

# A REVIEW OF THE PHYTOCHEMISTRY AND MEDICINAL USES OF *LONCHOCARPUS* SPECIES

## ABSTRACT

The search for new medications to cure human ailments depends heavily on research into natural products. The use of these medicinal plants as a source of biologically active substances with therapeutic capabilities for treating a variety of disorders has been observed and documented over time. *Lonchocarpus* (*Fabaceae*, *papilionadeae*) is a plant genus that has been demonstrated to possess a variety of chemicals with many distinct functions but has not yet undergone a complete investigation. This review covers biological and pharmacological functions, applications, and phytochemical components of the four selected species of *Lonchocarpus* plants distributed in Nigeria, including *Lonchocarpus bussei*, *Lonchocarpus cyanescens*, *Lonchocarpus laxiflorous* and *Lonchocarpus sericeus*. *Lonchocarpus* is a rich source of many various kinds of polyphenolic chemicals. According to phytochemical investigations, Chalcones, flavans, Aurones, dibenzoylmethane derivatives, rotenoids, pterocarpans, flavanols, flavones, flavanones, isoflavones and flavonols are some of the classes that fall under this category.

**Keywords:** *Lonchocarpus*, flavonoids, pharmacological, isolation, phytochemicals.

### Introduction

Plant-derived medicines have long attracted the attention of experts from all over the world since they are generally safe and have a good impact on human health. Plants with a long history of usage in ethnomedicine can be a valuable source of medicines for the treatment of a variety of ailments and infectious diseases in the pharmaceutical sector. The majority of different types of bioactive chemicals with a variety of therapeutic qualities are thought to be present in medicinal plants. According to the World Health Organization (WHO), traditional medicines are the primary source of basic healthcare used by over 80% of the world's developing population. A variety of pharmaceuticals can be created from different medicinal plants, according to the WHO (Fransworth *et al.*, 1985).

Natural treatments for ailments have been used throughout human history (Abdullahi *et al.*, 2007). The main reason for this is that these natural compounds are desirable candidates for drug development since they have been linked to health benefits as demonstrated by traditional medicine (Cassidy *et al.*, 2011). As a result, new drugs are still derived from plants (Cseke *et al.*, 2006). According to a recent US study published by Moronkola *et al.*, (2009), 25% of the drugs that pharmacists prescribe contain plant extracts or active components that come from higher plants. Currently, 119 chemical compounds that come from 90 different plant species are thought to be significant medications. 74% of the medications were found by examining the active components found in plants that were traditionally utilized for medical purposes.

Furthermore, 50% of the most often prescribed drugs in the US have a connection to natural products or were inspired by them. As a result, the phytochemicals were either used to make synthetic derivatives or analogs, or the natural compounds themselves were used directly (Dorcas *et al.*, 2013). 80% of people use drugs made from plants for medical purposes, according to Vogler *et al.*, (2006). The drugs that are used most frequently are those for infectious diseases and anticancer therapies (Regnault-Roger and Calvo, 2004). Only a small subset of those species have been studied for possible drug use, hence there are still a large number of higher plants that need to be investigated (Abdullahi *et al.*, 2007).

The *Lonchocarpus* series of the *Fabaceae* family is one of these higher plants whose comprehensive investigation is still pending. The largest family of flowering plants is the *Fabaceae* family, also referred to as *Leguminosae* (Haegnauer and Grayer-Barkmajer, 1993).

The pod, or legume in scientific parlance, is a distinctive feature of plants in this family (Schrire *et al.*, 2005). According to Wojciechowski *et al.*, (2004) and Xueqin *et al.*, (2011), this family contains approximately 20,000 species dispersed across 650 genera and is rich in terpenoids, polysaccharides, nitrogen-containing substances, flavonoids, lipids, and anthraquinones. In terms of the production of medicines, dye, fodder, decorations, wood, tannins, essential oils, resins, flavors, piscicides, insecticides and even human food, it is currently one of the most commercially significant families (Kokwaro, 2009). Additionally, as legumes that fix nitrogen, they have an effect on the ecology (Bentjee, 1994; Mannetje, 2002).

