CHARACTERISTICS OF SEED KERNEL OIL FROM *PODOCARPUS FALCATUS*

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FELEKE S, HAILE F, ALEMU A & ABEBE S. 2012. Characteristics of seed kernel oil from *Podocarpus falcatus*. The objective of this work was to evaluate the yield and physicochemical characteristics of fixed oil, namely, *Podocarpus falcatus* oil from different provenances. Mature fruits of *P. falcatus* collected from four sites (Assela, Kersa, Hirna and Shashemene) were extracted using Soxhlet apparatus with hexane. The average moisture content of *P. falcatus* seed kernel was 8.31% and the oil yield 52.96% (maximum 57.34% and minimum 50.89% from Hirna and Assela sites respectively) of dry kernel weight. Analysis of variance showed that there was no significant variation in oil yield between provenances. There were significant variations in saponification value and refractive indices between provenances of the oil. The specific density (0.89), saponification value (189.3 KOH mg g^{-1}) and refractive index (1.47) of the oil extracted from kernels of *P. falcatus* were compared with common edible oil. The oil obtained from *P. falcatus* seed kernel could therefore be used in the production of edible oil.

Keywords: Saponification value, refractive indices, fruit, oil yield, provenance

FELEKE S, HAILE F, ALEMU A & ABEBE S. 2012. Ciri-ciri minyak daripada minyak isirung *Podocarpus falcatus*. Objektif kajian ini adalah untuk menilai ciri-ciri minyak lemak *Podocarpus falcatus* yang berasal dari provenans berbeza. Buah *P. falcatus* yang matang dikumpul dari empat tapak iaitu Assela, Kersa, Hirna dan Shashemene dan seterusnya diekstrak menggunakan heksana dalam radas Soxhlet. Purata kandungan lembapan biji benih *P. falcatus* ialah 8.31% daripada berat kering isirung sementara hasil minyaknya ialah 52.96% (maksimum 57.34% dari provenans Hirna dan minimum 50.89% dari Assela). Analisis varians menunjukkan bahawa tidak terdapat perbezaan signifikan dalam hasil minyak antara provenans. Terdapat perbezaan signifikan dalam nilai penyabunan serta indeks refraktif dalam minyak antara provenans. Ketumpatan tentu (0.89), nilai penyabunan (189.3 KOH mg g^{-1}) dan indeks refraktif (1.47) minyak yang diekstrak daripada isirung *P. falcatus* dibandingkan dengan minyak makan biasa. Keputusan menunjukkan bahawa minyak isirung biji benih *P. falcatus* dapat diguna untuk menghasilkan minyak makan.

INTRODUCTION

Podocarpus falcatus, which belongs to the family Podocarpaceae, grows at 1500–2500 m altitude above sea level in areas with mean annual rainfall of 1200–1800 mm (Azene 2007). It is an evergreen tree reaching up to 46 m in height with long, clean cylindrical trunk. This species is native to east and southern Africa, especially the Afromontane forest. In Ethiopia, *P. falcatus*, locally known as podo, is mainly found in Assela, Bale, east of lake Awasa, Jemjem and the Megada forests of Sidamo and Wollega (Getachew & Demel 2005).

The timber of *P. falcatus* is used for construction and household utensils. Being free of odour and taste, it is locally the most preferred timber for butter and cheese boxes and other food containers. Podo wood has a density ranging from 480 to 599 kg m^{-3} at ambient conditions (WUARC 1995). Due to the intensive utilisation of its timber, it is currently found in the highlands as scattered trees, restricted to farmlands and patches around riverbanks. Apart from timber values, podo also has non-timber value. In some areas of Ethiopia, e.g. Assela, Shashemene and Hirna, local communities collect the fruit of *P. falcatus* growing in their areas to produce edible oil.

