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# Quality assessment of oil from *Parkia filicoidea* (Mkundi) seeds

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**Oil was extracted from *Parkia filicoidea* seed, an African locust bean seed locally known as Mkundi and its quality was determined in order to unravel its potential as source of edible oils in Malawi. The quality of the oil was determined by analysis of the iodine value, peroxide, saponification value, acid value, impurity percentage, colour and cloud point. The result showed that Mkundi seeds contain about 12.06 ± 0.26% crude oil with an impurity of 4.2%. The colour of the oil was deep red. The iodine (mg $I_2$/g), saponification (mg KOH/g), peroxide (mEq/g) and acid (mg KOH/g) values ranged from 20.13 to 21.23, 176.72 to 185.13, 1.92 to 2.20 and 3.36 to 4.60, respectively. These values fall within the ranges of edible oils found in the market and, therefore, Mkundi seeds are potentially a source of edible oil in Malawi.**

**Key words:** *Parkia filicoidea*, edible oils, quality, Malawi, African locust bean seed.

## INTRODUCTION

Natural vegetable oils and fats are increasingly becoming important in nutrition as well as the manufacturing industry worldwide. Nutritionally, vegetable oils are important sources of dietary energy and antioxidants. In the manufacturing industry, they are used as raw materials for the manufacture of various food, cosmetic, pharmaceutical and chemical products. Vegetable oils account for 80% of the world's natural oils and fat supply (Okullo et al., 2010).

Vegetable oils are sourced from diverse varieties of leguminous plants. With an ever increasing demand for vegetable oils for food and industrial applications, there is need for considerable expansion of oilseed crop production (Çamaş et al., 2007). This expansion can be achieved by exploring other sources of vegetable oils, especially underutilized oilseeds (Popoola et al., 2016).

Africa is one of the continents endowed with richest biodiversity in the world with an avalanche of many food plants used as herbs, health foods and for therapeutic purposes (Farombi, 2003), one of which is the African locust bean. The African locust bean tree is a perennial tree which belongs to sub-family, Mimosodee and family Leguminosae (now Fabaceae) (Akande et al., 2010). Locust bean tree is a leguminous crop peculiar to the tropics. The tree is not normally cultivated but can be seen in population of two or more in the savannah region of West Africa (Hopkins, 1983). The various types of African locust bean tree are *Parkia clappertoniana,*

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**Table 1.** Physicochemical properties of *P. filicoidea* seed oil extracted.

| Property | Value |
|---|---|
| Colour (Lovibond) | 9.3R, 4.0B, 35.0Y: Deep red |
| Iodine value, Wij's (g of I/100 g oil) | 20.72 ± 0.55 |
| Saponification Value, mg KOH/g | 148.46 ± 4.28 |
| Acid value, mg KOH/g | 4.04 ± 0.63 |
| Cloud point | 4°C |
| Peroxide value, mg $O_2$/g | |
| Fresh | 1.95 ± 0.30 |
| After 2 weeks | 2.17 ± 0.31 |

*Parkia bicolor, Parkia filicoidea* and *Parkia biglobosa.* In Malawi, locust bean (*P. filicoidea*) is found in abundance as the wild uncultivated type. It grows well in Zomba, Nkhatabay and Ntchisi districts where the climate is temperate (Forestry Research Institute of Malawi, 1998).

The locust bean seed is widely used for its remarkable nutritional and dietary value. The seeds are rich in protein, lipids and vitamin B2 and when fermented are rich in lysine. The fat in the beans is nutritionally useful (approximately 60% unsaturated). The fermented locust bean seeds are commonly used in soups and stews (Owolarafe et al., 2011). The locust bean seed is also rich in carbohydrate, soluble sugars and ascorbic acid and the cotyledon is very nutritious, has less fibre and ash contents (Alabi et al., 2005). Its oil is suitable for consumption since it contains very low acid and iodine contents; it has essential acids and vitamins and serves as a protein supplement in the diet of poor families and has been reported to be non-toxic. The oil also has very high saponification value and hence would be useful in the soap industry (Aiyelaagbe et al., 1996).

