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Characterization of Namibian *Sclerocarya birrea* (Marula/*Ondjove*) oil

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ABSTRACT

In northern Namibia, *Sclerocarya birrea* (A.Rich.) Hochst (Marula) oil is produced traditionally from the kernel of the Marula fruit by local women of the Awambo tribe for sale in local markets and for household use. The yellow oil, also called locally, ondjove oil, is used for food and cosmetics applications. Various local enterprises, such as the Eudafano Women’s Cooperative based in the town of Ondangwa, are producing cold-pressed virgin Marula oil from the kernels purchased from local women, which is also sold locally and some being exported for the international cosmetics market. The aim of the study was to analyze the physico-chemical properties of Marula oil from Namibia prepared by two different extraction methods as it is a valuable commercial product with potential developments in the food and cosmetics industry. Physico-chemical characterization was carried out for the traditional prepared (MaTrd) and cold-pressed Marula (MaCld) oil. Compositional analysis of the oils was carried out with GC-MS, ¹³C-NMR and ¹H-NMR. MaTrd oil had acid value, 1.64 (±0.10) mg KOH/g, saponification value, 186.61 (±0.85) mg KOH/g, iodine value (Hanus), 66.96 (±0.57), peroxide value, 0.186 (±0.006) mequiv/kg, anisidine value, 0.0781 (±0.0341), specific gravity, 0.916 (±0.001), and refractive index, 1.4645 (±0.001). MaCld oil had acid value, 5.16 (±0.057) mg KOH/g, saponification value, 187.94 (±0.55) mg KOH/g, iodine value (Hanus), 70.22 (±1.10), peroxide value, 0.122 (±0.016) mequiv/kg, anisidine value, 0.0797 (±0.0261), specific gravity, 0.914 (±0.003), and refractive index, 1.4645 (±0.003). Fatty acid analysis of MaTrd and MaCld revealed the presence of major fatty acids such as palmitic (16.28% and 16.72%), stearic (14.09% and 13.21%), and oleic acid (66.56% and 67.33%) respectively.

INTRODUCTION

Sclerocarya birrea (A. Rich) Hochst. Subsp. *caffra* (Sond.) Kokwaro of the family Anacardiaceae (the mango family), is a medium sized tree (about 10 m or more in height), with fruits (indehiscent) appearing February to June and becoming yellow when ripe (Palgrave, 1983). *S. birrea* is related to the mango family and is drought resistant producing plum sized fruits that are butter yellow when ripe (NBRI, 2016a). For the rural communities of southern Africa, the Marula tree is an important segment of their culture and food, but has over the years become a focus for commercial opportunities (Wynberg et al. 2002). The Marula tree is of great social, cultural and economic importance to the Aawambo communities of northern Namibia. Fruits are harvested from the ground in January to May and the fruit flesh is removed to make certain beverages, while the kernels are left to dry in the sun for oil extraction at a later stage. The intact seed kernels can be stored for up to one year before decortication (Travel News Namibia, 2012) and subsequent marula oil production.

