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Chemical composition and nutritional properties of *Terminalia catappa* L. oil and kernels from Benin

Composition chimique et propriétés nutritionnelles des amandes et huile de fruits de Terminalia catappa *L. du Bénin*

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ABSTRACT

This work focuses on the physico-chemical characterization of kernels and oil of *Terminalia catappa* L. from Benin. The detailed physico-chemical properties are given including the nutritional composition and fatty acid profile, but also the phenolic content, phytochemical screening and antioxidant capacity which were determined for the first time. The kernel (100 g) contained 5.5 g of moisture, a high level of lipids (64.7–140.4 of Recommended Daily Intake (RDI)), proteins (36.0% RDI), sugars (6.0% RDI), and tannins (0.6%). The defatted kernels (100 g) contained high levels of manganese (184.8–236.1% RDI), magnesium (173.6–235.2% RDI), iron (89.7–201.9% RDI), zinc (87.9–120.9% RDI) and calcium (41.5% RDI), and contributed for 98.6% of RDI proteins. The kernel oil showed a high level of unsaturated fatty acids including oleic (27.1%) and linoleic acids (26.6%) and saturated fatty acids such as palmitic acid (40.0%) as well as several phytosterols and triterpenes. These kernels and their unsaturated oil are of interesting nutritional value but could also be used as a biofuel or lubricant. The presence of phenolic and terpenic derivatives may also explain at least in part their use in traditional medicine.

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RÉSUMÉ

La caractérisation physico-chimique de l'huile et des amandes de fruits de *Terminalia catappa* du Bénin a été réalisée. Les propriétés physico-chimiques ont été analysées, notamment la composition nutritionnelle et le profil en acides gras, mais aussi la teneur en polyphénols, le criblage phytochimique et l'activité antioxydante, qui ont été déterminées pour la première fois. Les analyses réalisées montrent que 100 g d'amandes contiennent 5,5 g d'humidité, un taux élevé de lipides (contribuant pour 63,7 à 140,4% de la dose journalière recommandée (DJR)), de protéines (36,0% de DJR), de sucres (6,0% DJR) et de tanins (0,6%). L'amande délipidée contient des taux élevés de manganese (184,8–236,1% DJR), de magnésium (173,6-235,2% DJR), de fer (89,7-201,8% DJR), zinc (87.9–120.9% DJR) et calcium (41.5% DJR), et contribue pour 98,8% de la DJR en protéines. L'huile est riche en acides gras insaturés, tels que l'acide oléique (27,1%) et l'acide linoléique (26,6%), et en un acide gras saturé, l'acide palmitique (40,0%), et contient aussi des phytostérols et triterpènes. Ces amandes et cette huile de type insaturé ont une valeur nutritionnelle intéressante et peuvent aussi être utilisées comme biocarburants ou lubrifiants pour moteurs. La présence de composés phénoliques et terpéniques peut aussi expliquer, au moins en partie, leur usage en médecine traditionnelle.

1. Introduction

Nuts have been the food of man from the earliest times in many parts of the world [1]. The interest on nuts is based on their nutritive value as they contain a significant amount of high quality proteins and vital minerals [2]. The superior quality of nut proteins makes them good substitutes for animal food, but nuts are also good sources of edible oils and fats [3].

Terminalia catappa (Tropical almond) is a large, spreading tree now distributed throughout the tropics in coastal environments. The tree is tolerant to the strong winds, the salt spray, and moderately to a high salinity in the root zone. It mainly grows in freely drained, well aerated, sandy soils. The species has traditionally been very important for coastal communities, providing a wide range of non-wood products and services. It has a spreading, fibrous root system and plays a vital role in coastline stabilization [4]. It is widely planted throughout the tropics, especially along sandy seashores, for shade, ornamental purposes, and edible nuts. The timber makes a useful and decorative general-purpose hardwood and is well suited for conversion into furniture and interior building timbers. Fruits are produced from about 3 years of age, and the nutritious, tasty seed kernels may be eaten. Tropical almond, easily propagated from seed, grows rapidly and blooms with minimal maintenance in appropriate environments. Selected cultivars of the species warrant wider commercial planting for joint production of timber and nuts. The tree has a demonstrated potential to naturalize in coastal plant communities, but not to adversely dominate such communities [4]. The productivity and marketing of cultivars with large and/or soft-shelled nuts need to be assessed. There is also a need for experimental work to develop vegetative propagation techniques and more efficient techniques for processing fully mature fruits including drying, storage, and cracking of nuts. Nutrient potential has been previously studied and shows the high protein content, fiber, fat, minerals and tannin content of the kernels from different origins [5–8]. The mineral profile of this kernel revealed many important minerals as magnesium, calcium, phosphorous and iron in appreciable proportions [5–8]. It has aphrodisiac activity and may be useful in the treatment of certain forms of sexual inadequacies such as premature ejaculation [9]. It can also be used in the treatment of liver cancer and diabetes [10]. Extracts from the leaves and bark of the plant are also reported to have anti-HIV, anti-carcinogenic, and hepatoprotective properties [10]. Generally, oil is extracted from kernels by pressing or using a solvent [11,12] and contained more than 50% of unsaturated fatty acid and in high proportion, palmitic, oleic, linoleic and stearic acids [8,13,14]. It has also been shown that this oil has acceptable physico-chemical properties to be used as a biodiesel [15]. Information was available on the kernels from African countries such as Somalia [13], Congo [8], Ghana [10] and Nigeria [3,5]. But to our knowledge there are no reports to date concerning the *T. catappa* L. oil and kernels from Benin. The aim of this study is to describe the chemical composition and the nutritional properties of *T. catappa* L. oil and kernels from Benin.

2. Materials and methods

2.1. Chemicals and drugs

Dimethyl sulfoxide (DMSO), 1,1-diphenyl-2-picrylhydrazile (DPPH), 40 component fatty acid melthyl esters (FAMEs), and Folin-Ciocalteu's phenol reagent were purchased from Sigma-Aldrich (Steinhein, Germany), Acros Organics (New Jersey, USA), and Fluka Chemie (Buchs, Switzerland). Hexane was purchased from Fluka Chemie, anhydrous Na_2SO_4 from UCB (Brussels, Belgium) and absolute ethanol and absolute methanol from Labotec (Brussels, Belgium). All compounds and solvents were of analytical grade. Hide powder CRS was obtained from European Pharmacopoeia (EDQM, Strasbourg Cedex).

2.2. Plant material, kernel obtaining and grinding

T. catappa nuts were obtained from fruits harvested in August 2013 in Calavi (South of Benin) and a voucher