Currently in Malawi, the focus is on sunflower, groundnuts, soybeans and cotton as the main four oil seeds (Ministry of Trade and Industry, 2014). These conventional sources of vegetable oil have little impact on meeting the increasing demand of vegetable oil for both human and industrial use. Hence, there is need to supplement the supplies with other sources, especially underutilized oilseeds (Popoola et al., 2016). With the current research trend towards the use of unconventional oil seeds for commercial vegetable oil production, it is worthwhile to examine the physico-chemical characteristics of oils from some of these less common seeds that, at present, exist as uncultivated types in order to explore their wider exploitation. Hence, this study was carried out to extract oil from *P. filicoidea* (Mkundi) seeds and evaluate its quality as a natural source of edible oils in Malawi

## MATERIALS AND METHODS

Mature seeds were collected from Zomba and Nkhatabay districts of Malawi in the months of January and February. The seeds were sun-dried to facilitate handling during removal of husks and for easy crushing. The husks were carefully removed using a scalpel blade to avoid damaging the seed inside. The seeds were then ground using a mortar and a pestle.

### Oil extraction

Oil was extracted from the samples using Soxhlet apparatus with diethyl ether as the extracting solvent. After extraction, the solvent was removed from the extract through evaporation on rotatory evaporator followed by in an oven set at 40 to 60°C. The extracted oil was subsequently used for analysis (Caltest Standard Operating Procedure, 2009). The oil obtained was stored under refrigeration (4°C), until used for further analysis.

### Analysis of the oil

#### *Physical and chemical parameters of Mkundi oil*

The extracted Mkundi oil was analyzed for some important physical and chemical properties. Oil yield, color, cloud point, acid, iodine, saponification and peroxide values of the oil were determined using standard American Oil Chemists' Society methods (AOCS 1997). The percentage impurity of the oil was determined using standard Official Methods of Analysis of the Association of Analytical Chemists (AOAC, 1990).

### Statistical analysis

The statistical analysis was performed using Statistix 8 for Windows (Analytical Software, Tallahassee, USA). All analyses were performed in triplicate. Data were expressed as mean ± standard deviation (SD) and statistical significance was assigned at $P \leq 0.05$ level.

## RESULTS AND DISCUSSION

### Physicochemical properties

The knowledge of physical and chemical properties of edible oils is important, having a role in processing functionality, storage stability and nutritional behaviour. Physicochemical properties of the extracted Mkundi seed oil are presented in Table 1.

The major characteristics usually included in national

**Table 2.** Requirements for edible oils from the four main oil seeds in Malawi.

| Physicochemical property | Cotton | Groundnut | Sunflower | Soybean |
|---|---|---|---|---|
| Acid value, mg KOH/g | 0.6 | 4 | 0.6 | 4 |
| Colour | Dependent on gossypol content | 35Y, 4R | 25Y, 3R | Not specified |
| Free Fatty Acids (% by mass, maximum) | <0.15 as oleic acid | <0.15 as oleic acid | <0.15 as oleic acid | <0.15 as oleic acid |
| Iodine value, Wij's | 100-115 | 80-106 | 126-135 | 120-143 |
| Moisture and volatile matter (% by mass, maximum) | 0.1 | 0.1 | 0.1 | 0.1 |
| Peroxide value, mg $O_2$/kg (maximum) | 2 | 2 | 2 | 2 |
| Refractive index | 1.4580 - 1.4660 at 40°C | 1.4680 - 1.4720 at 2 °C | 1.4670 -1.4690 at 4 °C | 1.4660 -1.4700 at 4 °C |
| Saponification Value, mgKOH/g | 189-198 | 188-196 | 188-194 | 189-195 |
| Unsaponified matter, (% by mass, maximum) | 15 | 10 | 15 | 15 |

and international standards and trading specifications and used for quality control for crude oils in laboratories include the free fatty acids, iodine value, saponification value, refractive index, specific gravity, unsaponifiable matter, moisture and impurities. These are intended to give a quick impression of the authenticity of the oil and the likely losses in refining (Gunstone, 2002). However, vegetable oils generally exhibit considerable deviations in their composition, thus it is difficult to define single values for chemical and physical properties of edible oils (Shatta et al., 2016). The characteristic requirements for edible oils in Malawi as set by the Malawi Bureau of Standards, a national quality regulatory body (MBS, 2011) are shown in Table 2.

