Mg (%)	K (%)
Busia	0.12 ± 0.1	0.19 ± 0.0	1.21 ± 0.4
Bondo	0.10 ± 0.0	0.18 ± 0.1	1.25 ± 0.5
JKUAT	0.20 ± 0.1	0.20 ± 0.1	1.38 ± 0.3
Mombasa	0.22 ± 0.1	0.24 ± 0.0	1.24 ± 0.3

The values are means ± SD, n = 3

Potassium content studied in the Yellow oleander seeds varied from 1.21 % (Busia) to 1.38 % (JKUAT) as presented in Table 4.3. The high content of potassium can be utilized beneficially in the diets of people who take diuretics to control hypertension and suffer from excessive excretion of potassium. The calcium content studied in the Yellow oleander seeds varied from 0.10 % (Bondo), to 0.22 % (Mombasa) as presented in Table 4.3. Virtually all foods contain calcium and dietary calcium intake is the principle root of exposure (WHO, 1983). Magnesium content in the Yellow oleander seeds studied ranged from 0.18 % (Bondo) to 0.24% (Mombasa). The sodium values varied from 800 ppm (Bondo) to 930 ppm (Mombasa) as shown in Table 4.3. One-way t-test analysis of the seed cake showed that sodium content of the seeds was significantly higher ($p < 0.05$) than those of the other micro-minerals. A high potassium / sodium ratio irrespective of the region of origin makes Yellow oleander seeds interesting for diets with a defined electrolytic balance (Stamler, 1994).

Table 4.4 shows the micro-mineral contents lead and cadmium content (wet weight basis).

Crop	Cu (ppm)	Mn (ppm)	Zn (ppm)	Na (ppm)	Fe (ppm)	Cd (ppm)	Pb (ppm)
Busia	28.1 ± 5.2	2.1 ± 1.4	26.2 ± 2.0	890 ± 6.0	23.8 ±1.6	0.19 ± 0.0	0.84 ± 0.1
Bondo	27.0 ± 3.6	2.2 ± 0.1	24.5 ± 1.8	800 ± 10	27.1 ± 1.9	0.18 ± 0.1	0.83 ± 0.3
JKUAT	26.2 ± 4.8	1.4 ± 0.3	25.1 ± 2.1	850 ± 5.8	28.2 ± 2.3	0.17 ± 0.01	0.87 ± 0.1
Mombasa	25.7 ± 3.7	3.3 ± 1.0	27.2 ± 3.2	930 ± 6.2	26.4 ± 2.0	0.2 ± 0.12	0.80 ± 0.0

The values are means ± SD, n = 3

Iron occurs as a natural constituent of plants and animals. The iron content in Yellow oleander seeds cake studied varied from 23.8 ppm (Busia) to 28.6 ppm (JKUAT) as presented in Table 4.4. Estimates of daily requirements of iron depend on age, sex, physiological status and its bioavailability and range from 10-50 mg/day (FAO and WHO, 1983). The average lethal dose of iron is 200-250 mg/ kg of body weight. Death has occurred following the ingestion of as low as 40 mg/kg of body weight (National Research Council, 1979). The recommended daily intake for iron is about 10 mg for children, men, and about 18 mg for women (Warlaw and Kessel, 2002). For pregnant women, the requirement is about 27 mg/day. From Table 4.4, it is apparent that an intake of 100 g daily of defatted Yellow oleander seed cake can provide adequate supplement of iron for pregnant women.

The Zinc content in Yellow oleander seeds cake varied from 24.5 ppm (Bondo) to 27.2 ppm (Mombasa) as presented in Table 4.4. The estimated daily requirements of Zinc range from 3–5

mg/kg for children and 11-14 mg/kg for adults. Depending on zinc salt oral LD50 of Zinc is 350 mg/kg of body weight Zinc Sulphate and 2510 mg/kg Zinc Ethanoate body weight in rats (Sax and Lewis, 1989). From Table 4.4, it is apparent that an intake of 100 g daily of defatted Yellow oleander seed cake can provide adequate daily supplement of zinc physiologically.

The Copper content in Yellow oleander seeds cake studied varied from 25.7 ppm (Mombasa) to 28.12 ppm (Busia) as presented in Table 4.4. Foods such as nuts and seeds contain more than 10 ppm of copper. Depending on animal species, oral LD50 vary between 15 (guinea pigs) and 416 (rats) ppm body weights (Slooff, 1989). The lethal oral dose for human adults lies between 50 and 500 mg of Copper II salt.

5. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The fatty acid composition of Yellow oleander oil was high in unsaturated fatty acids oleic and linoleic acid. The high oil content and high unsaturation of the fatty acids provide sufficient incentive for propagation of Yellow oleander plant to improve its economic status. Other nutritive factors such as proteins, fibre, moisture, ash and mineral contents were favourable for human consumption. A high potassium/sodium ratio irrespective of the region of origin makes Yellow oleander seeds interesting for diets with a defined electrolytic balance. The high content of potassium can be utilized beneficially in the diets of people who take diuretics to control hypertension and suffer from excessive excretion of

potassium. This will help to fight against malnutrition, especially protein–calorie malnutrition thus leading to better nutrition and health in Kenya and Africa in general if the seed cake can be and used for consumption.

Recommendations

Yellow oleander plants from all the four regions have admirable nutritional values. Hence, farmers should be advised to cultivate the plant without reservation to improve their future living standards.

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