

Medicinal Plants Used in Complementary Medicinal for the Treatment of Burns in Rutshuru Territory (North-Kivu, Democratic Republic of Congo).

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Abstract

Background: Burns are a common problem in the Democratic Republic of Congo and other many countries in the world. Its management poses a difficult challenge. The purpose of this study was to investigate medicinal plants used in the Eastern part of the Democratic Republic of Congo, especially in Rutshuru territory, used in management of burns. **Material and methods:** Ninety-three healers belonging were interviewed about the plant species used in traditional medicine for the management of burns in Rutshuru area. The name of the plants, the plant parts, the modes of preparation and the modes of administration of recipes were recorded. Cited plants were collected and identified at herbarium of the Laboratory of Ecology and Plants Resource Management, Faculty of Sciences, Official University of Bukavu. The plants ecological status was also determined. **Results:** Twenty-seven species of plants belonging to nineteen botanical families were identified. The main habitat preference of species is cultivated (81.4%), annual herb constituted 29.9% of morphological type while 29.9% of biological types are microphanerophytes. The topical application was the main mode administration. Leaves constituted sixty percent of plant organs used for drug preparation. **Conclusion:** Some plant species cited (70.3%) are known in the literature to treat burns. Further studies should be undertaken to investigate effectiveness of other plants that have not yet been studied and to determine their pharmacological properties.

Keywords: Medicinal plant, Burn, Rutshuru

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I. INTRODUCTION

Burn is defined as tissue injury caused by heat, chemicals, electricity, radiation etc. According to the depth, burn wounds are classified as first degree (superficial), second degree (partial thickness) and third degree (full-thickness).^[1] There are several causes of burns, ranging from direct heat (Including flames and hot liquids) to chemical or electrical injury. Presentations differ on the cause, and severity is depending on both contact time and the temperature to which the skin has been exposed.^[2] Perhaps the most traumatic injury to the victim, over the years burns have been treated with various wound coverings, both natural and synthetic aiming at find the most efficient means to control the damage that go beyond the site of the injury.^[3] Burn wound repair involves dynamic reciprocity between cytokine cells and extracellular matrix. The process is divided into three phases including inflammation phase, a proliferation phase and a tissue remodeling phase.^[4]

A burn may be life threatening especially in the very young and very old. A burn is very painful 'it hurts like hell', regular sleep is very difficult. Burns are preventable, yet they keep occurring estimated mortality rates of fire-related burns in 2002 worldwide were 322 000; 40 000 of them occurred in sub-Saharan Africa (WHO). More people suffer from disabilities and disfigurement caused by burns. This results in personal and economic effects on both the victim and family ultimately culminating in social stigma and restriction in participation in society. According to the WHO Global Burden of Disease estimates for 2004, just over 310 000 people died as a result of fire-related burns, of whom 30% were under the age of 20 years. However, it project for 2004 makes it clear that burns are an important contributor to the overall disease toll in children in the low-

income and middle-income countries of the African, South-East Asia and the Eastern Mediterranean regions.^{[5],[6]}

Throughout history, man used various natural materials as a remedy for various diseases. In the past few decades, most natural products were replaced with synthetic drugs that were based on modern chemistry and biotechnology. Ethnopharmacological research is considered crucial in the development and discovery of new drugs from natural sources.^[7]

The rich countries can easily provide health care and quality pharmaceuticals whereas poor populations have wider opportunities in the practice of traditional medicine, which sometimes is the only source of affordable and accessible care in remote areas.^[8]

Many medicinal plant species worldwide are used in traditional medicine for treating different diseases. The world health organization (WHO) has estimated that about 80% of the population living in the developing countries depends tremendously on traditional medicine for their primary health needs.^[9] It is estimated that about 80% of the rural communities utilize traditional medicines for their day to day needs.^[10] Herbal products could be extensively preferable due to their widespread accessibility and the vast experiential data retrieved from traditional medicine.^[11]

To treat various diseases, disorders, and many pathological conditions, in Congolese Alternative Medicine, healers and people used medicinal resources mainly medicinal plants.

