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Chemical Composition and Physical Characteristics of the Essential Oil of *Cymbopogon schoenanthus* (L.) Spreng of Burkina Faso

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Abstract: Essential oils have a significant role in the society where they are variously used in fields such as medicine, pharmacy, cosmetics, chemical and food-processing industries. This justifies interest which they cause and thus systematic studies are undertaken on aromatic species, allowing without any doubt their use advisedly. This study concerns the characterization of the essential oil of *Cymbopogon schoenanthus* of Burkina Faso, extracted by drive with the water vapor in a distillation operation. The analysis of the chemical composition is carried out by Gas Chromatography. It shows that the 16 made up ones identified account for 65. 2% of the essential oil composition. These compounds belong to the two classes regularly met in essential oils: the mono ones and sesquiterpenes. However, proportion of monoterpenes (53. 2%) is higher than that of sesquiterpenes (12%). Among the identified compounds two monoterpenes (the piperitone and δ-2-carene) remain the principal components in the essential oil. Then the authors determine the density d = 0.9057 by double weighing, the optical activity α = +28.175 by polarimetry and the refractive index n = 1.465 by an interferometric method which they describe. *Cymbopogon schoenanthus* is an aromatic plant of the family of *Poaceae* very often used in traditional pharmacopoeia for internal as well as external treatments.

Key words: *Cymbopogon schoenanthus*, essential oil, optical activity, refractive index, interferometry

INTRODUCTION

Essential oils have multiple applications in medicine, pharmacy, cosmetics and industry. Their economic, scientific and medicinal interest justifies the many publications met in the literature and the great diversity of the vegetable species whose oils are marketed. Indeed, the systematic investigation of the aromatic plants allows adequate and rational utilisations with an optimal success and safety (Rabat, 2002).

The family of *Poaceae* includes food and industrial crops, turf and many other grasses. Some members of the *Poaceae* form the dominant vegetation in warm regions and are the subject of several works. There are about 40 species in the genus *Cymbopogon* from mainly tropical and sub-tropical Asia, Africa, New Guinea and Australia according to Cornish (2006). Many laboratories in several countries are deeply involved in studying various aspects of this plant and the work already done covers a wide array of topics including botanical identification, plant description, cytogenetics, cells tissue and organ *in vitro* cultures, (Shamar and Remresh, 2000).

In this research, we give the chemical composition and the physical characteristics of the essential oil of *Cymbopogon schoenanthus*. Its refractive index (n) is measured by an interferometric technique, its optical activity (α) by polarimetry and its density by double weighing. The physicochemical properties are significant to assess the quality of this oil and thus can be used as basic criteria for its identification.

MATERIALS AND METHODS

This study started in 1999 by chemical analysis of different essential oils of Burkina Faso, (Djibo *et al*., 2004) and has been completed later on, since 2005 by physical measurements in our laboratory with very accurate equipments.

Cymbopogon schoenanthus (L.) Spreng is an odorous grass, being presented in extended colonies, composed of independent tufts on the basis of a rhizomatous stock. The long and broad leaves are swollen at the base, the base of each group of leaves thatches giving a lengthened final panicle, composed of several ears. The long inflorescence, is made of clusters (Nacoulma-Ouedraogo, 1996; Kerharo and Adams, 1974). It is a plant which one meets in the sudano-sahelian areas, on the argilo-lateritic grounds and generally plentiful in July and August in Burkina.

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The broken into leaf stems or the rhizomes are used in the therapeutic traditional ones, as well of internal use, like tonic, antispasmodic, febrifuge, intestinal disinfectant, as external, like disinfecting funerary, antimalaria and against Guinea worm (Olivier-Bever, 1996). In Egyptian traditional medicine, this plant has a good reputation to be an antispasmodic and a renal diuretic. Another medication consists in preparing a tea-like decoction. Later, several authors Abdel *et al.* (1969) and Locksly *et al.* (1982) established that the active ingredient responsible for the antispasmodic activity is a sesquiterpenediol, the cryptomeridiol.