The fruit (which is actually the seed) of *Podocarpus* tree is greenish-blue ovoid in shape, about 1–1.85 cm long and 1–1.25 cm in diameter. It turns yellowish to purplish when ripe and contains a single seed in hard-shelled coat. In the traditional way of oil extraction, sun-dried seed is crushed, heated in a pan and boiled with water to produce approximately 10% oil (Demel 1994).

There is an increasing need for the screening of potential oil-bearing crops or trees from underutilised resources based on their physicochemical parameters. Therefore, the aim of this study was to investigate the yield and physicochemical characteristics of oil produced from *P. falcatus* of different provenances (location).

MATERIALS AND METHODS

Sample collection and preparation

Fruits of *P. falcatus* were collected from four sites, namely, Assela, Kersa, Hirna and Shashemene in Ethiopia for two successive years, i.e. 2004 and 2005. Four trees in each site were randomly selected and mature fruits collected. The epicarp (outer cover) and mesocarp (pulp) of the fruits were removed manually and the nuts were dried under shade for a week with frequent spreading to control fungal growth at 20–22 °C. Moisture content of the kernel was determined by drying at 105 °C in an oven.

Extraction and chemical analysis

Oil from samples of each tree was separately extracted with hexane in Soxhlet apparatus for 3 hours boiling at 70 °C. Physicochemical properties (oil content, refractive index, saponification value, peroxide value and specific density) were determined according to AOAC (2000). Refractive index n_D was measured at 25 °C using a refractometer with a sodium lamp.

Data analysis

Results were expressed as mean values of three replicate measurements. A one-way analysis of variance (ANOVA) was used to analyse the variation in oil yield, saponification values, peroxide values and refractive indices. Analyses of means of the treatments were carried out using least significance difference (LSD) at $p < 0.05$.

RESULTS AND DISCUSSION

An average of 250 g (25%) kernel was obtained from a kilogram of dry fruit. Average moisture content of *P. falcatus* kernel was 8.31%, while average oil content was 52.96% on dry weight basis. However, there was no significant difference in oil yield between provenances although the highest yield was obtained from samples from Hirna (57.34%) and lowest, Assela (50.89%) (Figure 1). Comparing with published works, oil yield of *P. falcatus* seed kernel was slightly higher than the common oil crop niger seed (40%) and some tropical trees such as *Terminalia bellirica* (47%), *Trichilla emetica* (51%), *Solanum nigrum* (34%) and *Balanites aegyptica* (46–50%) (Abu-Al-Futuh 1983, Seegler 1983, Nag & De 1995, Dhellot et al. 2006).

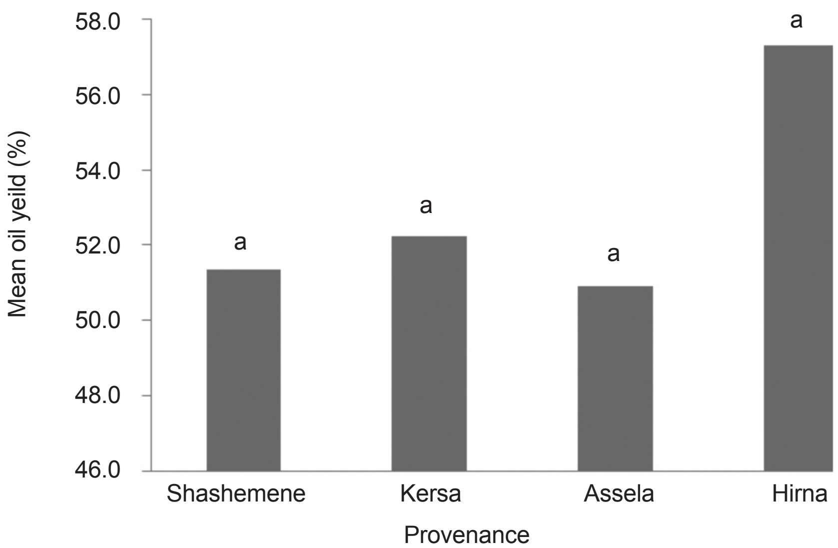

Figure 1 Mean oil yeild from *Podocarpus falcatus* seed kernel; means with similar letters are not significantly different at $p < 0.05$