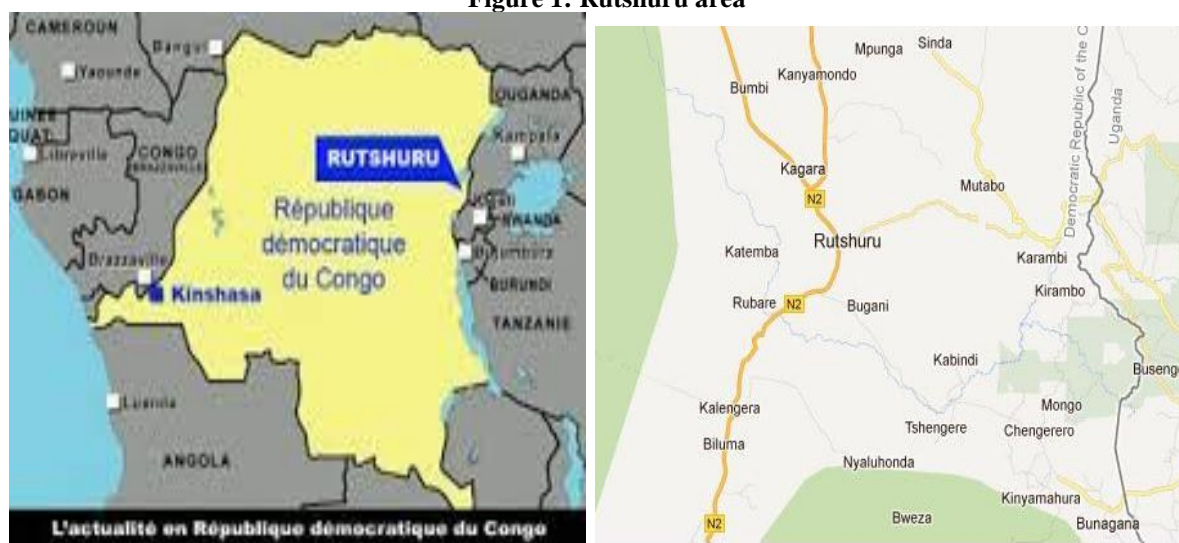
The aim of this study is to carry ethnopharmacological knowledge of medical plants used for burns in eastern part of Democratic Republic of Congo, Rutshuru territory in particular.

II. MATERIALS AND METHODS

Study Area

Rutshuru territory is a local entity of the North Kivu province. It was created in 1909. It is divided into two chiefdoms (Bwisha and Bwito) where Kings (*Mwami*) have considerable power. Situated to the east of the Democratic Republic of Congo, Rutshuru territory extends from Rwandan and Ugandan borders in the east to the Mitumba range in the west. It is bounded on the south by Nyiragongo area and the Republic of Rwanda, on the west by the Masisi and Walikale areas, on the north by Lubero area and Edouard Lake and on the east by Rwanda and Uganda Republics. A large area of Rutshuru (2,400 km²) is occupied by the Virunga National Park and its related reserves, which are classified as world heritages. The soil is clayey, sandy, clayey-sandy and sandy-clay; Rich and very productive, which makes 90% of the population of the territory of the farmers. The vegetation of Rutshuru is dominated by grassy and arbistic savanna. However, several forest species and woodland are remarkable in the Bwisha (Binza, Busanza and Kisigari) and Bwito chiefdoms (Tongo, Kihondo and Kanyabayonga) as well as in part of the Virunga National Park. On average, Rutshuru has a temperature of 26° C. Its average annual rainfall is 1800 mm of water. It knows the alternation of two seasons: the rainy season (September to December and March to May) and the dry season (June to August and January to February).^[12]

Figure 1: Rutshuru area



Survey Methodology

An ethno pharmacological survey was conducted from January 2016 to December 2016. Ninety-three traditional healers were identified and interviewed. The identification of the collected plants was carried out by comparison with different vouchers referenced at the herbarium of the Laboratory of Ecology and Resource

Management Plants, Faculty of Sciences of the Official University of Bukavu, in Democratic Republic of Congo (Eastern part).

The data checklist for Ethnopharmacological field work focuses on the following elements.^[13]: Identification of the traditional healer (name, age, address, quality); plant data (scientific and vernacular names, village survey, parts used, time of harvesting, stage or degree and organ development); plant therapy data : modes of preparation and administration (transaction and pharmaceutical form, concentration of the organ, dose, frequency of taking, instructions and any other associated plants); other indications (diseases and symptoms, physiological effects, against indications and side effects).