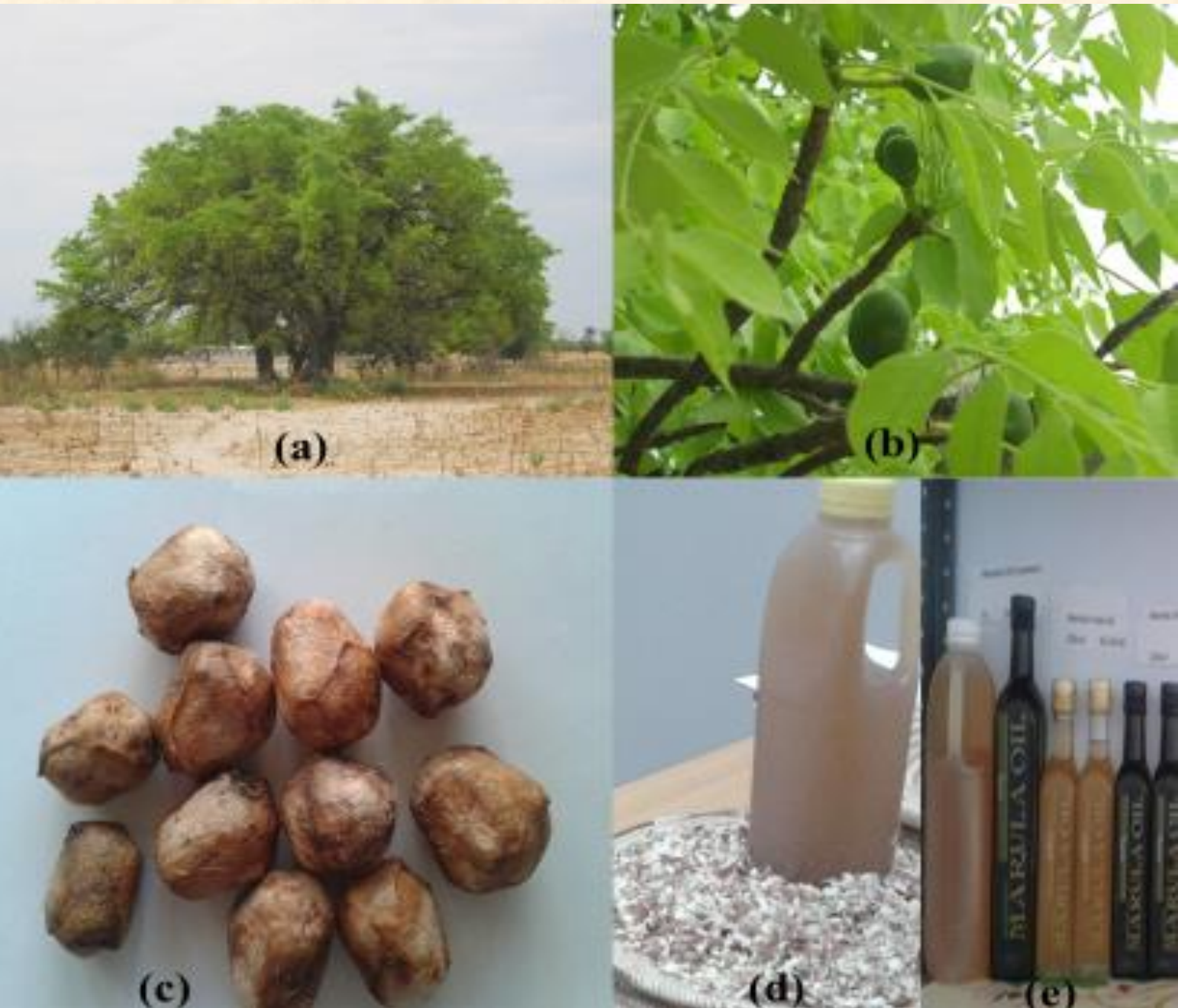


Figure 1 (a-e): Tree (a), leaves and fruits (b), dried kernels (c), traditional oil and nuts (d), bottled cold pressed oil at Eudafano Women’s Cooperative for sale (e) of *S. birrea*.

