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ETHNOBOTANICAL AND PHYTOCHEMICAL STUDY OF *ELEUSINE CORACANA* (L.) GAERTNER), PLANTS USED IN VARIOUS WAYS IN CHAD

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ABSTRACT

This study explores the properties of two varieties (red and white) of Eleusine coracana (l.) Gaertner) by identifying metabolites in its leaves and seeds. Carried out in Krim-Krim between August and September 2022, it includes ethnobotanical surveys of 91 people. The plant is associated with the treatment of 14 ailments, mainly malaria (21.03%), ringworm (16.27%), rheumatism (13.49%) and diabetes (12.30%). Chemical analysis reveals the presence of alkaloids, sterols, terpenoids, tannins, anthocyanins and cardiotonic heterosids in the seeds, as well as flavonoids, saponins and free quinones in the leaves, confirmed by TLC. Seeds also contain dietary fiber (26.62% for reds, 8.47% for whites) and fat (1.075% for reds, 1.185% for whites).

KEYWORDS: Ethnobotany, phytochemical, *Eleusine coracana*, antioxidant activity, Krim-Krim.

INTRODUCTION

Nature remains an inexhaustible source of food and remedies for human well-being, with uses varying according to the plants available (Mangambu et al., 2012). Among these plants, cereals are a mainstay of the world diet, providing energy, hydrocarbons, proteins, dietary fiber, minerals and trace elements (Fatiha et al., 2021). Cereals, monocotyledons in the Poaceae family, produce edible grains that are mainly used for human consumption, often ground into flour, and are also used in animal feed and industry (Mireille Gayet, 2016).

The aim of this work is to contribute to the development of neglected crops threatened with extinction in Chad and the use of this species of Eleusine coracana.

Eleusine, a species of millet, is an annual herb of the Poaceae family, native to Africa and cultivated for its edible seeds. Eleusine's vast cultivation area stretches from Malaysia to the east and south of Africa, where it barely overlaps with the Fonio cultivation area to the east. Only one variety of Eleusine is known in this contact zone, in the Chad region and northern Ubangi-Chari (De Wet, 2006). This minor cereal plays an important role in the diet of Asia and Africa, particularly in poor regions (Hoare, 2017). Regular consumption protects against cardiovascular disease, type II diabetes and gastrointestinal cancers (Mc Keown, 2002).

In Chad, Eleusine is grown in the plains of the middle Logone and other regions of the Lake Chad basin, although it is little known to most of the population. It is grown in small quantities and used as a lean crop in times of food shortage. Although this cereal is largely under-used, it has major advantages for solving local food, health and socio-economic problems, which justifies this study aimed at verifying the scientific relevance of its uses.

Research into the composition and properties of Eleusine confirms that this cereal can be considered as an 'alicament' beneficial to human health (Quaranta, 2009).

Eleusine promotes growth and bone strength. It combats anemia thanks to its high thiamine and iron content, while the vitamin C present in its sprouted seeds facilitates the assimilation of iron. It manages type 2 diabetes thanks to its high polyphenol and fiber content (Quaranta, 2009). It improves heart health, containing magnesium and potassium, regulating cholesterol and preventing cardiovascular disease (Tangvoraphonkchai et al., 2018; Tobian et al., 2000). Its high polyphenol and antioxidant content helps to reduce oxidative stress and prevent various diseases.

Eleusine provides energy by being rich in carbohydrates, proteins and unsaturated fats, which improves sporting performance (Hayamizu., 2017). It has relaxing properties thanks to its tryptophan content, reducing anxiety, depression and sleep disorders. A source of protein and essential amino acids, it provides minerals that are beneficial for muscles and metabolism. Its dietary fiber content aids digestion and prevents constipation (Lattimer et al., 2010).
What's more, Eleusine improves the production of breast milk thanks to its many nutrients. Its amino acids help maintain youthful skin and prevent premature ageing. It prevents obesity by slowing digestion and reducing appetite, thereby promoting weight loss (Kumar et al., 2016).

Eleusine coracana has been used traditionally since ancient times to treat various illnesses. The crushed leaves are applied to cow udder inflammation and wounds, while the flour is used to treat wounds (Byavu et al., 2000). It is also used against smallpox, influenza and measles, and to treat swollen feet. The seeds are ingested to treat diarrhea, dysentery and cholera (Giday et al., 2001). Eleusine porridge is eaten to relieve hemorrhoids, and an infusion of its roots to treat diarrhea and dizziness (Tabuti et al., 2003). The plant also helps maintain an optimal body temperature during the rainy season and is used to treat roundworm, leprosy, liver disorders, diabetes, intestinal disorders, and cancer (Amir et al., 2014; Abdullahi et al., 2015). Several biological activities of Eleusine have been carried out. Eleusine has beneficial properties such as anti-diarrheal, anti-ulcer, anti-diabetic, anti-inflammatory, antimicrobial and antioxidant properties (Viswanath et al., 2009; Chethan et al., 2007b; Shobana et al., 2009).