Floristical Description of Plants collected

Classification was made by family with various Morphological Types, Biological Types, Habitat Types, and Phytogeographic Distributions. The biological typing adopted in this study is defined according to the Raunkiaer's classification applicable for the tropical regions.^[14] as mesophanerophytes (MsPh), geophytes (G), microphanerophytes (McPh), chamephytes (Ch), nanophanerophytes (NaPh), chamophytes (Ch), and therophytes (Th). The morphological types have been inventoried as Tree (T), Shrub (Sh), Vivace herb (Vh), Annual herb (Ah), and Liana (Ln). The habitat types were Cultured (Cult), Ruderals (Rud), Fallow (Fal), Forest (For). The phytogeographic distribution of species was done according to Central Africa's chorographic subdivisions: Pantropical (Pan), cosmopolitan (Cosm), Afrotropical (Af Tr), tropical America (Tr Am) and Centro-guinean (CGuin).^[15] The habitat types were Cultured (Cult), Ruderals (Rud) and Fallow (Fal). Descriptive statistical analysis was used for calculating frequencies and percentages of occurrence. The literature review helped in complementing and confronting the ethnobotanical and medical information about the censored plants to support or justify the pharmacological potential.

III. RESULTS

Table 1: Ecological characteristics of medical plants used for burns in Rutshuru (DR Congo)

| Families | Scientific names | Morphological Types | Biological Types | Habitat Types | Phytogeographic Distribution |
|-----------------------|----------------------------------|---------------------|------------------|---------------|------------------------------|
| <i>Alliaceae</i> | <i>Allium Cepa</i> L. | Ah | Th | Cult | Pan |
| | <i>Allium sativum</i> L. | Vh | G | Cult. | Cosm. |
| | <i>Daucus carota</i> L. | Vh | G | Cult | Cosm |
| <i>Brassicaceae</i> | <i>Brassica oleracea</i> L. | Vh | Ch | Cult | Cosm |
| <i>Caricaceae</i> | <i>Carica papaya</i> L. | T | McPh | Cult | Pan (Am tr) |
| <i>Convolvulaceae</i> | <i>Ipomea patatas</i> (L.) Lam | Vh | McPh | Cult | Pan |
| <i>Cucurbitaceae</i> | <i>Cucurbita pepo</i> L. | Ah | Th | Cult | Cosm (Am tr) |
| <i>Fabaceae</i> | <i>Acacia</i> sp. | T | MsPh | Fal | Af tr |
| | <i>Arachis hypogaea</i> L. | Ah | Th | Cult | Pan (Am tr) |
| <i>Lamiaceae</i> | <i>Rosmarinus officinalis</i> L. | Sh | NaPh | Cult | Cosm |
| <i>Lauracea</i> | <i>Laurus nobilis</i> L. | Sh | MsPh | For | Cosm |
| <i>Myrtaceae</i> | <i>Eucalyptus globulus</i> L. | T | McPh | Cult | Pan |
| <i>Pedaliaceae</i> | <i>Sesamum indicum</i> L. | Ah | McPh | Cult | Cosm |
| <i>Plantaginaceae</i> | <i>Plantago major</i> L. | Vh | NaPh | Rud | Cosm |
| <i>Poaceae</i> | <i>Hordeum vulgare</i> L. | Ah | McPh | Cult | Cosm |
| | <i>Zea mays</i> L. | Ah | Th | Cult | Cosm |
| <i>Oleaceae</i> | <i>Jasminum</i> sp. | sh | MsPh | Fal | Pan (Af tr) |
| | <i>Olea europea</i> L. | T | MsPh | Cult | Cosm |
| <i>Rosaceae</i> | <i>Fragaria vesca</i> L. | Vh | Th | Cult | Pan |
| | <i>Rosa</i> sp. | Sh | MsPh | Cult | Cosm |
| | <i>Rubus inedulis</i> L. | L | McPh | Cult | Af tr |

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| | | | | | |
|-------------------------|--------------------------------------|----|------|------|-------------|
| Rubiaceae | <i>Coffea arabica</i> L. | Sh | MsPh | Cult | Pan (Af tr) |
| Solanaceae | <i>Solanum lycopersicum</i> L. | Vh | Th | Cult | Cosm |
| | <i>Solanum tuberosum</i> L. | Ah | McPh | Cult | Cosm |
| Theaceae | <i>Camellia sinensis</i> (L.) Kuntze | Sh | McPh | Cult | C-Guin |
| Urticaceae | <i>Urtica dioica</i> L. | Ah | Ch | Fal | C-Guin |
| Xanthorrhoeaceae | <i>Aloe vera</i> (L.) Burm.f. | Sh | G | Cult | Pan |