Results obtained in this study for refractive index, saponification value and specific density of *P. falcatus* were in agreement with characteristics of most edible oil such as niger, linseed, cotton seed and *B. aegyptica* oils (Abu-Al-Futuh 1983, Seegler 1983). There were significant variations in refractive index between oil of different provenances as presented in Figure 2. The average refractive index (1.47) of oil extracted from kernels of *P. falcatus* was similar to those of common niger (1.46–1.48) and watermelon (1.47) seeds (Nkafamiya et al. 2007). Refractive indices of natural fats and oils are related to the degree of unsaturation and with saponification value of the oil (Rudan-Tasic & Klofutar 1999, Gerhard 2002).

The average saponification value of *P. falcatus* kernel oil in this study was 189.3 KOH mg g^{-1}. This value is within the range of oil seeds from common oil crops (188–198 mg g^{-1}), watermelon (201 mg g^{-1}) and baobab (196 mg g^{-1}) (Nkafamiya et al. 2007, Zeomar et al. 2008). The saponification value of the kernel oil from the four provenances ranged from 113 to 248. Oil with high saponification value are composed of high molecular weight components (Gerhard 2002). *Podocarpus falcatus* oil from Shashemene had the highest saponification value.

A high peroxide value of the oil, i.e. 36.8 meq kg^{-1} was observed in this study. This may be due to the auto-oxidation of fatty acid components mainly linoleic acid and storage condition, i.e. at room temperature with sunlight exposure (Gunstone 1999, López et al. 2001, Ozlem 2008). High peroxide value was reported for camelina oil stored at high temperature and exposed to light for more than a month (Abramovič & Abram 2006). Furthermore, the positive test for rancidity indicated a low shelf life level of the oil. Freshly extracted edible oil is expected to have an acceptable shelf life, i.e. 5–8 years. This means its peroxide value should be less than 5 meq kg^{-1} (Gunstone 1999, Rudan-Tasic & Klofutar 1999). However, there are reports indicating that even freshly pressed olive oils have peroxide value of about 5 meq kg^{-1}. For example, oil extracted from *S. nigrum* exhibited 7.4 meq kg^{-1} (Dhellot et al. 2006). Generally, the higher the peroxide values, the higher the probability of the oil to become rancid.

There was no significant difference between sites for specific density of the extracted oil (Figure 4). The specific density (0.90) of the oil from the kernels of *P. falcatus* agreed well with the data reported for edible oil of common oil seeds (0.91–0.93) such as niger, rapeseed, linseed, sunflower, watermelon seed kernel oil (0.92) and *Sterculia striata* (0.85) (Seegler 1983, Nag & De 1995, Onyeinke & Acheru 2002).

In conclusion, the *P. falcatus* kernel oil had good physicochemical properties in comparison with common edible oil crops. Therefore, it could be used in the production of edible oil and value-added products. The production of oil from the *P. falcatus* tree and its popularisation