II. MATERIALS AND METHODS

II.1. Ethnobotanical study

II.1.1. Type and period of study

This was a descriptive cross-sectional and analytical study conducted over a period of 9 months, from August 2022 to May 2023. It took place in eight localities in the department of Guéni, in the province of Logone Occidental in Chad. These localities include Krim-Krim, the departmental capital, as well as its surrounding areas, notably Bémangra, Andji, Békague, Karkaye, Tchéré Bawol, Tchéré Dondo, and Djeguerenkass.

II.1.2. Study variables

II.1.2.1. Socio-demographic variables of the populations concerned

The socio-demographic variables were: age, sex, level of education, method of acquiring knowledge about the plant.

II.1.2.2. Ethnobotanical study variables

These variables were as follows

- Method of plant cultivation: local name, year, causes, varieties (number and local names), surface area, sowing method, crop association, development cycle, harvesting period, soil type, seed storage;
- Various uses of the plant: food, traditional medicine (diseases treated, parts used, method of preparation, route of administration, harvesting time), other uses.

II.1.3. Methodology: data collection methods

II.1.3.1. Ethnobotanical survey

II.1.3.1.1. Sampling and data collection

The ethnobotanical surveys were conducted using a survey form between 22 August and 21 September 2022. These forms were completed following semi-structured interviews, conducted individually or in groups (focus groups) in each selected locality. The participants, randomly selected from men and women aged 20 and over, were met in various locations (markets, households, streets, etc.) in the eight localities studied.

Each participant was interviewed individually using a pre-established questionnaire. The data collected concerned socio-demographic characteristics (sex, age, level of education, profession, ethnic group) as well as knowledge about the use of Eleusine coracana (cultivation practices, forms of use, parts of the plant used, methods of preparation, diseases or ailments treated).

After each interview, a preliminary identification of the plants was carried out on site. Photographs were then taken of the plants and some samples were collected and packaged for further identification at the Botany and Plant Ecology Laboratory of the Faculty of Exact and Applied Sciences (FSEA) at the University of N'Djamena.

II.1.3.1.2. Collection and identification of plant material

The plant material collected during this study was the red and white seeds and leaves of Eleusine coracana (L.) Gaertn. These different organs were collected in August 2022 in the Bémangra area. The various Eleusine organs were then dried in the shade at room temperature for 48 to 92 hours. The seeds and leaves were crushed and then stored in glass bottles protected from light and humidity.

II.1.3.1.3. Data analysis and processing

The data recorded on raw data sheets were transferred to a database and processed using Excel spreadsheets to be presented in the form of tables or figures. Two ethnobotanical parameters, the frequency of citation (FC) and the use value of plant parts (VU) were calculated using the formula:

$$FC = \frac{n}{N} x100$$

- Where :
  - **n**: number of individuals citing the information
  - **N**: total number of informants

$$VU = \sum \frac{U}{N}$$

- Where
  - **U**: total citations for the plant parts/organs
  - **N**: total number of informants

II.2. Phytochemical survey

The chemical composition of the plant is studied in order to identify the main secondary metabolites responsible for its various therapeutic activities. To this end, two types of analysis were carried out to identify the different groups of compounds: qualitative and quantitative analysis.

II.2.1. Plant material

The study focused on the seeds and leaves of *Eleusine coracana* (Figure 1).

a)

b)

Figure 1 : Dried leaves (a) and seeds (b) of Eleusine.

II.2.2. Qualitative Analysis

The identification of the chemical families in plant extracts was performed using two methods: characteristic coloration and/or precipitation tests (test-tube reactions) and thin-layer chromatography (TLC). Simple and rapid, the coloration and precipitation tests reveal various secondary metabolites. TLC was used to confirm the results of the chemical screening.

II.2.2.1. Tube reactions

These are based on coloring or precipitation reactions which are more or less specific to each class of active ingredient. Any change in color or precipitate formation is used as an indicator of a positive response to these tests. The phytochemical groups sought in plant extracts during these tests are: flavonoids, terpenes, tannins, alkaloids, anthraquinones, saponins, free quinones, anthocyanins, and cardiac glycosides.

Flavonoids: Identified using the HCl-CH_3OH-H_2O and Mg mixture reaction.