Legend: Tree (T), Shrub (Sh), Vivace herb (Vh), Annual herb (Ah), and Liana (L), mesophanerophytes (MsPh), geophytes (G), microphanerophytes (McPh), chamephytes (ChPh), nanophanerophytes (NaPh), therophytes (ThPh), Cultured (Cult), Ruderals (Rud), Fallow (Fal), Forest (For), Pantropical (Pan), Cosmopolitan (Cosm), Afro-tropical (Af Tr), Tropical America (Tr Am), Centro-guinean (C-Guin).

Table 2: Ethnobotanical data on plants used to treat burns in Rutshuru area (DRC)

| <i>Species</i> | Local name | Part used | Uses | Frequency of citation (%) |
|----------------------------------|--------------------------|------------------|---|------------------------------------|
| <i>Allium Cepa</i> L. | Litunguru sumo (S) | Bulbs | Juice of bulbs (minced) with honey | 3.4 ^a 2.3 ^b |
| <i>Allium sativum</i> L. | Litunguru (S) | Bulbs | Crushed bulbs are applied as poultice | 4.5 ^a 6.9 ^b |
| <i>Daucus carota</i> L. | Karoti (S) | Leaves | Application in poultice | 2.2 ^a 2.3 ^b |
| <i>Brassica oleracea</i> L. | Choux (F) | Leaves | Application of fresh leaves in poultice | 18.4 ^a 2.3 ^b |
| <i>Carica papaya</i> L. | Papai (S) | Unripe Fruits | Topical application of sap | 5.7 ^a 6.9 ^b |
| <i>Ipomea patatas</i> (L.) | Kijumbu (S) | Tuber | Topical application of tuber powder | 8 ^a 0 ^b |
| <i>Cucurbita pepo</i> L. | Ibahaza (K) Amoli (N) | Fruit Seed | Topical application of pip oil Application in poultice of grated or crushed | 3.4 ^a 0 ^b |
| <i>Acacia</i> sp. | Mugando (B) | Sap | Topical application of sap | 4.5 ^a 2.3 ^b |
| <i>Arachis hypogaea</i> L. | Kalanga (S) | Seed | Topical application of seed powder | 3.4 ^a 0 ^b |
| <i>Rosmarinus officinalis</i> L. | Romarin (F) | Aerial part | Topical application of oily macerate | 1.1 ^a 0 ^b |
| <i>Laurus nobilis</i> L. | Laurier (F) | Leaves | Application in poultice | 1.1 ^a 2.3 ^b |
| <i>Eucalyptus globulus</i> L. | Intufe (K) | Leaves | Topical application of oil | 3.4 ^a 4.6 ^b |
| <i>Sesamum indicum</i> L. | Inyanza (K) | Seed | Topical application of oil | 1.1 ^a 6.9 ^b |
| <i>Plantago major</i> L. | Imbatabata (K) | Leaves | Crushed leaves are applied as poultice | 4.5 ^a 4.6 ^b |
| <i>Hordeum vulgare</i> L. | Orge (F) | Seed | Semolina of the plant mixed with eggs, applied in poultice | 3.4 ^a 0 ^b |
| <i>Zea mays</i> L. | Ikigori (K) | Seed | Topical application of seed oil | 2.2 ^a 0 ^b |
| <i>Jasminum</i> sp. | Amarebe (B) | Flower | Oil is applied to improve healing | 1.1 ^a 2.3 ^b |
| <i>Olea europea</i> L. | Munzenze (B) | Seed | Oil is applied in compress | 3.4 ^a 4.6 ^b |
| <i>Fragaria vesca</i> L. | Maflesi (S) | Fruit | Application of crushed ripe fruit | 2.2 ^a 0 ^b |
| <i>Rosa</i> sp. | Rosier (F) | Fleur | Topical application the oil extracted from the petals | 1.1 ^a 2.3 ^b |
| <i>Rubus inedulis</i> L. | Inkeri (B) | Leaves | Topical application of powder with olive oil or lentisk oil Topical application of crashed | 2.2 ^a 0 ^b |

