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Native Oilseed Plants, Mufuko, Mushi And Muthongo From The Moxico Province, Angola

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ABSTRACT :- This research aims to study wild oilseed plants in the Moxico Province of Angola and assess the potential of using oils extracted from their seeds as an alternative to known oilseeds. Three such plants were identified: Mufuko, Mushi and Muthongo, whose ethnobotanical studies show greater resistance to drought and cold. Their respective seed yields per hectare are estimated at 4,800 kg/ha, 7,850 kg/ha, and 2,600 kg/ha. Gas chromatography coupled with mass spectrometry shows that the triglycerides are mainly composed of oleic, stearic and palmitic esters, with Mufuko having a more saturated carbon chain structure. The oil extraction yield from the seeds using Soxhlet and the solvent n-hexane is 94.50% for all three plants. The oil content of Mufuko, Mushi and Muthongo seeds is 33%, 42% and 52% respectively, exceeding that of conventional oilseeds such as palm, palm kernel, soybean, peanut, coconut and safflower by 45%, 30%, 20%, 50%, 22% and 42% respectively. The U.V. spectrophotometer shows that the salts content in their oils is 54.6, 60.6 and 41.6 ppm; the phosphorus content is 27, 113 and 64 ppm; and the nitrogen content is 229, 149 and 34 ppm, respectively. The phenol content exceeds 40 µg in the Mufuko plant.

KEYWORDS: Extraction, native plants, oil, yield

I. INTRODUCTION

The population of the southern region of Moxico Province, specifically the municipalities of Bundas, Luchazes and Moxico, is becoming increasingly impoverished due to drought. Consequently, people are migrating to urban centres, thereby depopulating rural areas. There are native oilseed plants with potential that could serve as an alternative to, or complement, the cultivation of maize, massambala, soybeans, groundnuts, sunflowers and dendém, all of which are susceptible to fluctuations in rainfall.

To this end, we have identified three plants traditionally known as Mufuko, Mushi and Muthongo. These plants are not yet referenced in any scientific literature, but they can be assimilated to Monambimbi (Barringtonia acutangula) from the Maiombe forest, Karin Nahra and Red Sandalwood by superposition in Google search, respectively [1], with very different stem, seed and leaf characteristics. Identified in the wetlands and savannah areas of Moxico Province, these plants can be cultivated in the same way as palm trees or coconut palms, thus significantly increasing family incomes and lifting them out of extreme poverty.

These plants are traditionally used for oil extraction in the above-mentioned municipalities, but the quantity produced is minimal and the quality of the oil is unclear. This study aims to evaluate the biomass, oil content and reproductive potential of the plants at the following stages:

- Ethnobotanical review of these plants;
- Seed production per hectare;
- Optimising the extraction of oil from the seeds using Soxhlet with n-Hexane solvent;
- Determining the extraction yield and oil content of the seeds;
- Chemical analysis of the oils with the Gas chromatography coupled with mass spectrometry and The U.V. spectrophotometer;
- Comparison of the extraction yield, content and quality of the oils under study with oils found on the market;
- Conclusion and orientation forb the academic community, for future in-depth scientific research; and the target areas mentioned above, for possible implementation.

II. MATERIAL AND METHOD

2.1. Material

The materials used in the experiments are bovine bones, shellfish shells, household vinegar, sodium carbonate, methanol and mufuko oil.

2.2. Ethnobotanical study

The ethnobotanical study was based on classifying this plant using Eichler's criteria and the principles of modern systematics. These criteria divide plants into vascular and non-vascular categories based on whether or not they have conductive vessels for substances, seeds, and fruits [2].

Studies of the mufuko plant for ordinary cultivation were conducted in the laboratories of the Agricultural Development Institute of Moxico (IDAM) and the Department of Chemical Engineering at Agostinho Neto University in Angola. The Mushi study was conducted at the Scientific Research Centre of the Higher Polytechnic Institute of Moxico, also in Angola.

Studies of the mufuko plant for ordinary cultivation were conducted in the laboratories of the Agricultural Development Institute of Moxico (IDAM) and the Department of Chemical Engineering at Agostinho Neto University in Angola. The Mushi study was conducted at the Scientific Research Centre of the Higher Polytechnic Institute of Moxico in Angola.