- **Terpenes/Sterols:** Tested using the Liebermann-Burchard reaction.
- **Tannins:** Detected using Stiasny's reagent.
- **Alkaloids:** Identified using Dragendorff's and Mayer's reagents.
- **Saponins:** Measured using foam height tests.
- **Anthraquinones:** Detected using 10% NaOH or KOH.
- **Quinones:** Identified with 10% ammonia.
- **Anthocyanins:** Tested using heated alcoholic HCl (HCl + EtOH v/v).
- **Cardiac Glycosides:** Detected using acetic anhydride and sulfuric acid.

II.2.2.1. Thin-Layer Chromatography (TLC)

This method supports the findings of the coloration tests by separating components based on their migration differences in a solvent system and their affinity for the stationary phase. The materials needed (extraction solvents, stationary phase, mobile phase, and chemical developers prepared according to Wagner and Bladt's 1996 protocol) are summarized in Table I. The TLC was performed on extracts obtained using solvents of increasing polarity.

Table I: Elution system and reagents for the development of TLC plates on silica gel.

Chemical Family	Extracts	Eluent	Developer
Flavonoids	Cyclohexane, dichloromethane, methanolic, and aqueous extracts of the plant's leaves and seeds	Chloroform/ethyl acetate (60/40)	Methanolic $AlCl_3$ solution
Terpenes	Cyclohexane and dichloromethane extracts	Toluene/ethyl acetate (93/7)	Sulfuric anisaldehyde

✓ **Expression of results**

The parameters involved are the colors, the frontal ratio (Rf) which characterizes the retention factor of each compound. The Rf is calculated using the following formula:

$$R_f = \frac{d}{D}$$

Where d is the distance travelled by the compound and D is the distance travelled by the solvent.

II.2.3. Quantitative analysis

II.2.3.1. Determination of crude dietary fiber in seeds

Crude dietary fiber (CDF) analysis using the Weende method, performed with the SELECTA Dosi-fiber instrument, is a classic method used to quantify the insoluble fibers present in food matrices or samples of plant origin. The method is based on successive treatments with acidic and basic solutions.

The main steps include:

- Acid treatment: The sample is boiled in a dilute sulphuric acid solution (typically 0.255 N). This treatment removes soluble proteins, simple sugars and some soluble polysaccharides.
- Alkaline treatment: Next, it is treated with a solution of potassium hydroxide (0.313 N), which eliminates lipids, extractables and hemicelluloses.

The residual material, once dried and weighed, represents the crude fiber content.

Knowing all the data, the overall crude fiber content of the sample in each crucible used for weighing can be calculated using the following formula:

$$\%\ \boldsymbol{fibre\ brute} = \frac{(\boldsymbol{W_1} - \boldsymbol{W_2})}{\boldsymbol{W_0}} \boldsymbol{x100}$$

Where:

W1: mass of the empty crucible or weighed after drying;

W2: mass after incineration;

Wo or (PE): test sample mass.

Finally, the overall crude fiber content is equal to the average of the 2 contents ($\frac{t_1 - t_2}{2}$);

- For red seeds: t_1 = 26.89% and t_2 = 26.35%
- For white seeds: t1 = 8.65% and t2 = 8.29%

II.2.3.2. Determination of fat in seeds

Lipids are mainly extracted using the gravimetric method to determine their concentration in foods. This method makes it possible to separate the fat present in a foodstuff or other substance and calculate its percentage. The principle is based on weighing the food in a cellulose capsule.

The Soxhlet was used for the extraction. Before extraction, the plant material was dried in an oven at 110°C for one hour. After weighing (test sample, PE), the dried plant material was introduced into the Soxhlet cartridge. For extraction, 50 mL of petroleum ether was placed in the extraction flask, and extraction was carried out for 8 hours at 105°C.

After extraction, the solvent-extract mixture was concentrated using a rotary evaporator, with the bath temperature set at 105°C. The mass of the fat was then determined. For each type of seed, two extractions were carried out.

The fat content (TMG) in the two seed samples was calculated using the following formula :

$$TMG(\%) = \frac{(m_2 - m_1)}{PE} x100$$

Where:

PE= test weight in g test weight in g

m_1 = mass in g of the empty flask;

m_2 = test sample in g after drying the sample;

The average fat content was calculated using the following formula:

$$Moyenne\ (\%) = \frac{\%TMG_1 + TMG_2}{2}$$

II.2.5. Methods for studying antioxidant activity

To evaluate the antioxidant activity of the extracts (methanolic and aqueous extracts of plant seeds), a qualitative method was employed based on scavenging the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical.