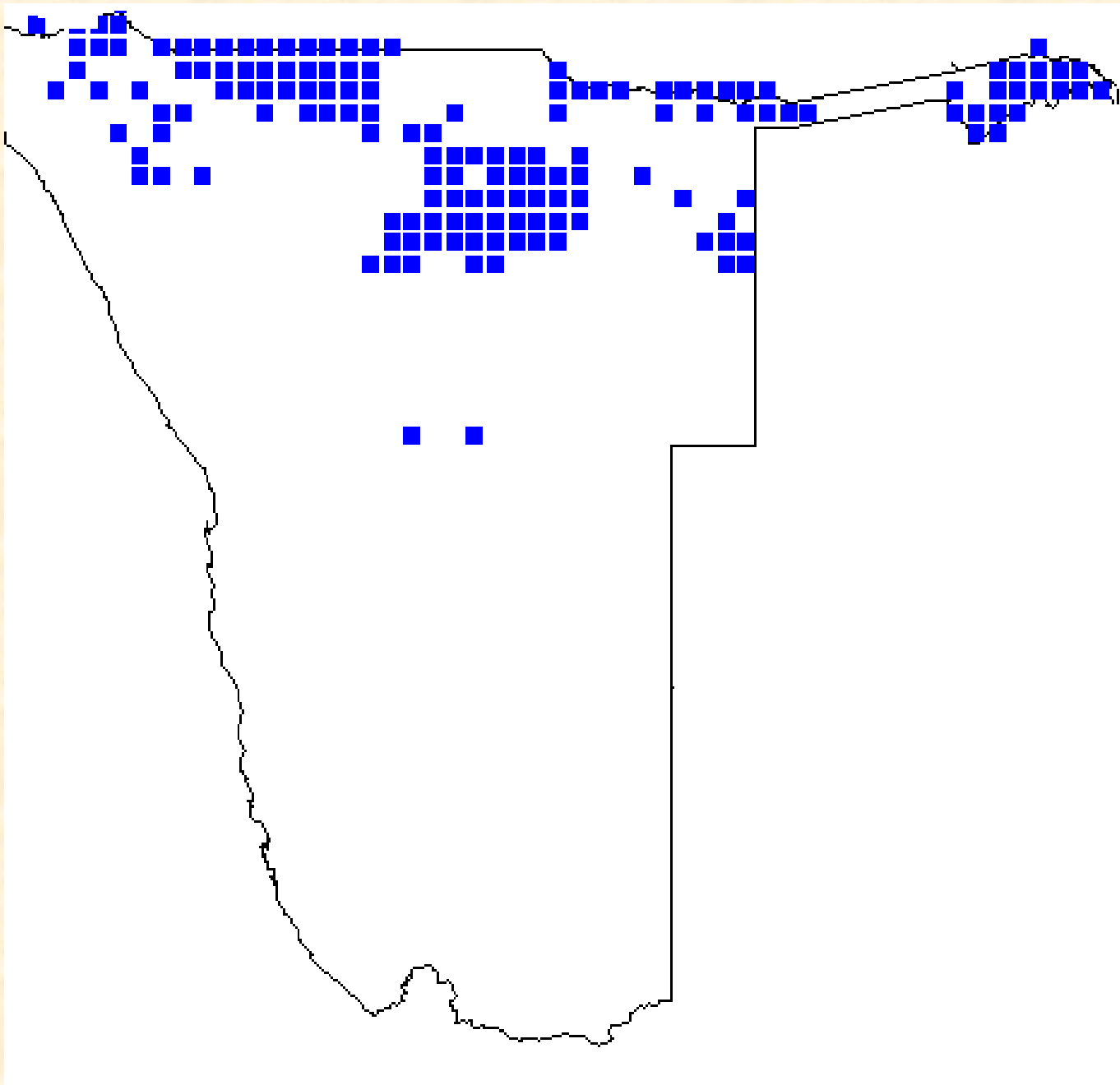


Figure 2: Distribution of *S. birrea* trees across Namibia (Adopted from Curtis & Mannheimer, 2005).



Figure 3: Traditional method of Marula oil production.

METHODS

Cold pressed Marula oil was purchased from the Eudafano Women’s Cooperative in Ondangwa. The traditionally prepared Marula oil was purchased from traditional homesteads. The acid value (AV), iodine value (IV), saponification value (SV) were analyzed according to the AOAC Official Methods (1998). Peroxide value (PV) and *p*-anisidine value were analyzed according to Jayaprakasha, Singh & Sakariah (2001) and AOAC Official Method: Cd 18-90 (1993), respectively. Specific gravity (SG) was determined according to AOAC method No. 40.1.08 (1990) and the refractive index using an ABBE refractometer (K7135, MRC) at 25 °C. ¹³C-NMR and ¹H-NMR were used for analysis of acyl compositions and GC-MS to determine fatty acid compositions.

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RESULTS

Table 1: Physico-chemical characteristics of Marula oil

Characteristic	Traditional	Cold-pressing
Oil appearance	Light yellow	Yellow
State of oil at 25 °C	Liquid	Liquid
Saponification value (mg KOH/g oil)	186.61 ± 0.85 ^a	187.94 ± 0.48 ^a
Average molecular weight (g/mol)	901.88 ± 4.08 ^a	895.52 ± 2.28 ^a
Acid value (mg KOH/g oil)	1.64 ± 0.10 ^a	5.16 ± 0.16 ^b
Ester value	184.98 ± 0.75 ^a	182.77 ± 0.63 ^a
Peroxide value (mequiv/kg)	0.190 ± 0.01 ^a	0.122 ± 0.02 ^b
<i>p</i> -anisidine value	0.083 ± 0.01 ^a	0.076 ± 0.02 ^a
Iodine value (Hanus)	66.96 ± 0.41 ^a	70.22 ± 1.10 ^b
Specific gravity (20 °C)	0.916 ± 0.001 ^a	0.914 ± 0.003 ^a
Refractive index (25 °C)	1.4645 ± 0.001 ^a	1.4645 ± 0.003 ^a

