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Current knowledge on traditional uses, phytochemistry, toxicity and biological activity of *Rourea Coccinea* (Schumach & Thonn.) Benth

Eric Agbodjento[1], Jean Robert Klotoé[1,2*], Isabelle Téniola Sacramento[3], Victorien Tamègnon Dougnon[1], Mathieu Hounkpatin[4], Jacques Tossou Dougnon[1], Jean Marc Atègbo[5]

[1]*Unité de Recherche en Microbiologie Appliquée et Pharmacologie des substances naturelles, Laboratoire de Recherche en Biologie Appliquée, Ecole Polytechnique d'Abomey-Calavi, Université d'Abomey-Calavi, 01BP2009 Cotonou, Bénin*

[2]*Ecole Normale Supérieure de Natitingou; Université Nationale des Sciences, Technologie, Ingénierie et Mathématiques; BP72 Natitingou.*

[3]*Ecole de Gestion et d'exploration des Systèmes d'élevages / Université Nationale d'Agriculture (EGESE/UNA) – Kétou*

[4]*Hôpital de zone de Mènontin, Ministère de la santé, Bénin*

[5]*Laboratoire de Physiopathologie Moléculaire et Toxicologie ; Université d'Abomey-Calavi, 01BP526 Cotonou, Bénin*

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Abstract

Rourea coccinea is a vegetable species of Connaraceae family generally found in West Africa and in intertropical Africa, which has important medicinal property. The purpose of this work is to make the review of the botanical, ethno-pharmacological, phytochemical, pharmacological and toxicological studies of *Rourea coccinea* carried out until December 2019. The collected data from several databases shows that *Rourea coccinea* mainly used in Africa in the treatment of malaria, hypertension, edema, rheumatism, diarrhea and gonorrhea. Phytochemical investigations carried out on different parts of plant revealed the presence of saponins, reducing sugar, steroids, glycosides, anthraquinones and polyphenolic substances. These compounds are responsible for the variety of effects pharmacological of the plant. Toxicological tests conducted on the species indicate the absence of toxicity of the leaves, stem and root of the plant. However, more in-depth toxicological and pharmacological tests are necessary in order to discover the therapeutic potential of this plant.

* **Corresponding Author:** Dr. Klotoé Jean Robert ✉ jrklotoe@yahoo.fr

Introduction

Connaraceae is a botanical family of dicotyledonous plants. It is in the major group Angiosperms (Flowering plants) (The Plant List, 2013). This botanical family includes about 267 species, divided into 19 genera. These plant species are trees, shrubs or more often lianas from tropical areas. The most important genera are Connarus (about 80 species) and *Rourea* (40-65 species) (Heywood *et al.,* 2007). Their habitat is generally the lowland rainforest and the savannah. Genus *Rourea* has about 65 species and 129 varieties (The Plant List, 2013). *Rourea* is a climbing shrub or small tree, usually with prominent lenticels (Osman *et al.,* 2019). The leaves are small and imparipinnate. An unbranched inflorescence bears flowers of five petals in the alyx. They have longer petals than sepals. The fruits are curved and hairless. *Rourea* sp. is widely distributed in the Amazon, Pacific region, Africa, and Asia (Osman *et al.*, 2019). The species of *Rourea* have important medicinal properties. Thus *Rourea induta* is used to treat rheumatisms and Chagas disease (Kalegari *et al.,* 2014). *Rourea cuspidate* Benth ex. Baker is commonly known in Brazil as herbal used to treat diabetes (Laikowski *et al*., 2017). *Rourea regusa* Planch, meanwhile, is used to treat respiratory diseases (Alsarhan *et al*., 2012). However, some species of Roureasp are toxic. It includes, for example, *Rourea orientalis, Rourea volubis, Rourea glabra* and *Rourea platysepala* which are poisonous and often used to deter animals (Oliveira *et al.,* 2012). Known under different names in several African pharmacopeias, *Rourea coccinea* Schumach. &Thonn is widely used for his therapeutic potential. The leaves, stems, and roots of this plant used variously in the treatment of many diseases (diarrhea, male and female infertility, hypertension, dysmenorrhea, malaria, inflammation, muscle aches, wound healing, rheumatism and gonorrhea). However, several pharmacological investigations conducted mainly in Africa on the species evoke a variety of pharmacological effects such as analgesic, antidiarrheal, anti-inflammatory, antipyretic, antioxidant and antimicrobial (Oke and Hamburger 2002; Atawodi *et al.,* 2002; Amos *et al.,* 2008; Adeyemi *et al.,* 2010; Wazis *et al.,* 2012).