The extracts were applied to aluminum-backed TLC plates coated with silica gel GF254 and developed using appropriate solvent systems: ethyl acetate/formic acid/water (8/1/1). After drying, the plates were sprayed with a solution containing 2 mg/mL of DPPH in methanol. Antiradical activity appeared as yellow-white spots on a violet background (Cavin, 1999).

III: RESULTS AND DISCUSSION

III.1 Results

III.1.1. Ethnobotanical results

III.1.1.1. Socio-demographic characteristics

His socio-demographic characteristics of the respondents, in terms of gender, age group educational level, profession and ethnic group.

- Gender

In terms of gender, the male population is higher (92%) than the female population (8%) in the area and in all localities.

- Age

In terms of age, the 51+ age group has the highest number of people (51.65%), followed by the 41-50 age group (26.37%), the 31-40 age group (17.58%) and the 20-30 age group (4.40%) in the area (Figure 2).

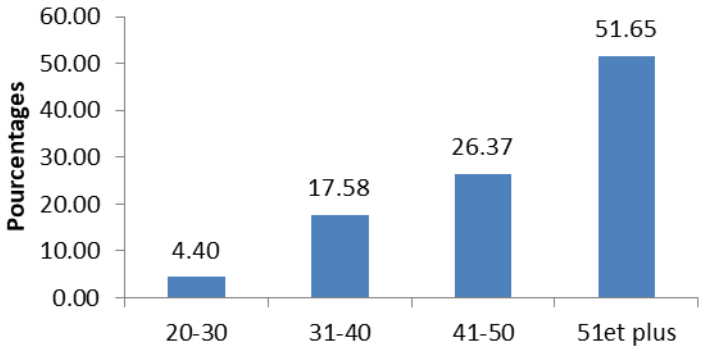

Figure 2: Percentage distribution of respondents by age group.

- Education levels

Semi-literate people were the most numerous, followed by the uneducated, with a respective total of 38 individuals, or 42% of respondents, and 29 individuals, or 32%, compared with secondary and higher education respondents, who represented 22% and 4% respectively (Figure 3).

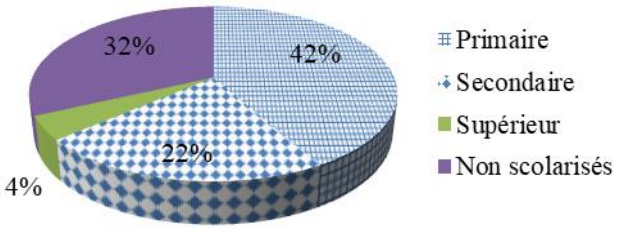

Figure 3: Distribution of respondents by level of education.

- Occupation

In terms of respondents' professions, farmers predominate (86%), while others account for 14%.

III.1.1.2. Knowledge of *Eleusine coracana*

- Cultivation techniques for the plant in the study area

Association of the plant with other plants

Cultivation of Eleusine coracana in association with other plants is dominant with a FC of 77%, i.e. mixed cultivation compared with monoculture (33%).

Soil types suitable for growing the species

The soil most suitable for Eleusine coracana cultivation is stony soil with a FC of 56.04%, followed by clay soil (26.37) and other types (17.58%) (Figure 4).

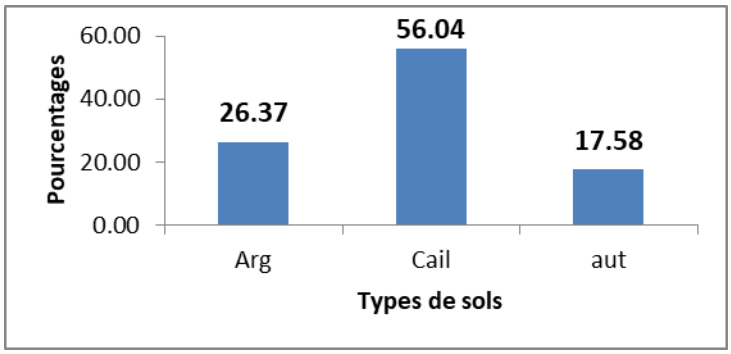

Figure 4: Soil types suitable

Legend: Arg = clayey; cail = stony; aut = other

- Causes, harvesting, seed storage, socio-economic importance of the plant in the area

The table below (Table II) shows why the plant was cultivated, how the seeds are harvested and stored, and the importance of the plant in the lives of the respondents.

Table II: Summary of cultivation, seed storage, and socioeconomic importance.