Fabaceae plants are employed in a vast number of basic medicines used in conventional medicine. Xueqin *et al.*, (2011) claim that it is a well-known source of alkaloids, terpenoids, flavonoids, steroids, phenylpropanoids, glycosides, phenols, and a range of essential oils. In Africa, the Caribbean Islands, tropical America, and Australia, Madagascar, possesses roughly 100 species of the genus *Lonchocarpus* (Fabaceae, Papilionoideae) (Magalhães *et al.*, 2007; Mesía-Vela *et al.*, 2001). At least 35 of those species have been studied, and the chemical studies indicate that they contain substances that could explain why the plants are used in traditional medicine (Jain and Bari, (2010). It has been demonstrated that many *Lonchocarpus* species are abundant sources of polyphenolic chemicals (Cassidy *et al.*, 2011). The isolation, phytochemistry and medicinal properties of compounds from *Lonchocarpus* species have not received much attention, despite extensive need for medicinal compounds for the treatment of known and unknown diseases globally. Therefore this review was carried out to discuss the phytochemistry of *Lonchocarpus* species and to call the attention of present and future researchers on the phytochemistry and medicinal uses of the plant especially natural product researchers.

### ***Lonchocarpus***

In tropical America, Africa, the Caribbean Islands, Australia and Madagascar, there are about 100 species of the genus *Lonchocarpus* (Fabaceae, Papilionoideae) (Vogler *et al.*, 2006; Mesía-Vela *et al.*, 2001; Borges-Argáez *et al.*, 2000; Jain and Bari, (2010); Lima *et al.*, 2009). At least 35 of those species have been studied, and the chemical studies indicate that they contain substances that could explain why the plants are used in traditional medicine (Jain and Bari, (2010); Reyes-Chilpa *et al.*, (2006). Some of these applications include treating fevers, leprosy, cataracts, and gastric-related issues (Mesía-Vela *et al.*, (2001); Reyes-Chilpa *et al.*, (2006). It has been demonstrated that many *Lonchocarpus* species are abundant suppliers of polyphenolic chemicals. Although they are not necessary for a plant's normal growth, development, or reproduction, polyphenolic chemicals are secondary metabolites that serve the needs of the plant (Cseke *et al.*, (2006).

According to Jaganath and Crozier (2010), the functions of these secondary metabolites include structural roles in various supporting or protective issues, allelopathic activity, defense-related activities, UV protection, pollinator attraction, and signal molecules involved in interactions between the plant's environment and the plant itself. In nature, polyphenols are abundant, especially in plants (Regnault-Roger *et al.*, (2004). Fruits, vegetables, cereal, tea, coffee, and wine all contain them. They are significant due to their biological characteristics, which include anti-inflammatory, anti-ulcer, anti-cancer, anti-viral, anti-fungal, and anti-oxidant action (Hatti *et al.*, 2009). These activities have increased interest in polyphenolic compounds.

The basis for polyphenolic compounds' antioxidant activity is their capacity to emit electrons, which can then help alter the redox state of enzymes containing metals or interact with the free radicals generated at the active site of the enzyme. The enzyme activity can be impacted

by polyphenolic substances in either case (Monin *et al.*, 2000). Just two of the numerous structural variations of polyphenolic compounds are stilbenes and flavonoids (Borges-Argáez *et al.*, 2002; Magalhães *et al.*, 2007; Fontenele *et al.*, 2005; Borges-Argáez *et al.*, 2007). Aurones, flavanones, pterocarpan, dibenzoylmethane derivatives, rotenoids, flavanols, flavones, flavonols, flavans, chalcones and isoflavonoids are some of the groups that they are made up of (Lima *et al.*, 2009; Magalhães *et al.*, 2007; Cseke *et al.*, 2006; Cassidy *et al.*, 2011).

According to Williams and Grayer (2004), Flavonoids with unique substitutions are abundant in *Lonchocarpus*. According to Ingham *et al.*, (1988), several *Lonchocarpus* species feature flavanones with prenyl and dimethylpyrano group linkages. It was discovered that many of these flavonoids shared a number of the same substituents. The prenyl (3-methyl-2-butenyl) group is one of these frequently occurring substituents.

This genus frequently contains the rotenoids rotenone and deguelin, which have demonstrated pesticide and insecticidal effects (Caboni *et al.*, 2004). The rotenoid, Deguelin, is helpful in the treatment of cancer and can be injected right into tumors (Hebert *et al.*, 2004). It is known that rotenone and some other rotenoids, such as deguelin and tephrosin, have insecticidal effects on a variety of insect species (Fukami and Nakajima, 1971). According to Fukami and Nakajima (1971), most economically manufactured rotenone comes from the roots of *Lonchocarpus* and Derris species in South America and Asia, correspondingly. The flavanones lupinifolinol, 3-O-methyl-lupinifolinol and lupinifolin were produced by extracting the root bark of the native Central American plant *Lonchocarpus guatemalensis* in methanol (Magalhães *et al.*, 2007).