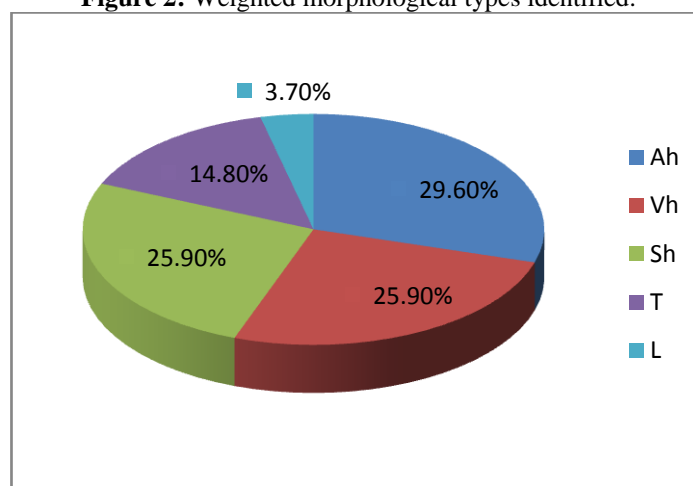
| | | | leaves | |
|--------------------------------|----------------------------|--------|---|------------------------------------|
| <i>Coffea arabica</i> L. | Kawa (S) | Seed | Topical application of powder | 3.4 ^a 0 ^b |
| <i>Solanum lycopersicum</i> L. | Tomati (B) | Fruit | Topical application of tomatoes grated on recent burns | 3.4 ^a 0 ^b |
| <i>Solanum tuberosum</i> L. | Birayi (S) Bitsungu (B) | Tuber | Topical application of raw pellets, slices or potatoes to raw poultry | 3.4 ^a 2.3 ^b |
| <i>Camellia sinensis</i> (L.) | Chai (S) | Leaves | Infused applied in compress | 3.4 ^a 2.3 ^b |
| <i>Urtica dioica</i> L. | Igisura (K) | Leaves | Infused applied in compress | 3.4 ^a 2.3 ^b |
| <i>Aloe vera</i> (L.) Burm.f. | Kitenende (N) | Sap | Topical application of sap | 9.1 ^a 39.5 ^b |

Legend: Local vernacular names: Bwiha (B); French (F); Kinyarwanda (R); Nande (N); Swahili (S); Rega (R); Frequency of citation by traditional healers (a); Frequency of citation in the literature (b).

Morphological types

Figure 2 shows morphological types of plants used in management of burns in Rutshuru area.

Figure 2: Weighted morphological types identified.

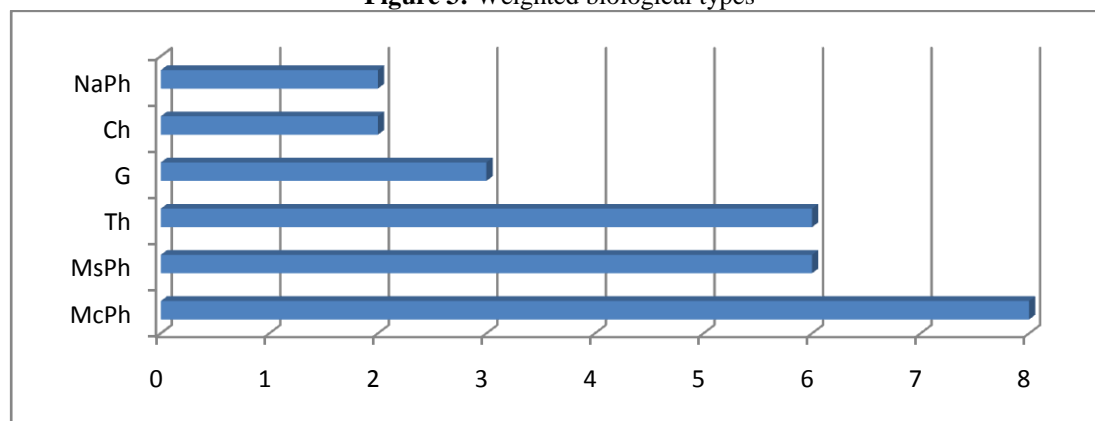


It can be noted from this figure that herbaceous plants represent about 55.5% of species (Annual herb=29.6% and Vivace herb=25.9%) while Shrub 25.9%, Trees 14.8% and liana represent 3.7%

Biological types

The inventory of twenty-seven species of plants used in treatment of burns in Rutshuru, has led us to identify biological types as follows (Figure.3).