Plant	Causes	Harvesting	Storage	Socioeconomic Importance
Eleusine coracana	Hunger during lean periods; disease care; income	Based on cultivated variety	Generally stored in bags for 1–5 years without chemical treatment	Meeting basic needs

- **Categories of Use and Utilized Plant Parts**

The most frequent use was for human consumption (39.27%). This use was reported by all those surveyed (FC=100%). Next comes use in pharmacopoeia (36.07%). The use of Eleusine coracana for cultural purposes is little known to the people surveyed (FC = 3.65%).

Several parts of Eleusine coracana are used for these purposes. The most commonly used organs are the seeds and leaves (Figure 5).

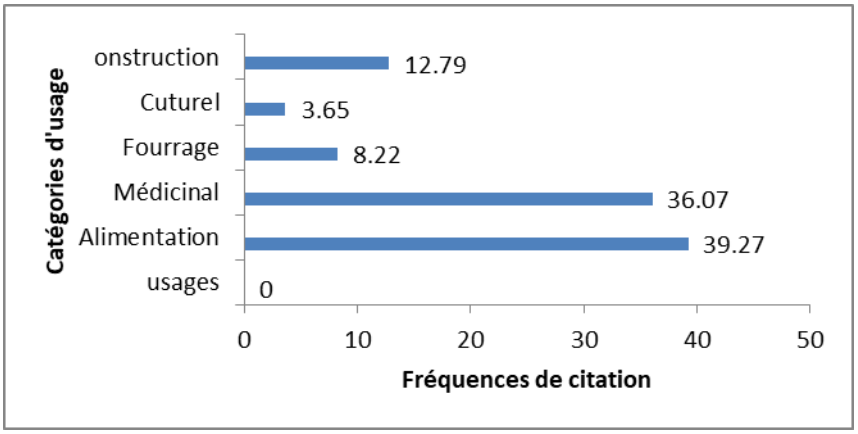

Figure 5 : Frequency of plant use categories.

- Use in the traditional pharmacopoeia

Fourteen (14) diseases treated by the plant were cited by respondents, namely coughs, malaria, boils, ringworm, cattle diarrhea, anemia, dysentery, rheumatism, diabetes, worms, gout, chickenpox, wounds and typhoid fever. The most frequently cited illnesses in almost all localities are malaria, ranking first with 21.03%, followed by ringworm (16.27%), rheumatism (13.49%) and diabetes (12.30%) (Figures 6 and 7). The organs used to treat these diseases are: leaves and especially seeds, which dominate with a rate of 94.08% versus 5.92%. The administration of Eleusine coracana medicinal recipes includes several preparation methods, namely decoction and maceration, of which decoction is the most widely used, with FC equal to 68.42%. The routes of administration are oral and cutaneous, with oral administration dominating in percentage terms at 68.42% (Table III).

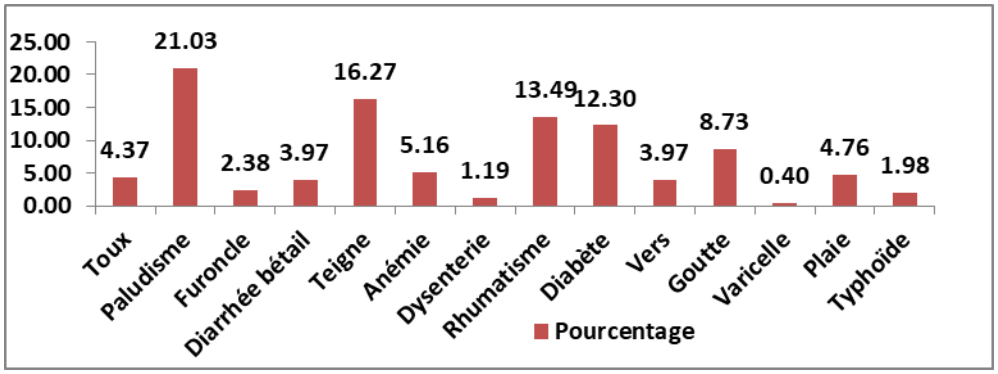

Figure 6: Frequency of casting diseases in the survey area.

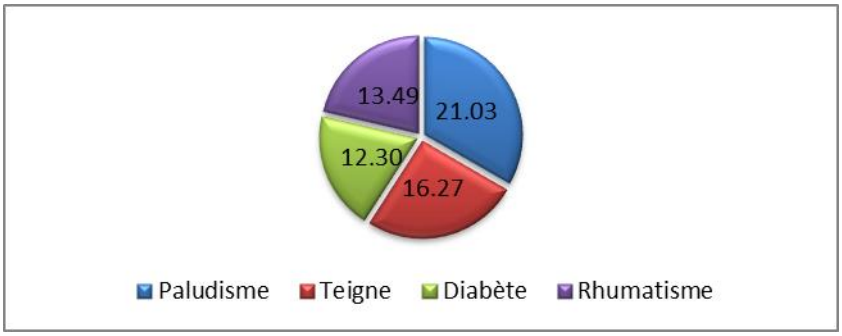

Figure 7: Percentage of diseases cited in localities.