Furanoflavan and Benzofuran-3-ol, two flavonoids that are new to *Lonchocarpus araipensis* (Benth.), were recently discovered. According to Lima *et al.*, (2014), these flavonoids exhibit antiallergic, anti-platelet, antioxidant, antiviral, anti-inflammatory and anti-tumor properties.

## **Phytochemistry of *Lonchocarpus* series**

### **Auronols and Aurones**

Aurones and auronols are present in most *Lonchocarpus* series. They are substances that are discovered in fruits and flowers and have an impact on the color of the plants in which these substances are present (Boumendjel, 2003). A five-membered ring is a characteristic of both aurones and auronols, which are closely related. The difference between the two categories of compounds is where the carbonyl group is located. Aurones are simply dihydroaurones in their saturated state. *Lonchocarpus obtusus* contained the first auronols ever discovered in nature. Derriobtusones A and B were given their names (Nascimento *et al.*, 1976). A highly uncommon auronol called Derriobtusone A has since been discovered in the *L. montanus* species of *Lonchocarpus*. In fact, derriobtusone A was one of the substances that were most prevalent in *L. montanus* (Jain and Bari, 2010).

### **Chalcones**

Chalcones are quite different from other flavonoids due to the absence of pyran ring. Chalcones lack the pyran ring that is present in other flavonoids. They are more conjugated and commonly colored (Cseke *et al.*, 2006). In accordance with Fontenele *et al.*, (2009), De-Andrade *et al.*, (2003), and Fontenele *et al.*, (2005), their chalcones show antioxidant, cytotoxic, anti-inflammatory, antitumoral, and antibacterial effects against a variety of pathogens, including

bacteria, viruses, and protozoa. 29 prenylated chalcones from different *Lonchocarpus* species have so far been isolated.

Most of these were separated from the plants' roots and seeds. However, it was shown that the first isolated chalcone from *L. nicou*, 3-O-methylabyssinone, is the only chalcone in the *Lonchocarpus* genus that is prenylated on the B-ring (Lawson *et al.*, 2010). Dihydrochalcone Erioschalcone B was just recently found in *Lonchocarpus*. It had been previously reported from the semisynthesis of tetrahydroflemichapparin-A. Recently, a novel natural substance made from *Eriosema glomerata* was described that had antibacterial properties (Yam-Puc and Pea-Rodriguez, 2009).

### **Flavanones, Flavanols, and Flavans**

Chalcones have been modified to become flavanones. The middle ring of flavanols' identical primary structure has an additional hydroxyl group. The underlying structural characteristics of flavans remain even though the carbonyl oxygen is converted into a hydroxyl or methoxy group (Gomes *et al.*, 1981). Only this flavanol was discovered in the *Lonchocarpus* species. The discovery of novel 2,4-dioxygenated flavans, isolated from *L. muehlbergianus*, was the first of its kind in nature (Gomes *et al.*, 1981).

The most prevalent flavonoid in the extract was identified to be 2,4,5,8-tetramethoxyfuran [7,6:2",3"] flavan. Recent studies on the biosynthetic routes to dibenzoylmethanes and flavones provide an idea of how these kinds of chemicals might be produced. A 2-hydroxyflavanone derivative is converted into a 4-hydroxyflavanone derivative, which can then be further alkylated (Jain and Bari, 2010). Another unique flavan, 4-ethoxy-5-methoxy-6",6"-dimethyl-2H-pyrano-[2",3":7,6]-flavan, was isolated from *L. xuul*. It is believed that this may not be a real metabolite and may instead be an artifact of the isolation process because ethoxyl derivatives among flavonoids are quite uncommon (Borges-Argáez *et al.*, 2000). It is conceivable that it is merely an artifact because it was the only ethoxy chemical found from *Lonchocarpus* (Magalhães *et al.*, 2007).

### **Isoflavonoids, Flavones and Flavonols in *Lonchocarpus***

The most prevalent of all the classes are flavones and flavonols. According to Cseke *et al.*, (2006), known flavonols have been found to exhibit antibacterial action. According to research by Braz *et al.*, (1975), known flavones have pharmacological effects that include being anti-inflammatory, antispasmodic, antinociceptive, anti-allergic, antioxidant, anti-ulcerogenic, antiviral, and anti-tumoral. The structure of isoflavonoids is different from that of other flavonoids in that ring B is attached to the carbon next to the carbonyl carbon rather than the carbon next to the oxygen (Braz *et al.*, 1975).