Figure 3: Weighted biological types

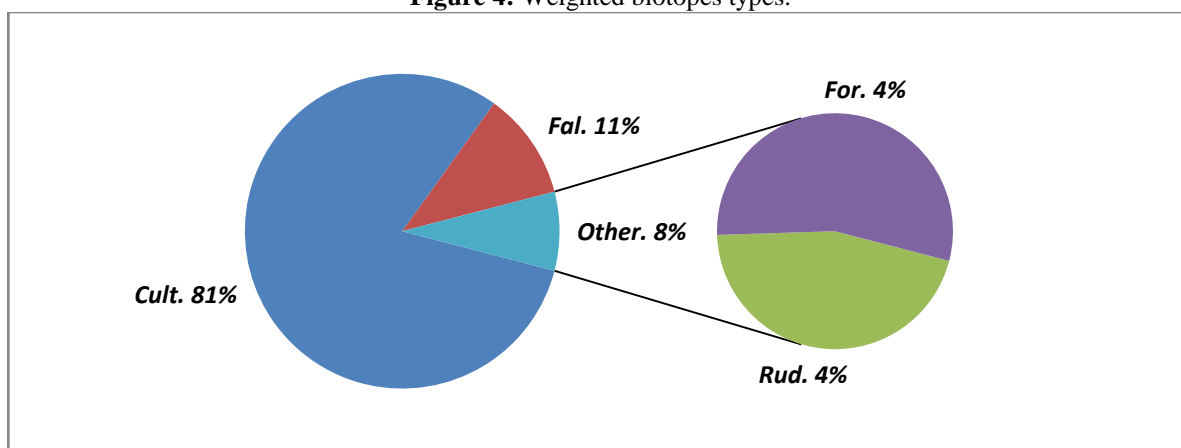


The biological types of the inventoried flora in treatment of burns in Rutshuru can be resumed as follow: Microphanerophytes represent 8 species (29.6%), mesophanerophytes theophytes, geophytes, chamaphytes and nanophytes respectively 6, 6, 3, 2 and 2 species.

Biotopes types

The species used in folk medicine to treat burns in Rutshuru city (Figure. 4) is found in different biotopes. Cultivated species are the main habitat type with 81.4% of used species followed by followed (11.1%), ruderals and forest (each with 7.4%).

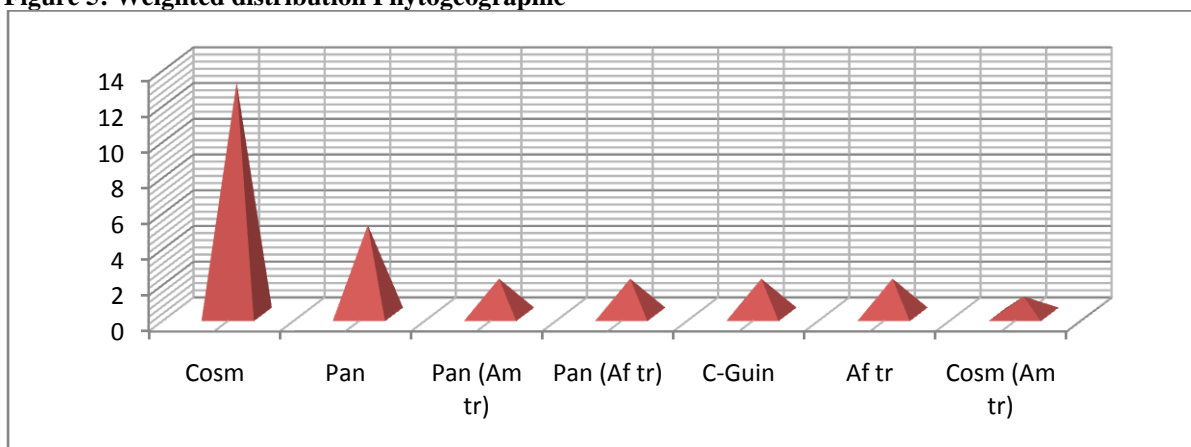
Figure 4: Weighted biotopes types.



Phytogeographic Distribution

The Phytogeographic distribution of the inventoried flora (Figure 5) can be resumed as follow: cosmopolitan represent 48.1% of all species, followed respectively by Pan (18.5%), Pan (Am tr), Pan (Af tr), C-Guin, Af tr represent each with 7.4% and Cosm (Am tr) represent only 3.7% each.