Decoction was the primary preparation method (68.42%), followed by maceration (31.58%). The oral route was dominant (68.42%) compared to cutaneous administration.

Table I: Preparation methods and administration routes.

Preparation Method					
	Decoction	**Maceration**	Infusion	**Other**	Total
NC	13	6	0	0	19
FC (%)	68,42	31,58	0	0	100
Administration Route					
	Oral	**Cutaneous**	**Topical**	**Other**	Total
NC	13	6	0	0	19
FC (%)	68,42	31,58	0,00	0,00	100,00

NC = nombre of citation

III.1.2. Phytochemical Results

III.1.2.1. Qualitative Analyses

- **Coloration and Precipitation Reactions**

Phytochemical screening revealed nine main groups of chemical compounds, including flavonoids, steroids, tannins, alkaloids, anthocyanins, and cardiotonic glycosides. Some compounds, such as flavonoids and saponins, were exclusive to leaves, while others, like tannins and alkaloids, were present in both leaves and seeds.

Table II: Phytochemical characterization in seeds and leaves of *Eleusine coracana.*

Métabolites secondaires	**Tests/Réactifs**	**Organes**	
		Graine	**Feuille**
Flavonoids	Cl-CH_3OH-H_2O et Mg	-	+
Stérols et terpénoïdes	Libermann	-	-
	Salkowski	+	+
Tanins	Action de $FeCl_3$	-	-
	Réaction de Stiasny	+	+
	Action de HCl	+	+
Alcaloids	Mayer	+	+
	Dragendorff	+	-
	Wagner	+	+
Anthraquinones	NaOH 10%	-	-
Saponins	Indice de mousse	-	+
Free Quinones	NaOH 1/10	-	-
anthocyanins	Action de HCl alcoolique	+	+
cardiotonic glycosides.	Action de H_2SO_4	+	+

The "+" sign indicates the presence of the group of chemical compounds in the tested extracts (seed and leaf), while the "–" sign indicates their absence.

- **Thin-Layer Chromatography (TLC)**

Figures 8 and 9 show the results of thin-layer chromatography on seed and leaf extracts, highlighting flavonoids, terpene compounds and saponins. Chromatographic results highlighted the presence of flavonoids, terpenoids, and saponins in varying solvent extracts from seeds and leaves. A comparative study with reference compounds such as quercetin and rutin revealed these compounds (figure 8 b).

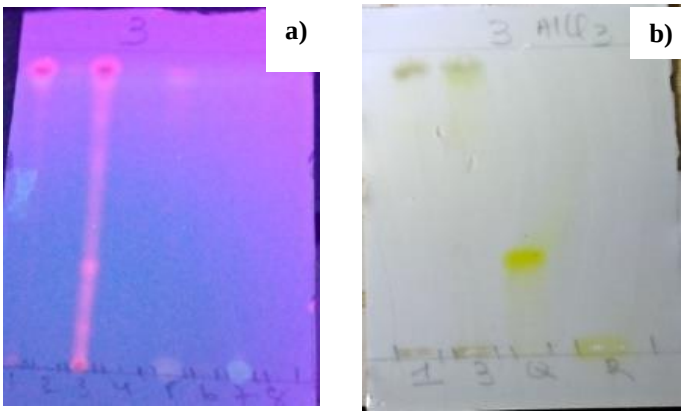

Figure 8 : Flavonoid chromatograms of solvent extracts with increasing polarities.

Eluent: chloroform and ethyl acetate (60-40); Observation under UV light at 365 nm (a) and $AlCl_3$ staining with visible light observation (b). (1, 3, 5, and 7: cyclohexane, dichloromethane, methanol, and aqueous leaf extracts; 2, 4, 6, and 8: cyclohexane, dichloromethane, methanol, and aqueous seed extracts). Q = Quercetin, R = Rutin.

In chromatogram(a), only extracts 1 and 3 show all-red spots with Rf values of 0.93 in 1 and 0.14; 0.18; 0.35; 0.66, and 0.94 respectively, while in chromatogram b, allowing comparison of two, in 1 and 3, appear two yellowish spots with equal Rf of 0.94.