Several flavonoids with antioxidant properties were found in the leaves, stems, and root barks of the Yucatan Peninsula's *Lonchocarpus xuul* and *Lonchocarapus yucatenesis* trees in earlier studies (Borges-Argaez *et al.*, 2007). The flavonoids were found to be somewhat active in terms of their antiprotozoal and cytotoxic effects (Borges-Argaez *et al.*, 2007). Included among these flavonoids were 2',4-dimethoxy-6'-hydroxylonchocarpin and 5,4'-dihydroxy-3'-methoxy(6:7).5,4'-Dimethoxy-(6:7) and 2,2 DimethylpyranoflavoneCarpachromene and 2,2 Dimethylpyranoflavone (Magalhães *et al.*, 2007).

It has been determined that several flavonoids serve a number of purposes. Some of these effects include the ability to lessen cardiovascular disease risk as well as anti-cancer, anti-

inflammatory, antibacterial, antiviral, antitumor, cytotoxic, and antiprotozoal properties. Flavonoids' antioxidant properties may be somehow related to this variety of actions (Borges-Argáez *et al.*, (2007); Jain and Bari, (2010); Blatt *et al.*, (2002).

According to Cseke *et al.*, (2006), isoflavonoids exhibit estrogenic, insecticidal, antifungal, and anticancer action. Both isoflavones and isoflavans are forms of isoflavonoids. While isoflavans resemble flavans in that they lack both the carbonyl oxygen and the double bond in ring C, isoflavones are similar to flavones in that they have both of these properties. The flavone content of *Lonchocarpus* was very high. There were many isolated flavones from various *Lonchocarpus* species. Numerous of the chemicals were discovered in several species. The sole flavonol identified in the *Lonchocarpus* species was quercetin. This well-known flavonol has a wide range of biological actions and is present in a wide variety of plants and foods (Xueqin *al.*, 2011; Magalhães *et al.*, 2007)

### **Pterocarpan in *Lonchocarpus***

Pterocarpan is produced from isoflavones, with the carbonyl oxygen now constituting a component of a five-membered ring, according to Gomes *et al.*, (1981). In *Lonchocarpus* species, these compounds haven't been found as frequently. They weren't as common among the different species, too. It was typical to find at least two of them in each species when they were discovered. In *Lonchocarpus montanus*, three pterocarpan were found, with medicarpin being the only one to be discovered in several *Lonchocarpus* species. There were just two pterocarpan in *L. laxiflorus*: philenopteran and 9-O-Methylphilenopteran (Magalhães *et al.*, 2007).

### **Rotenoids in *Lonchocarpus***

According to Magalhães *et al.*,(2007); Lawson *et al.*, (2010), *Lonchocarpus* produces a large variety of secondary polyphenolic metabolites based on the isoflavonoid skeleton, which comprises rotenoids. Despite the fact that a variety of flavonoids have been found in *Lonchocarpus*, its high concentrations of rotenoid compounds are what make it so well-known. Many *Lonchocarpus* species are harmful to insects and fish because they contain rotenoid chemicals (Mesía-Vela *et al.*, 2001; Reyes-Chilpa *et al.*, 2006).

Rotenoids are present in *Lonchocarpus*, however they are not as common as the other flavonoids (Magalhães *et al.*, 2007). In order to understand the makeup and biological functions of rotenoid-containing plants, there has been a resurgence in interest. This is due to their potential value as anti-carcinogenesis agents rather than only as agrochemicals (Fang *et al.*, 1999). Numerous additional derivatives, including epoxides of particular relevance, have been identified in addition to rotenone itself. Two rotenone epoxides were discovered in the roots of *L. nicou*, and they are regarded as the first plant-derived rotenone epoxides (Lawson *et al.*, 2010).

There has been the discovery of yet another class of rotenone and deguelin derivatives, but this time from both *L. urucu* and *L. nicou*. These novel rotenoid-like compounds have a novel skeleton with 1,5-benzodioxepin rings on the A and B and chromone rings on the C and D. This was the first time that a plant extract has contained these particular chemicals. It was established that they were genuine natural products and not byproducts of the extraction (Fang *et al.*, 1999).