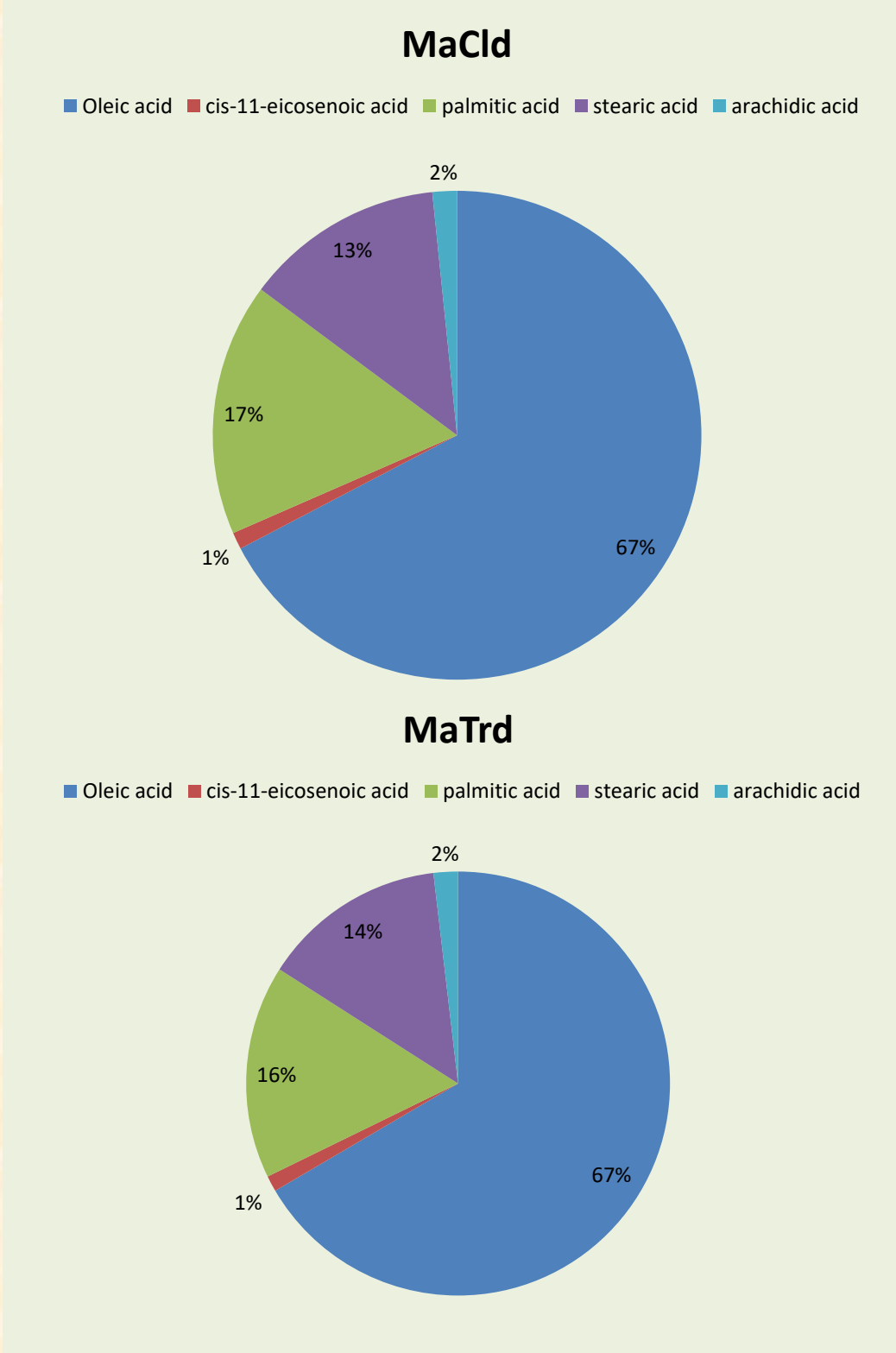


Figure 4: Fatty acid composition

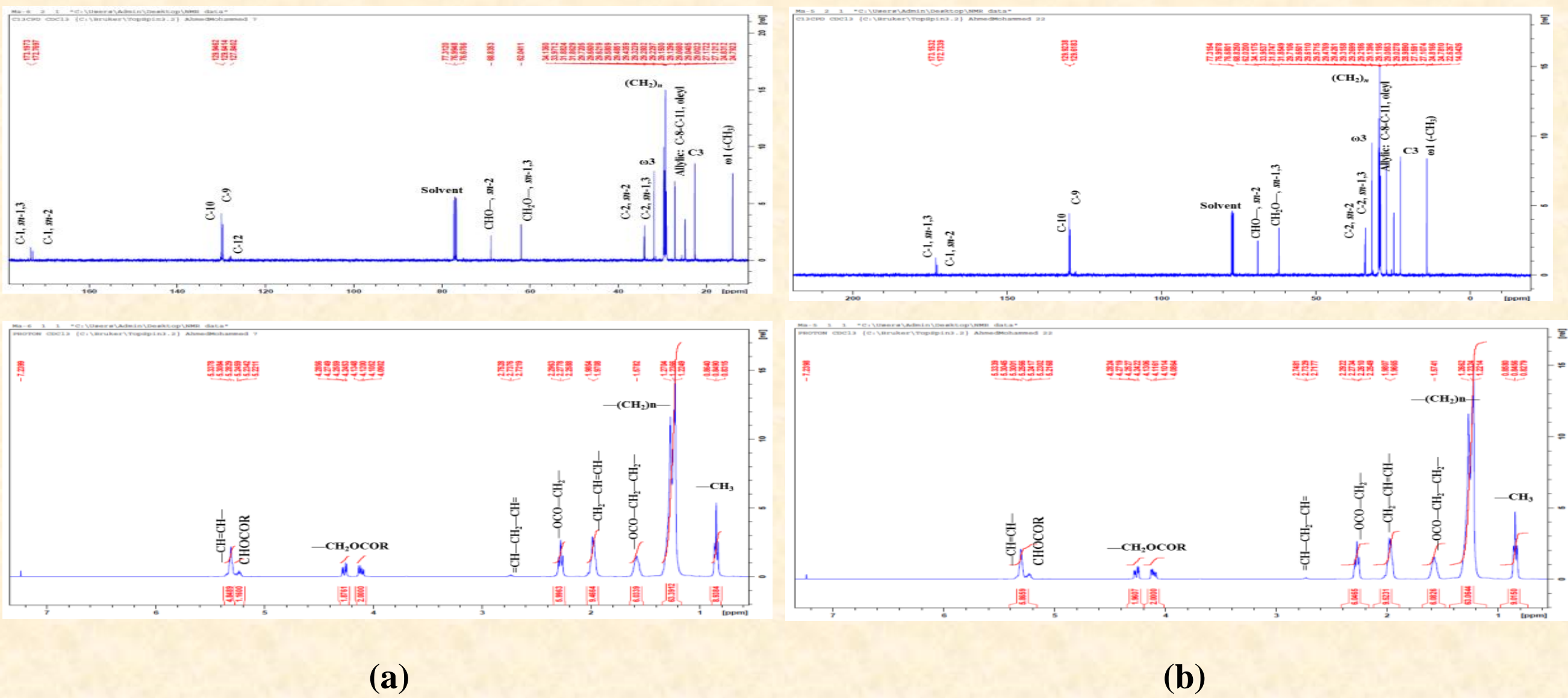


Figure 5 (a,b): ¹³C NMR and ¹H NMR (400 MHz, CDCl₃) spectra of cold pressed Marula oil (a), ¹³C NMR and ¹H NMR (400 MHz, CDCl₃) spectra of traditional Marula oil (b).

CONCLUSION

In Namibia, Marula oil is made traditionally in households and the cold pressed version is produced by a very limited number of small enterprises. It is very popular by the international community for use in cosmetic formulations. The oil possesses good quality characteristics making it suitable for food and cosmetic applications. Marula oil holds great economic importance for Namibia and can be an asset for development to improve the livelihoods of local communities and towards food security initiatives. Namibia’s indigenous seed oils are part of a rich cultural diversity and their characterization holds great potential towards the development of value-added products and their commercialization.

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