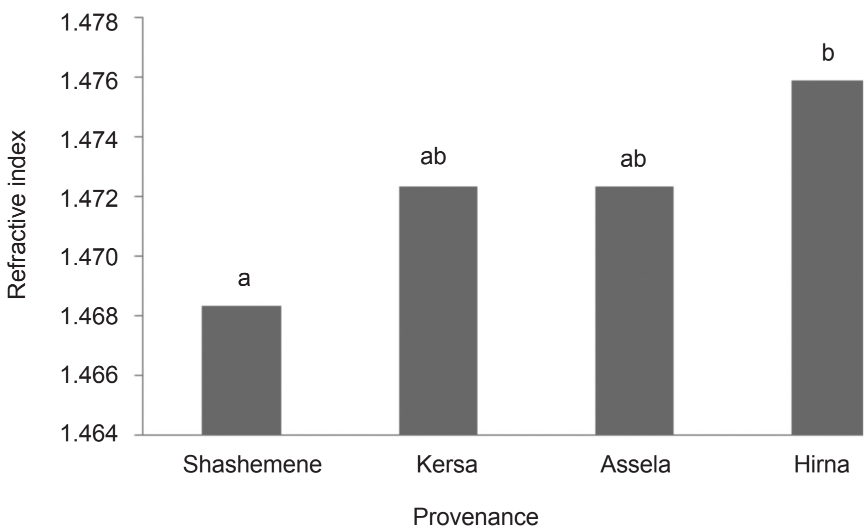

Figure 2 Refractive index of oil from *P. falcatus* oil; means with similar letters are not significantly different at $p < 0.05$

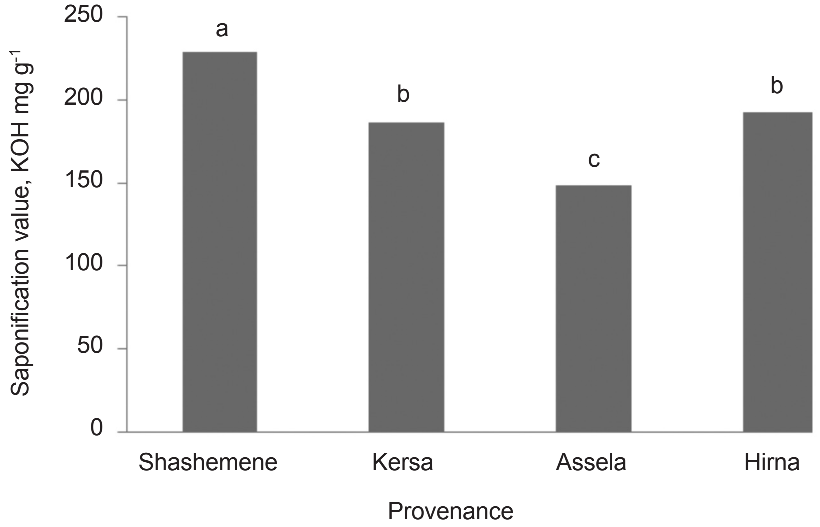

Figure 3 Saponification value of *P. falcatus* oil; means with similar letters are not significantly different at $p < 0.05$

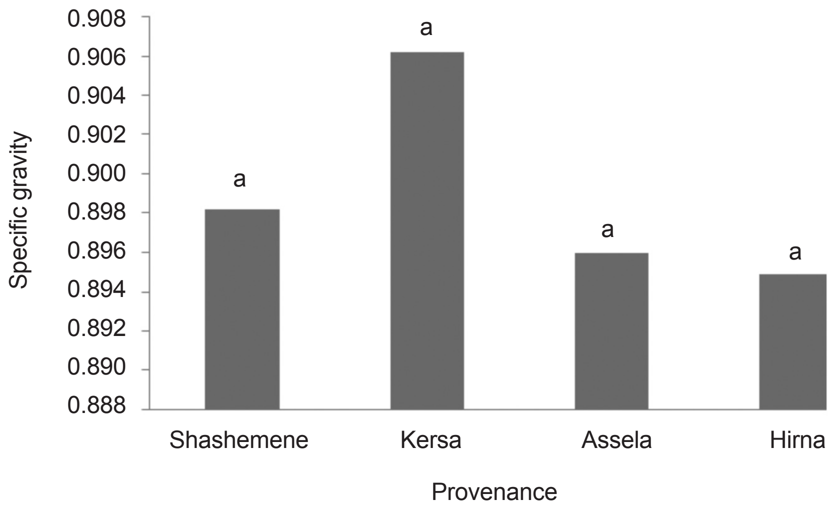

Figure 4 Specific gravity of *P. falcatus* oil; means with similar letters are not significantly different at $p < 0.05$

to other areas may directly contribute to income generation of the community besides ensuring the conservation of the species.

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