The aim of this review is to provide an update of scientific data current regarding ethnobotanical, pharmacological, phytochemical and toxicological studies carried out on the *Rourea* coccinea until December 2019.

Rourea coccinea

Geographical habitat and botanical characteristics

Rourea coccinea (Schumach & Thonn.) Benth (*Syn. Byroscarpus coccineus*) is a plant of the Connaraceae family. *Rourea coccinea* It is a shrub with many lenticles most often liana that is often found in intertropical Africa (East Tropical Africa: Tanzania West-Central Tropical Africa: Burundi, Central African Republic, Congo, Zaire ; West Tropical Africa: Ghana, Guinea, Nigeria, Togo; South Tropical Africa: Angola, Zambia) (Burkill, 1985). It is found mainly in secondary regions. *R. coccinea* grows on sandy or ferruginous soils with a humid tropical climate in Sudan (Adjanohoun *et al.,* 1989). Its taxonomic classification summarized in Table 1. *Rourea coccinea* (Schumach&Thonn.) Benth (Fig.1) is a shrubby shrub 1 to 2m tall. Leaves are imparipinnate with rachis 5-12 cm long with 5-6 pairs of sub-opposite leaflets(Burkill 1985; Mann *et al.,* 2003). Its fruits are capsular, glabrous, oblong and yellow about 15 mm long and 7 mm wide. They are slightly convex on one side and have a red or yellow capsule showing an open-orange black-seeded seed (Adjanohoun *et al*., 1989). The flowers of this plant are fragrant, white, pink, small and clustered. Flowering occurs between January and November and fruiting between October and April (Adjanohoun *et al.,* 1986; Mann *et al.,* 2003).

Ethnopharmacologia

In the African pharmacopoeia, *Rourea coccinea* is well known for its therapeutic potential (Adjanohoun *et al.,* 1989).The traditional use circumscribed in West Africa of a plant. Its leaves, stems and roots variously used in the treatment of the affections such as the diabetes, malaria, male and female sterility, the transmissible sexual infections, venereal diseases etc. In this African traditional medicine, the leaves of *R.*

coccinea are more used. Fig. 2 below summarizes the traditional uses of the plant for the treatment of diseases in Africa.

Phytochemistry

Phytochemical studies carried out on different parts of *Rourea coccinea* revealed the presence of a number of phytochemical components. These compounds vary according to the organ of the plant. Below does the phytochemical screening of the leaves, stems and roots of the plant reveal the phytochemicals.

Leaves: Qualitative phytochemical screening carried out on the leaves of *Rourea coccinea* by several authors showed the presence of saponins, tannins, steroids, reducing sugar, glycosides, flavonoids and anthraquinone in this part of the plant (Ahmadu *et al.*, 2006; Hamid and Aiyelaagbe 2011).

Table 1. Profile of *Rourea coccinea* (Akindele *et al.*, 2011).

Taxonomic classification	Reign	Vegetal
	Group	Dictotyledone
	Class	Magnoliopsida
	Family	Connaraceae
	Genera	Rourea
	Species	Coccinea
Synonyms	*Rourea coccinea* (Schumach. &Thonn.) Benth. Var. coccinea (1849). *Byrsocarpus coccineus* Schumach. &Thonn. (1827) *Rourea coccinea* (Schumach. &Thonn.) Benth. Subsp. Coccinea. *Byrsocarpus dinklagei* (Gilg) Schellenb. *Byrsocarpus poggeanus* (Gilg) Schellenb. *Byrsocarpus viridis* (Gilg) Schellenb	
Common/ Vernacular names	Benin: Vikplonba, nociovijè, yéhwéli, ganganlisè, hounsitogbwé, ahwanhazoun (fon); anyonma (goun); amodjè, amujewewe, orikotèni (yoruba, nago). Ivory Coast: Wotan, Botan (Baoule) Togo : Todhotodhoe, Ehumayero, Husitogboe (Ewe-Watchi); Amoyedje (Fe-Ana), Tomégavigbé (Mina-Gen)	

Table 2. Phytochemical components identified in the leaves, stem and roots of *Rourea coccinea*.