The average oil content of *P. filicoidea* seeds was found to be 12.06 ± 0.26% with an impurity of 4.2%. Its colour was deep red. The results indicate low oil content as compared to oil yield reported by Talabi and Enujiugha (2014) for African locust bean (*P. filicoidea)* as 20.68±0.71%. The cloud point was found to be 4°C, indicating that the oil can be stored at lower temperatures (Roiaini et al., 2015).

Acid value is often used an indicator for edibility of oil and suitability for industrial use (Augustine et al., 2013). Oils with high acid value are not suitable for cooking but can be utilised in the soap making and paint industries. Low acid values indicate stability over long periods of storage and suitability for consumption (Aiyelaagbe et al., 1996). The acid value obtained in this study (4.04 ± 0.63 mg KOH/g) is comparable to those of other vegetable oils most common in Malawi (Table 2). However, the acid value of the oil is lower than the ones reported for *P. biglobosa* seed oil and Shea nut (*Vitellaria paradoxa)* oil of 9.48 and 11.79 mg KOH/g, respectively (Augustine et al., 2013). Thus, the Mkundi seed oil could be utilised as edible oil as well as raw material for soap making and paint industries.

The iodine value is also an important characteristic of seed oils that guides its application in a processing industry and its classification. Oils with iodine value of less than 100 g I2/100 g are classified as non-drying oils (Igunbor et al., 2013). Non-drying oils are not suitable for ink and paint production due to their non-drying characteristics but may be useful in the manufacturing of soaps, leather and dressings, and as candle lubricants and hydraulic break fluids (Aremu et al., 2015; Adelaja, 2006; Kochhar, 1998). The iodine value obtained in this study (20.72 ± 0.55) clearly indicates that the Mkundi seed oil is a non-drying oil and could therefore be utilised as a raw material in the manufacture of leather, dressings, as candle lubricants and hydraulic break fluids (Aremu et al., 2015).

The iodine value also indicates the degree of unsaturation of a fat or oil which reflects the susceptibility of the oil to oxidation (Gunstone, 2002). Aremu et al. (2006) reported that the lower the iodine value, the lesser the number of unsaturated bonds; thus, the lower the susceptibility of such oil to oxidative rancidity. The low iodine values in this study indicate that the oil contains low level of polysaturated fatty acid and hence reduce the susceptibility to oxidative rancidity. This is also supportedby the peroxide value obtained which is also an indicator of deterioration of oil (rancidity); peroxide values (meq $O_2$/kg) less than 10 signify fresh oils and values between 20 and 40 leads to rancid taste (Adelaja, 2006). The peroxide value (mg $O_2$/g) for the fresh Mkundi seed oil was 1.95 ± 0.30 which rose to 2.17 ± 0.31 after two weeks of storage at room temperature. This falls within the required peroxide values for conventional oils and confirms the low susceptibility of the Mkundi oil to rancidity (Augustine et al., 2013; MBS, 2011).

The saponification value gives a measure of the average molecular weight of the fatty acids present in the oil which also govern the utilisation of the oil (Talabi and Enujiugha, 2014; Alabi et al., 2005; Akanni et al., 2005). Talabi and Enujiugha (2014) reported that Locust bean seed *(P. filicoidea Welw)* oil with high saponification value (358.69 mg/g) contained low molecular weight fatty acids and may not be useful in soap making. Aalbi et al. (2005) reported saponification value of 160.60 ± 1.21 mg/g for oil derived from the cotyledon of *P.biglobosa* seed oil and suggested that the oil could be used in soap making industry. Akanni et al. (2005) reported saponification values ranging between 169.98 ± 4.25 and 239.830 ± 1.155 mg/g for some non-conventional seed oils and suggested that the oils contain high molecular weight fatty acids, and could be used in soap making industry. The saponification value obtained in this study (148.46 ± 4.28 mg/g) indicates the presence of lower molecular weight fatty acids in the Mkundi seed oil and thus not suitable for soap making.

## Conclusion

The results of this study show that the Mkundi seed is potentially a good source of edible oil with low iodine and acid values; however, the yield of the oil is low. Physicochemical properties of Mkundi seed oil indicate that it is non-drying oil, has low levels of polyunsaturated fatty acids and has low susceptibility to deterioration by oxidation. However, there is need for further research on toxicity levels of the oil before its exploitation as edible oil in Malawi.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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