A recent ethnobotanic study, carried out by Millogo-Rasolodimby *et al.* (1997) shows that this plant is used in traditional pharmacopoeia in Burkina to treat the cough of infants and children.

Chemical analysis: The vegetable material (leaves), collected during the rainy season, in July in Saaba, located at the periphery of Ouagadougou, is dried, sheltered from the sun, at the ambient temperature under ventilation during three days.

The essential oil extracted by hydrodistillation with a device of Clevenger type at IRSAT (Ouagadougou) is analyzed by Gas Chromatography and the identification of the components by comparison with a sample studied by coupling Gas Chromatography and Mass Spectrometry, (Djibo, 2000). The results appear in Table 1.

Physical characteristics: They are mainly the refractive index (n), the density (d) and the optical activity (α) for the essential oil and their determination is entirely conducted in our laboratory.

Measure of refractive index: The experimental device used for the measurement of (n) is composed of a Michelson interferometer, lit by a laser (He-Ne) wavelength λ_0 = 632.8 nm. A convergent lens of focal distance f = 20 mm placed at the exit of the laser, before the interferometer makes it possible to obtain a widened beam which can give on a screen located at 50 cm of the rings of interference.

After a calibration by checking the laser wavelength by counting the (Z) number of dark rings which ravel in the centre of the figure of interference, three methods of calculation of refractive index (n) are possible:

The first one is based on the variation of the optical way. The second needs a solution of known index, and the third which we describe uses the radiation of the laser.

One should determine initially the laser radiation wavelength λ_0. With this intention, we produce a (d) displacement of the mobile mirror which varies the optical way corresponding of (2d), involving a displacement of the rings.

The number of dark rings having ravelled in the centre of the figure of interference is:

$$Z = \frac{2d}{\lambda_0}$$

Then, one can obtain the wavelength in essential oil while proceeding in the same way as for λ_0. Therefore:

$$n = \frac{\lambda_0}{\lambda}$$

The results are consigned in Table 2 and 3.

Measure of optical activity: For the measurement of (α) we use the Ceti Polaris polarimeter. We initially read the white (α_0) by using distilled water; then we have the value $\grave{\alpha}$) corresponding by using essential oil. The value of the optical activity (α) of essential oil is calculated by making the difference ($\grave{\alpha}$-α_0). The results are in Table 4.

Table 1: Chemical composition of the essential oil of *Cymbopogon schoenanthus* (L.) Spreng of Burkina Faso

Components	Time of retention on column OV101 out of mn	Percentage
1 δ-2-carene	9.051	8.2
2 P-Cymene	9.405	0.1
3 Limonene	9.778	1.5
4 Cis-p-menth-2-èn-1-ol	12.402	0.5
5 Trans-p-menth-2-èn-1-ol	12.9	0.3
6 α-terpineol	14.429	0.5
7 Pipéritone	16.323	42.0
8 β- elemene	20.743	0.5
9 β-Caryophyllene	21.576	0.5
10 Octanoate of 3méthylbutyle	23.655	0.1
11 Elémol	24.791	6.2
12 β-Eudesmol	26.896	1.8
13 T-Muurobol	27.075	1.1
14 β-Eudesmol	27.317	0.7
15 α-Eudesmol	27.44	1.0
16 Bulnesol	27.726	0.2
Total		65.2
Monoterpenes		53.2
Sesquiterpenes		12.0

Table 2: Verification of Laser wavelength

(Z) numbers dark rings	Outdistance (d) in μm	Wavelength λ_0 in nm
100	31.5	630.0
200	63.3	633.0
300	94.6	630.7
400	126.4	632.0
500	157.8	631.2
600	190.4	634.7

Table 3: Refractive Index of Cymbopogon schoenanthus essential oil

(Z) number of dark rings	Outdistance (2d) in μm	Wavelength λ in nm	Refractive Index $n = 638.2/\lambda_0$
100	43.3	433	1.461
200	87	435	1.454
300	129.5	431.67	1.466
400	172.5	431.25	1.467
500	215	429	1.475
600	260.5	434	1.458

Table 4: Optical activity of the essential oil of Cymbopogon schoenanthus

Value (α_0) in degrees	Value (α) in degrees	Optical activity (α) in degrees
0.6	29.4	28.8
0.6	28.15	27.55

Density: Density measurements are taken using a numerical balance of very high degree of accuracy by double weighing at the ordinary temperature.