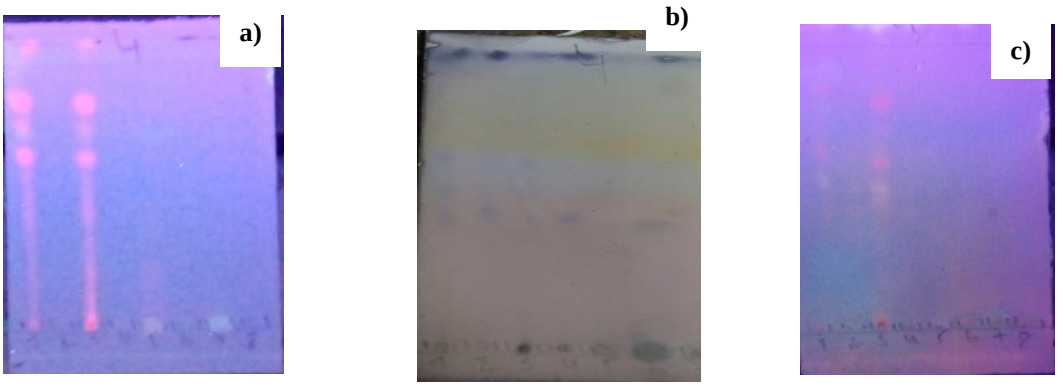

Figure 9: Chromatograms of terpenes/sterols from solvent extracts with increasing polarities. Eluent: chloroform and ethyl acetate (60-40); observation under UV light at 365 nm (a); detection with sulfuric anisaldehyde and heating, observation under visible light (b); detection with sulfuric anisaldehyde, observation under UV light at 365 nm (c). 1, 2, 3, 4, 5, 6, 7, 8: plant extracts (1, 3, 5, and 7: cyclohexane, dichloromethane, methanol, and aqueous leaf extracts; 2, 4, 6, and 8: cyclohexane, dichloromethane, methanol, and aqueous seed extracts).

In figure 9, the chromatogram(a) shows spot all red in color only in extracts 1 and 3 with RFs which are, in 1, 0.28; 0.49; 0.79 and 0.94 and in 3 0.10; 0.21; 0.46; 0.70; 0.79 and 0.94. Chromatogram(b) shows black spots with approximately equal Rf ranging from 0.67 to 0.68 in both organs and in all extracts 1, 2, 3, 4, 5, 6, 7 and 8, while chromatogram(c), after revelation with anisaldehyde and observation at UV 365 nm, shows red spots with the same Rf as (a) in extract 3, while in 1, other yellow spots with Rf below 0.94 have been added to the red spots.

III.1.2.2. Quantitative Analyses

• Determination of Crude Dietary Fibers

Table V shows the variation in fiber content (FC) in the red and white seeds of the plant. The average fiber content is 26.62% for red seeds and 8.47% for white seeds.

Table III: Dietary Fiber Content in the Two Types of Seeds (as % of sample).

Samples	PE(g)	M_{CV} ou W_1(g)	W_2(g)	Fiber Percentage	Mean Percentage
Seed 1	1,2100	29,7576	29,4322	26,89%	**26,62%**
Red 1’	1,1820	29,7240	29,4125	26,35%	
Sed 2	1,0402	29,0966	29,0066	8,65%	**8,47%**
White 2’	1,0352	28,7932	28,7073	8,29%	

- **Determination of fat content**

Table VI shows the fat content in the two seed samples (red and white), with averages of 1.075% and 1.185% respectively:

Table VI: Fat content in Eleusine seeds (red and white).

Samples	PE(g)	m_1(g)	m_2(g)	m_1–m_2(g)	TGM (%)	Mean (%)
Seed 1	5,0009	62,0535	62,1071	0,0536	1,07	
Red 1’	5,0015	62,5072	62,5615	0,0543	1,08	**1,075**
Seed 2	5,0004	62,5244	62,5841	0,0597	1,19	
Red 2’	5,0014	62,0744	62,1335	0,0591	1,18	**1,185**

III.1.3.2. Antioxidant Activity of the Plant

Figure 10 presents the results of the antioxidant activity of the methanolic and aqueous extracts of the plant seeds, along with a quercetin solution at a concentration of 0.5 mg/mL. These results show that after adding the methanolic DPPH solution onto the plate, a dissipation of the purple color was observed, and nearly both plant extracts reacted positively to the test.

Figure 10: Chromatogram of antioxidant activity after spraying with mixture (DPPH). Elution system: ethyl acetate/formic acid/water (8/1/1); 3: methanolic extract; 4: aqueous extract and Q: quercetin.