Phytochemical components	Leaves	Stem	Roots
Phenols	+	+	+
Saponins	+	+	+
Alkaloids	-	-	+
Carbohydrate	+	-	+
Reducingsugar	+	+	+
Steroids	+	+	+
Glycosides	+	-	+
Anthraquinone	+	+	+
Tannins	+	-	+
Flavonoids	+	+	+
Coumarins	+	-	-
Anthocyanins	-	-	-
Phlobatannins	-	-	-

+: Presence - : Absence.

These same secondary metabolites with the exception of tannins and alkaloids have been identified by Ezeh *et al*., (2019) in leaves of *Rourea coccinea* harvested in Nsukka Nigeria. Vickery and Vickery (1980) reported the presence of 4-hydroxycoumarin and di-coumarol in the leaves of the plant. In these leaves, Ahmadu *et al.* (2007) identified three flavonoid glycosides: quercetin 3-O-α-arabinoside (I), quercetin (II) and quercetin 3-β-D-glucoside.

Fig. 1. Leaves of *Rourea Coccinea*, photo taken at the Botanical Garden of the University of Abomey Calavi, Republic of Benin (Source: Agbodjento, 2019).

Stem : Hamid and Aiyelaagbe (2010) conducted a phytochemical study on this part of the plant. It appears that saponins, anthraquinones, reducing sugars, glycosides, steroids, and flavonoids have identified as major phytochemical components of the stem of *Rourea coccinea*. Roots : Phytochemical studies on roots of *Rourea* coccinea showed that this part of the plant is rich in tannins, flavonoids, saponins, anthraquinones, steroids, glycosides and alkaloids (Muhammad *et al.,* 2017). These authors have identified in the fraction of ethyl acetate of the roots of this plant, thirty (30) bioactive molecules including among others 2-cyclohexene-1-one, catechol, 2-amino-imidazole-5-propionic acid, 4-methoxybenzene 1,2-diol, 2-hydrocoumarin, 2,4-dimethoxyphenol and 2,6-hydrobenzaldehyde, trolamine, coumarin, phenol etc. Study of Sunday *et al.* (2019) showed that the aqueous extract of the bark of the roots of *Rourea* coccinea are composed of phenol, tannins, flavonoids, saponin, alkaloids and carbohydrate.

A quantitative screening of the same extract of this part of the plant performed by these authors indicates a richness in saponin (10.6%), tannins (7.2 %) flavonoids (6.2%), phenol (5.8) and alkaloid (4.4%) (Sunday *et al*., 2019). Table 2 summarizes the phytochemicals identified in the roots, stem and leaves of *Rourea coccinea*.

From the cross-analysis of these phytochemical data collected, it appears that at the present stage compounds such as saponins, reducing sugar, steroids, anthraquinones and flavonoids identified in

the leaves, roots and stem of *Rourea coccinea*. By contrast, anthocyanins and phlobatannins are absent from these plant organs. In addition, alkaloids identified only in the roots whereas coumarins are present only in the leaves of the plant. This variation in the phytochemical components of the leaves, roots and stem of *Rourea coccinea* gives the plant a variety of pharmacological effects.