2.3. Preparation of the seeds

The bunches were collected and the seeds were sorted. The good seeds were then placed in an incubator at 30°C for 72–96 hours to speed up the maturation process. The fruits must be collected and transported quickly and carefully to avoid injury, which could accelerate oil oxidation due to rotting. The seeds were washed in cold water below 30°C to prevent the oil being extracted by maceration alone. This washing process removes flowers, dust, and potential bacteria.

The seeds were dried by exposing them to sunlight for six days and to a temperature below 30°C in a greenhouse. Above this temperature, oil loss from the drying trays was observed.

2.4. Extraction of oil from seeds

The solvent extraction process involved crushing and sieving the dried seeds through a 0.833-mesh sieve. After weighing, the samples were placed in a Fisher brand Soxhlet extraction apparatus at temperatures of 45 and 50 °C. The solvents used for extraction were n-hexane and diethyl ether at 68 °C for two hours. The solution was subsequently distilled at the aforementioned temperature, with the oil collected at the bottom of the flask and the solvent recovered through condensation.

2.4. Determination of oil extraction yield

The oil extraction yield from Mufuko seeds is calculated using equation (1):

$$r = \frac{m_o}{m_A - m_R} . 100 \qquad (1)$$

Where;
r: extraction yield (%);
m_o : The mass of oil extracted from the mufuko seed (g);
m_A : Mass of the mufuko seed sample (g);
m_R : Mass of dry residue (g)

2.5. Determination of oil content in seeds

The oil content obtained from the extraction process is calculated using the following equation (2):

$$\%T = \frac{m_o}{m_A} . 100 \qquad (2)$$

Where;
%T: Oil content in the mufuko seed, expressed as a percentage of the extraction rate (%);
m_o: The mass of oil extracted from the mufuko seed (g);
m_A: Mass of the mufuko seed sample (g).

2.6. Chemical analysis of oil

A The compounds present in the oil were identified using a Varian 300S gas chromatography-mass spectrometry (GC-MS) instrument under the following analysis conditions:

- Oven temperature: 50 ºC;
- Injector temperature: 250 ºC;
- Carrier gas flow (He): 1.1 ml/min;
- Mode: Splitless;
- Capillary column type: VF-5MS (5% phenyl-95% polydimethylsiloxane);
- Column length: 30 m;
- Column inner diameter: 0.25 mm;

- Stationary phase thickness: 0.25 µm.

The initial oven temperature was set to 50 °C, with a heating rate of 10 °C/min, until reaching 155 °C. It was then held at this temperature for six minutes. The second temperature ramp was created by heating at a rate of 30 °C up to 275 °C over 30 minutes. One microlitre of the sample was injected into the chromatograph in splitless mode with a constant flow rate of 1.1 ml/min of helium as the carrier gas. The mass spectra were then compared with those in the National Institute of Standards and Technology (NIST) database to identify the compounds [3].

III. RESULTS AND DISCUSSION

We present and discuss the results of determining the oil extraction yield and its content in Mufuko, Shi and Thongo seeds, as well as its mineral and organic composition. We emphasise the comparison with vegetable oils that are commonly used for biodiesel production. We acknowledge that the extraction yield (94.5%) and oil content (32%) of Mufuko seeds were previously determined by the main author in his doctoral thesis [4], and that our presentation of the Muthongo plant calculations merely illustrates the procedure.

3.1. Extraction yield of Thongo seed oil

Table 3.1 shows the average yield of five samples of Thongo oil extracted using n-hexane with a Soxhlet apparatus.

Table 3.1: Extraction yield of thongo Oil

Sample number	Dry seed weight (g)	Seed weight after extraction (g)	Oil weight in seed (g)	Extraction yield (%)
1	71	35,00	36,00	95,12
2	120	60,86	59,94	94,86
3	60	28,00	32,00	96,12
4	50	22,04	27,96	96,56
5	50	23,00	27,00	92,59
AVERAGE	351	168,9	154,94	95,05

Table 3.1 shows that the average extraction yield using a Soxhlet extractor and n-hexane is 95.05%. This figure is consistent with that observed for other oils on the market (see Table 3.4).