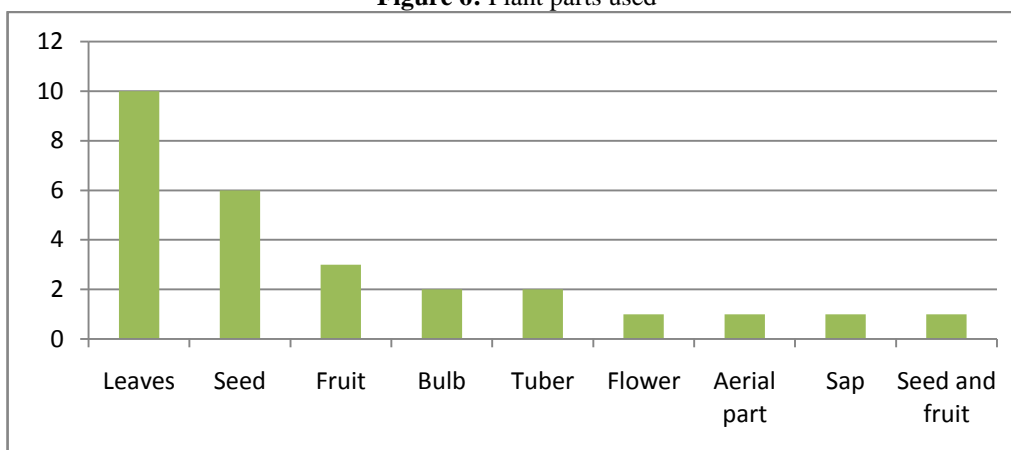
Figure 5: Weighted distribution Phytogeographic



Plant parts used

According to this figure, the leaves are the most used parts in the treatment of burns (Figure 6). They represent 37% of the used plant parts cited by traditional healers in this survey. The following parts are respectively seed (22.2%), fruit (11.1%), bulb (7.4%), tuber (7.4%) and flower, aerial part, sap each only 3.7%.

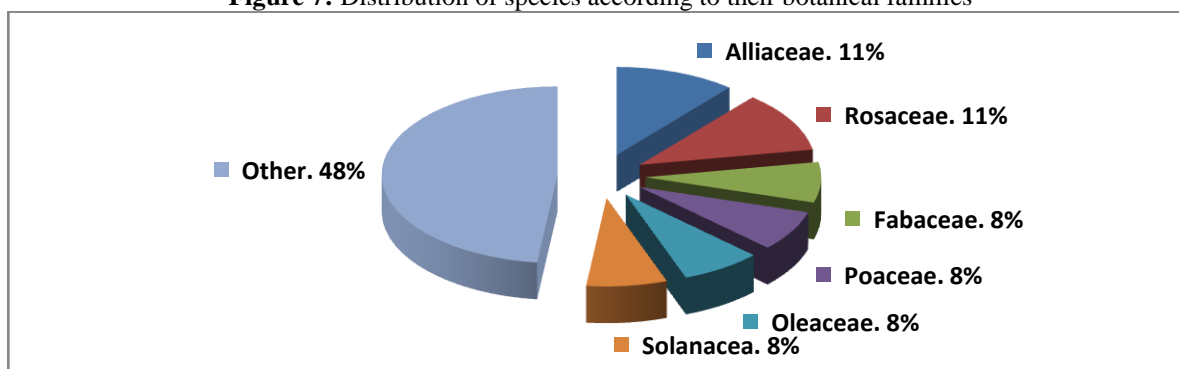
Figure 6: Plant parts used



Botanical Families Involved in the Study

Twenty-seven species of plants belonging to 19 different families were collected. Alliaceae and Rosaceae families are the most represented with two plants species each (11.1%) followed by Fabaceae, Poaceae, Oleaceae and Solanaceae, with one specie each (7.4%) and the others families are represented as shown in Figure 7.

Figure 7: Distribution of species according to their botanical families



IV. DISCUSSION

Many previous studies described the Anti-scratch effect some species *in vivo*, cited in this present study.