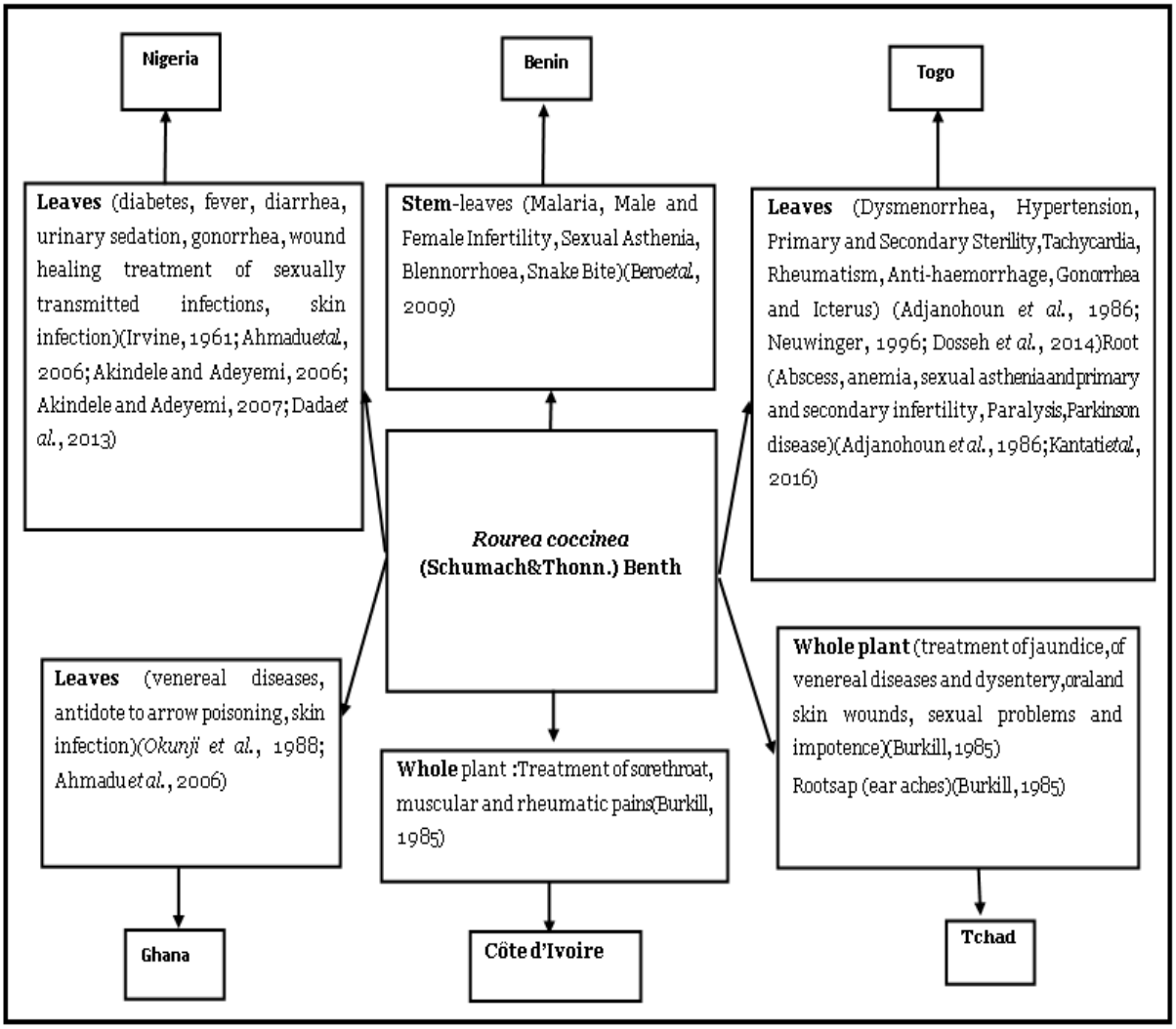

Fig. 2. Traditional uses of *Rourea coccinea* in Africa.

Biological and pharmacological activities

Scientific studies conducted on *Rourea coccinea,* mainly on its leaves, suggest a variety of pharmacological effects. The Results of these pharmacological investigations indicates the anti-inflammatory, anti-diabetic, anti-malarial, antimicrobial, hypotensive and aphrodisiac potential of the plant.

This pharmacological potential of *Rourea* coccinea could attributed of the secondary metabolits identifies in differents parts of the plant. Thus, the anti-inflammatory and antioxidant potentials of the leaves and roots of the plant could linked to the flavonoids identified in these plant organs. Agrawal (2011) indicate that flavonoids have antioxidant and anti-inflammatory properties. These flavonoids are also responsible for the antimicrobial properties of *Rourea coccinea* (Cushnie and Lamb 2005). Furthermore, the anti-diarrheal effect of the leaves of *Rourea* coccinea is linked to the presence of tannins revealed by phytochemical screening. Indeed, Ashok (2012) indicated that tannins are phenolic compounds capable of reducing the permeability of the intestinal mucosa and thus producing an anti-diarrheal effect.