RESULTS AND DISCUSSION

The yield obtained is interesting (4.6%) and depends certainly on the period of harvest, the part of the plant and the extraction process (Onadja, 2006).

The chemical analysis results in Table 1 show that the 16 made up ones identified account for 65.2% of the essential oil composition. These compounds belong to the two classes of made up regularly met in essential oils: the mono ones and sesquiterpenes. However, proportion of monoterpenes (53.2%) is higher than that of sesquiterpenes (12%). Among the identified compounds two monoterpenes (the piperitone and δ-2-carene) remain the principal components in the essential oil. The rate of piperitone is about 42% and that of δ-2-carene, 8.2%.

Given the principal components and their proportions, the chemical composition of the essential oil of *Cymbopogon schoenanthus* of Burkina approaches that the same collected species in Togo (Koumaglo *et al*., 1994) and differs from the chemical compositions of essential oils of the samples from Sudan and India, (Ashok and Aldo, 1993). However, although *Cymbopogon schoenanthus* of Burkina contains the same types of compounds as that of Togo, its oil is made conspicuous by the absence of certain components. For example, the α-eudesmol, one of the principal components of Burkina *Cymbopogon schoenanthus* essential oil misses in the oil of the species of Togo. It will be also noted that the monoterpenes such as the (pinene Z)-hydrate, (pinene E)-hydrate, the estragol, humulene, it (E)-β-farnesene, the α and β-cadinenes, the oxide of caryophyllene and β-terpineol present (but in small proportion) in the essential oil of the samples of Togo, miss in the oil of Burkina Faso. One raises also the absence in the latter of the sesquiterpenic compounds such as the tyglate of citronnella identified in the *Cymbopogon schoenanthus* oil of Togo.

For the laser wavelength, we have the average: $\lambda_0 = (631.93 \pm 2.35)$ nm (Table 2) and for refractive index: $n = (1.465 \pm 0.010)$. The values obtained for the refractive index (Table 3) and the density ($d = 0.9057 \pm 0.0010$) of *Cymbopogon schoenanthus* are comparable with those of *Mentha piperita* of Burkina (N'Goya *et al*., 2005), even though for optical activity they are different ($\alpha = +28.175 \pm 0.625$) (Table 4). These optical techniques need enough quantity of oil for measuring.

Let us announce however, that we do not check out so far in the literature, data of the physical characteristics of *Cymbopogon schoenanthus* essential oil.

Besides its high content in essential oil, *Cymbopogon schoenanthus* is an aromatic plant commonly used in the traditional pharmacopoeia in Burkina Faso; hence its economic, medicinal and scientific interest. Here we have references which can for sure help for an adequate utilisation of this natural product, ((Benchelah *et al*., 2004). Organoleptic characteristics (aspect, colour, smell …) are not sufficient to appreciate the purity and quality. An essential oil is an active and volatile substance which may be dangerous if it is not used properly.

CONCLUSION

The chromatographic analysis of *Cymbopogon schoenanthus* essential oil shows that this one has like majority components, the piperitone (42%), δ-2-carene (8.2%) and elemol (6.2%). Being given, on the one hand, the richness of this essential oil plant (yield of 4.6%) and on the other hand, its abundance on the burkinabe territory, it can be exploited. That more especially as the piperitone, its majority component, is used like precursor in the synthesis of menthol, itself employed in the preparation of drinks and in the tobacco industry to scent the cigarettes according to The Merck Index (1989).

This work also concerned the determination for the first time of the physical characteristics of the plant essential oil: refractive index using an interferometric method, optical activity and density. These physicochemical characteristics constitute useful references, points of comparison being used as quality standards in the commercial transactions (David Crow, 2006). Indeed, falsifications are numerous, either because essential oil is expensive, or because it was lengthened with terebenthine for example or was enriched in elements by synthesis.

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