In a study on Wistar rats, intraperitoneal administration of *Allium sativum* bulb extract could reverse the oxidative responses to burn injury after 24 h in liver, intestine and lung tissue [16]. It also reduced microbial count in a dog model.^[17] Ethanolic extract of the plant showed burn healing activity by decrease in microbial count in rabbit.^[18] *Brassica oleracea* leaf extract showed burn healing function with increase in reepithelialization and vascularization.^[19] *Olea sp.* purified olive oil was investigated for treatment of partial-thickness porcine burns, but there was no significant difference between treatment and negative control groups.^[20] *Sesamum indicum* seed, seed oil and a mixture of them were effective for healing process of burn wound. The burn healing effects were reversely dose dependent, and better results were obtained by the oil.^[21]

Plantago major seed had healing potential of burn wound by improving tissue organization, re-epithelialization and granulation.^[22] Although the most studied species of this genus is *Aloe vera* which the gel demonstrated burn wound healing potential by anti-inflammatory effect and increasing re-epithelialization and microcirculation TNF-a, IL-6 and leukocyte adhesion were found to be decreased in a rat model of burn wound treated with *A. vera* gel. A human study proved the efficacy of *A. vera* on second-degree burn wound patients. A multi-component herbal preparations “Ampucare®” on based of *Jasminum officinale*, that showed burn healing effect with enhancement of antioxidant function, NO level, as well as increase in protein level and vitamin C in rats.^[1]

Carica papaya fruit latex had burn healing effect by increasing re-epithelialization and hydroxyproline content of the damaged tissue.^[23] *Camellia sinensis* leaf extract was able to improve burn wound contraction by angiogenesis in rat model.^[24]

Aloe vera is one of the oldest healing plants known. It is used topically for cuts, burns, insects stings, bruises, acne and blemishes. *Aloe vera* leaf contains Vitamin C, Vitamin E and amino acids which are essential for wound healing.^[25] Furthermore, acemannan, a complex carbohydrate isolated from *Aloe* leaves, has been shown to accelerate wound healing. However, the intra dermal administration of essential oil of *Eucalyptus globulus* increased the capillary permeability and promotes wound healing.^[26] It Leaves of *Aloe vera*, fruits and leaves of *Olea europaea* have been reported in treatment of burns and wound healing. The emollient and astringent properties of Leaves from *Plantago major* and *Urtica dioica* have been cited.^[7] Local use of *Olea europaea* treated with water and salt, prevents formation of blisters in burns. However, *Sesamum indicum* is applied alone on burns. *Plantago major* is good for hot swellings, burns, herpes and urticarial.^[27] *Acacia sp.* has used to treat burns in Kenya.^[28]

Many clinical studies have demonstrated the therapeutic efficacy of *Aloe*-based preparations.^{[29],[30],[31],[32],[33]} Several other studies cited the use of *Aloe* in the management of burns.^{[34],[35],[36]} The results of healing potential of the leaves aqueous extracts of *Solanum nigrum* and the showed that despite the better wound healing effect and had a significant potential for burn wound healing.^[37]

The methonolic extract of root of *Sesamum indicum* was obtained and was incorporated in gel and ointment bases. These preparations were evaluated for in vivo wound healing on rat using excision wound model.^[38] According an ethnopharmacological study realized in Indian, *Eucalyptus globulus* and *Laura noblis* have been identified as species that possessed a wound healing activity.^[39]

Potatoes (*Solanum tuberosum*) have many constituents including a host of tannins, flavonoids, and alkaloids. The tannins have a drying action which has been linked to relieving diarrhea. They have also been used externally for burns and inflammation.^[40]

The pulp of the fruit from *Carica papaya* contains the enzyme papain. It can be used to remove the slough from the wound, to remove thick crusts and to reduce hypergranulation.^[41]

Les results of this present study showed that the leaves are the most used parts in the treatment of burns with medicinal plants in Rutshuru (Figure 7). It represents 37% of used plant parts cited by traditional healers in this survey. In most other ethnobotanical studies where plants are used to treat various skin disorders, the leaves are also the preferable plant part used.^[42]

The use of leaves could be justified by the abundance of chemical groups they contain. In fact, leaves are known as main synthesis site of secondary metabolites in plants and are the most commonly used plant parts by traditional medicine practitioners.^{[43],[44],[45]}

V. CONCLUSION

Many people in the world and in Democratic Republic of Congo, in particular, depend on traditional health care and use natural products resolve their health problems. This present study was conducted was undertaken in the prospects of implementation of initiatives that could lead, in the future, to the manufacture of improved traditional medicines for the treatment of burns it is expected that the results of this study will lead to phytochemical and pharmacological investigations of some of these plants are in progress

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