3.2. Oil content of thongo seed extraction

Table 3.2 shows the oil content of muthongo seeds.

Table 3.2: Representation of the average weight of the il content.

Number of Experiments	Dry seed weight (g)	Seed weight after extraction (g)	Oil weight in seed (g)	Weight of extracted oil (g)	Oil content (%)
1	71	35,00	36,00	34,24	50,70
2	120	60,86	59,94	56,86	49,95
3	60	28,00	32,00	30,76	53,33
4	50	22,04	27,96	27,00	54,12
5	50	23,00	27,00	25,00	54,00
AVERAGE	351	168,9	154,94	173,86	52,42

As can be seen in Table 3.2, the oil content of Muthongo seeds ranges from 50 to 55%. This value is higher than that of most oils found on the market, as shown in Table 3.4.

3.3. Chemical analysis of oil

The characterisation of the extracted oil revealed significant differences between the extraction methods. Extraction was carried out in the Isp-Moxico laboratory using n-hexane as the solvent and the Soxhlet method. ENI then presented us with the mineral composition results for the muthongo oil obtained by solvent extraction and pressing, as shown in Table 3.3.

Table 3.3: Mineral composition of oils extracted from muthongo seeds.

Seed		Seed of Muthongo	Seed of Muthongo	Seed of Mufuko	Seed of Mushi
Typology		Oil extracted in solvent	Pressing oil	Solvent-extracted oil	Solvent-extracted oil
Por	Ppm	0,5	6	1,3	<0,5
Ca	Ppm	17	6	27	60
Mg	Ppm	18	2.5	12	32
Na	Ppm	1,4	<0,5	5	8
K	Ppm	3	<0,5	6	-
Fe	Ppm	0,8	2	1,4	-
Sn	Ppm	0,1	-	0,4	-
Zn	Ppm	0,8	0.5	1,4	-
ΣSal	Ppm	41,6	17	54,5	-
P	Ppm	68	3	27	149
N	Ppm	21	34.4	229	113
S	Ppm	4	4.5	13	14

3.4. Comparison of the extraction yield, content and quality of the oils under study with oils found on the market.

Table 3.4 shows the extraction yield and oil content of certain oilseeds.

Table 3.4: Comparison of Extraction Yield and Oil Content of Certain Oilseeds [5]

Oleaginosa e método de extração	Teor de Óleo (%)	Rendimento de Extração (%)
Thongo (by solvent)	50-55%	________
Fuku (by solvent)	28-33%	92-96%
Shi (by solvent)	30-44%	91-96%
Thongo (by solvent)	Até 52,42%	95,05%
Soy (by solvent)	18–20%	85–90%
Palm (Dende) (by pressing)	36–45%	90–95%
Cocoa (by solvent)	20-30%	92-96%
Amendoim (por solvente)	45–50%	85–92%
Milho (por solvente)	4–10%	80–88%

Table 3.3 above illustrates the mineral content of thongo oil, highlighting higher levels of phosphorus and salts at 68 ppm and 41.6 ppm respectively, compared to the 3 ppm and 17 ppm respectively shown by extraction by pressing. In terms of nitrogen composition, pressing yields a higher quantity of oil due to the infiltration of organic compounds that cannot be separated by solvent extraction.

As can be seen in Table 3.4, Muthongo seeds have been found to have higher values than the aforementioned seeds, particularly in terms of oil content.

IV. CONCLUSIONS

The native oilseeds under study have high biomass levels in terms of height, stem and branching. They can also withstand droughts, making them ideal for the reforestation of arid areas.

These plants can be cultivated in the same way as other well-known oilseeds. This suggests that they could complement traditional oilseeds in the market, thus increasing dietary intake and family income. Based on their chemical composition, these oils could also be used in biodiesel production as an alternative to the food oils typically used for this purpose.

Further research into the technical and economic viability of these species in conventional agricultural production is recommended, based on previous ethnobotanical studies of their germination, growth and productivity.

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