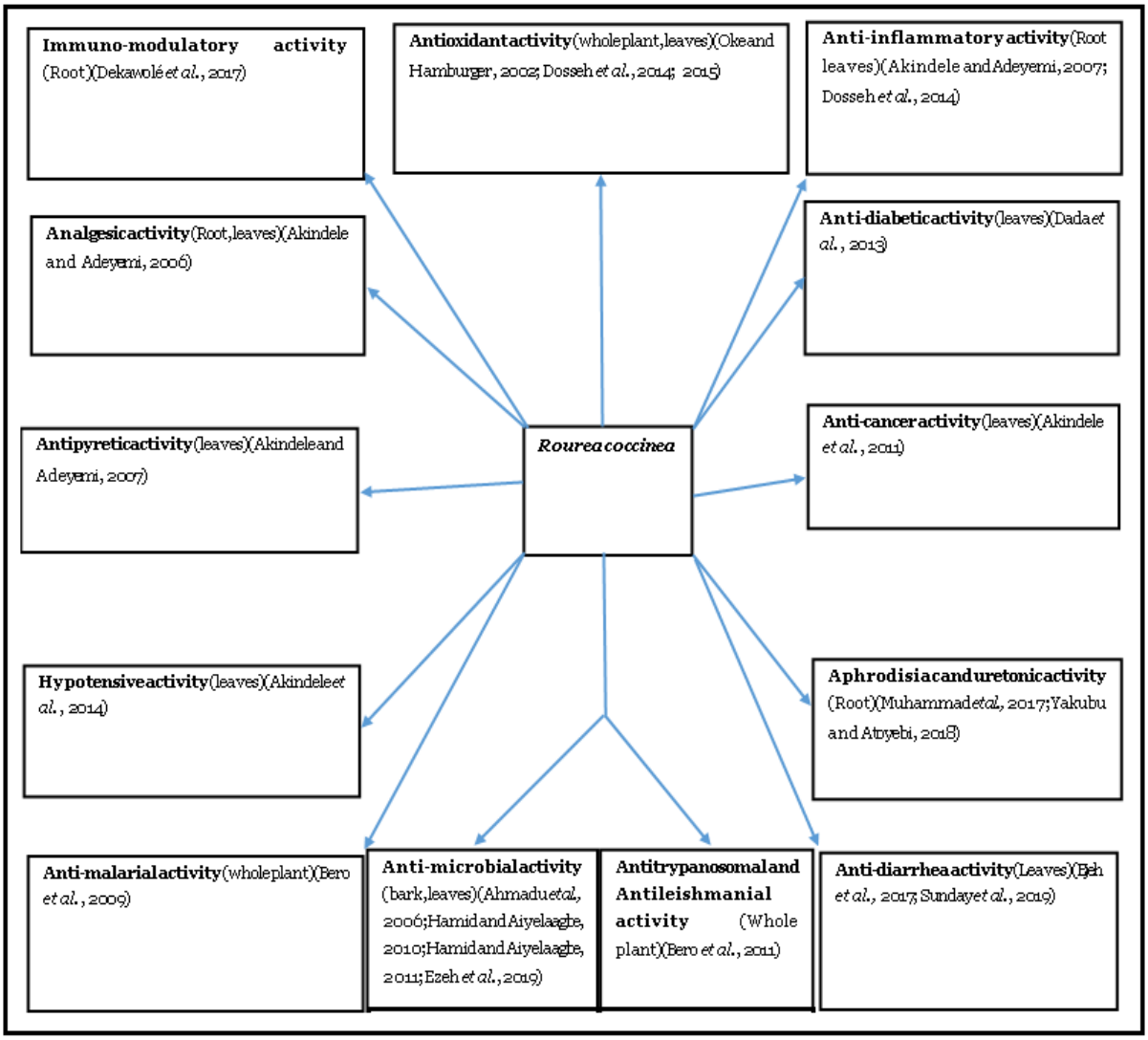

Fig. 3. Biological and Pharmacological activities of *Rourea coccinea*.