III.2. DISCUSSION

Among the 91 individuals surveyed regarding their knowledge of the plant, 92% were men and 8% women, indicating that men possess a higher level of knowledge. This could be explained by social and cultural barriers that have limited women's access to this knowledge, as well as by the physical nature of the agricultural work involved in growing Eleusine coracana, which is often carried out by men. Moreover, in many African societies, traditional knowledge is predominantly passed on to men, reflecting their predominant role in agricultural professions, while women are generally occupied with domestic tasks.

The age of the interviewees ranged from 20 to over 50, with an average of 35. The most represented age group was 51 and over (51.65%), followed by 41–50-year-olds (26.57%), together accounting for 78.02% of respondents. Older people, who are often custodians of ancestral knowledge, have a higher level of knowledge about the plant. These results confirm the observations of Lougbegnon et al. (2015) that age influences the level of plant knowledge.

In terms of level of education, 74% of respondents had a primary school education or were illiterate, suggesting that the less educated are more interested in the plant. Among occupations, farmers accounted for 86% of respondents, illustrating the importance of agriculture in the region. Eleusine coracana is mainly grown on stony soils (56.37%) and as a mixed crop (77%), often with okra or sorghum.

Eleusine coracana plays a crucial socio-economic role for growers (86%), enabling them to earn a living. In terms of uses, it is mainly used for food (39.27%) and medicinal purposes (36.07%).

As far as food is concerned, Eleusine coracana seeds are often ground into flour for the preparation of various dishes such as balls, porridges and cakes. In animal feed, the leaves are mainly used as fodder after the seeds have been harvested. The use of seeds and leaves in food and traditional medicine has been confirmed by various authors.

In terms of medicinal uses, Eleusine coracana is used to treat 14 diseases, including malaria (21.03%), ringworm (16.27%), and diabetes (12.30%). Leaves and seeds are the most widely used parts, with seeds predominating (94.08%). These parts contain secondary metabolites that confer therapeutic properties.

Culturally, the plant is used in traditional hairstyles and to test the suitability of young girls for engagement. The leaves are also used for roofing traditional houses.

Chemical analyses show that the seeds and leaves contain various bioactive molecules, confirming their traditional use in medicine. Results of chemical composition tests indicate that red seeds are richer in fiber (26.62%) than white seeds (8.47%), which contributes to their health benefits, notably for intestinal transit and blood sugar regulation.

With regard to the antioxidant activity results (Figure 10), they showed that after revelation with a methanolic solution of DPPH at 2 mg/mL (highlighting the antiradical activity), the extracts the methanolic and aqueous extracts of the seeds, produced yellow spots characterizing spots or bands of discoloration. These values indicate good activity in the presence of $AlCl_3$ at the top, suggesting that the antioxidant compounds present in each extract have the capacity to reduce the DPPH radical. These antioxidant activities by free radical scavenging can be attributed to the presence of compounds observed at TLC level, notably flavonoids, terpenic substances, or phenolic compounds revealed during chemical screening with anisaldehyde. These results are in line with those obtained by Viswanath et al. (2009), who

studied the antioxidant activity of Eleusine and confirmed the free radical scavenging potential of the phenolic content of the integument. Bellato et al. (2013) proposed that regular consumption of whole grains of Eleusine could protect the body against several types of chronic disorders, thanks to the presence of antioxidant compounds such as phenolics and flavonoids.

These different results clearly show that Eleusine coracana is a plant with multiple uses, including food, medicine and culture (Nicodème, 2020). Its chemical properties justify its therapeutic use, and it plays an important role in the local economy.

CONCLUSION

This study explored the ethnobotanical and phytochemical properties of *Eleusine coracana*, an endangered plant in Chad. Research conducted in Krim-Krim and its surroundings revealed that the plant is widely recognized and utilized by local populations, particularly the elderly, the uneducated, and farmers, who possess ancestral knowledge about it. *Eleusine coracana* addresses the nutritional and health needs of communities, helping to solve certain socio-economic issues. It is used to treat 14 diseases, including malaria, ringworm, rheumatism, and diabetes, with the seeds being the most utilized part.

Phytochemical analysis revealed the presence of various secondary metabolites, such as alkaloids, sterols, terpenoids, tannins, anthocyanins, cardiac glycosides, flavonoids, and saponins. The seeds are rich in dietary fiber (26.62% for red seeds and 8.47% for white seeds) and contain fats (1.075% for red seeds and 1.185% for white seeds). Methanolic and aqueous extracts showed notable antioxidant activity.

The importance of this plant in nutrition and traditional medicine lies in its richness in carbohydrates, proteins, minerals, dietary fiber, fats, and other bioactive compounds, which enhance its therapeutic properties and justify its use in traditional medicine and diet.

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