The presence of coumarin in the leaves makes it possible to evoke antidiabetic, antipyretic and analgesic properties. Li *et al.* (2017) reported that coumarin-rich plants have antipyretic, analgesic and are very beneficial in the treatment of diabetes. A study indicated that the aphrodisiac effect of the roots of *Rourea coccinea* are attributed to the saponins and flavonoids identified in this part of the plant (Muhammad *et al.*, 2017).

This above-mentioned scientific evidence justifies the traditional uses of *Rourea coccinea* in several African pharmacopoeias. However, other biological and pharmacological potentialities such as anti-infectious, spermatogenic, sedative, anti-oedematous, anti-convulsant, anti-cancerous activities can be explored to increase the therapeutic potential of the plant. Fig. 3 below summarizes the biological and pharmacological activities of *Rourea coccinea*.

Toxicological study

The toxicological investigations carried out on *Rourea* coccinea concerned the tests of acute, sub-acute and sub-chronic toxicity. A study carries on acute toxicity test of the ethanolic extract of the root bark of *Rourea coccinea* (Syn *Byrsocarpus coccineus*) harvested in Lome (Togo) showed that this extract administered to Wistar rats at a single dose of 5000 mg/kg produced no toxicity or mortality (Dosseh *et al.*, 2015). Similarly, the results of the sub-acute toxicity test

conducted by these authors indicate a safety of the roots of *Rourea* Coccinea (Dosseh *et al.*, 2015). This same observation is made in the studies conducted in Nigeria (Ejeh *et al.*, 2017; Sunday *et al.,* 2019). This indicates that the LD_{50} value for this extract is above 5000 mg/kg of body weight.

Unlike roots, the use of leaves of *Rourea* coccinea is not free of any danger. Wazis *et al.* (2012) evaluated the acute toxicity of different extracts (Ethanolic, Ethyl acetate, N-Butanol extracts) of the leaves of the plant in Wistar rats and mice by different administration routes. The results vary depending on the type of extract and the route of administration. Indeed, aqueous extract, administered orally to Wistar rats, caused animal mortality (LD_{50} = 3.46 g/kg) at the dose of 4g/kg body weight. By intraperitoneal route, the LD_{50} of this extract is above 1 g/kg body weight in both Wistar rats and mice. For the ethanolic extract, the LD_{50} in IP is greater than 1 g/kg for Wistar rats and 282.24 mg/kg for mice. For ethyl acetate extract, the LD_{50} is greater than 1g/kg in rats and mice by intraperitoneal route and 3.3g/kg for the extract for rats by oral route. N- Butanol extract was found to be more toxic than other extracts (LD_{50} is 141 mg/kg for wistar rats and 89.44 mg/kg for mice). In Togo, Adeyemi *et al.* (2010) obtained similar results. Indeed, these authors reported that the aqueous extract of *Rourea* coccinea administered intraperitoneally to Wistar rats caused the mortality of all animals at a dose of 800 mg / kg body weight (LD_{50}= 158.4 mg/kg). Oral route; the extract produced no mortality at the dose of 10 g/kg body weight but signs of toxicity such as sedation, contortion and others were observed.

These observations suggest that, like some species of *Rourea* sp, the use of leaves of *Rourea* coccinea at high doses in traditional medicine may pose risks of toxicity.

Conclusion

Rourea coccinea is a medicinal plant common to several African pharmacopoeias. Its traditional use for the treatment of pathologies circumscribed in tropical Africa. This plant has been the subject of very few scientific studies. These studies showed a variety of pharmacological effects such as anti-inflammatory, anti-diabetic, anti-malarial, antimicrobial, hypotensive and aphrodisiac activities. Tests of toxicity carried out on the species indicates that at high doses, the plant can be toxic. Further pharmacological and toxicological tests needed to identify the full therapeutic potential of this plant and toxicological profile.

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Conflicts of interest

No conflict of interest.

Authors' Contributions

All authors participated in the realization of this article. They also read and approved the final version of the manuscript.

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