### **Stilbenes in *Lonchocarpus***

The most basic type of polyphenolics are stilbenes, which are composed of two benzene rings linked by an ethene. Similar types of substituents to those in flavonoids have been discovered in stilbenes. These consist of prenyl, hydroxyl, and methoxy groups. Numerous plants have been

found to contain hydroxystilbenes. According to Xueqin *et al.*, (2011), they are typically hydroxylated at 3, 5, 3, 4', 5, 2, 3, 5, or 3, 3', 5. Methoxy and prenyl groups may also be present in these patterns. *Lonchocarpus* frequently contains prenylated stilbenes (Magalhães *et al.*, 2007). There are many compounds that include at least one prenyl group. These include longistylins A through D and chiricanins A through E, as well as 3,5-dimethoxy-4-prenylstilbene and 3,4',5-trimethoxy-4-prenylstilbene (Magalhães *et al.*, 2007).

### Coumaronochromones, 3-Phenylcoumarins and Acids in *Lonchocarpus*

According to Blatt *et al.*, (2002), 3-phenylcoumarins are isoflavones that have undergone further C-2 oxidation. They are the only ester-containing molecules in the flavonoid class and are the only ones to undergo C-2 oxidation, making them less frequent than some of the other flavonoids. Only three of these particular chemicals were discovered in *Lonchocarpus* species. Two, though, were identified from the same plant, which may be significant for these kinds of chemicals (Blatt *et al.*, 2002).

The B-ring of coumaronochromones, a kind of rotenoid, has been condensed into a five-membered ring (Lawson *et al.*, 2010). It was discovered that *Lonchocarpus nicou* contained the first instances of a prenylated benzoic acid. Even though prenylated phenolic acids are uncommon in nature, it has been observed that the asteraceae family contains them (Xueqin *et al.*, 2011).

**Table 1: Some *Lonchocarpus* Species and Their Ethnomedical Uses**

<i>Lonchocarpus violaceus</i> (Balche) Root bark Stem bark	Stress reduction, an alternative to alcohol and an intoxicating substance, an anticancer, a mosquito repellent, fish poison, and an insecticide.	Udeani <i>et al.</i> , 1997 Correa, 1984
<i>Lonchocarpus eriocalyx</i>	Fever, malaria, a skin condition, thrush, and ringworms ringworm treatment, insect repellent, and headache alleviation	Kareru <i>et al.</i> , 2007 Yenesew <i>et al.</i> , 2004
<i>Lonchocarpus costaricensis</i>	Insecticide, Treatment of thrush	Caboni <i>et al.</i> , 2004
<i>Lonchocarpus araripensis</i>	Rheumatism, diabetes, skin diseases and arthritis.	Julianeli <i>et al.</i> , 2011
<i>Lonchocarpus urucu</i> (Barbasco) Root bark Stem bark	Anti-HIV, anti-insect, anti-pest, anti-headache, and treatment for skin conditions.	Udeani <i>et al.</i> , 1997 Correa, 1984
<i>Lonchocarpus oliganthus</i>	Acts as Insecticide	Xueqin <i>et al.</i> , 2011
<i>Lonchocarpus cyanescens</i>	Ulcers, Antioxidant, arthritis	Samwel, <i>et al.</i> , 2014
<i>Lonchocarpus laxiflorus</i>	Back pain, rashes, ulcers, intestinal worms, mental disease, headaches, and back	Neuwinger, 1996 Okello and Ssegawa, 2007

	discomfort.	
<i>Lonchocarpus</i> <i>Yucatenesis</i>	Headache and Fever	Borques- Argaez <i>et al.</i> , 2007
<i>Lonchocarpus chiricanus</i>	Insecticide	Jean-Robert <i>et al.</i> , 2001
<i>Lonchocarpus xuuul</i>	headache and fever	Borques- Argaez <i>et al.</i> , 2007
<i>Lonchocarpus guatamalensis</i>	Fever, headache	Xueqin <i>et al.</i> , 2011
<i>Lonchocarpus castilloi</i>	Antifungal and Anti-termitic	Alavez-Solano <i>et al.</i> , 2000

In addition to being used to treat tumors, eruptions, scurvy, backaches, convulsions, and wounds, a variety of *Lonchocarpus* plants have also been used as diuretics, laxatives, stomachics, and parasiticides (Mesía-Vela *et al.*, 2001; Reyes-Chilpa *et al.*, 1995). Many species of *Lonchocarpus* are protected from insect attack due to the toxic and/or antifeedant properties of polyphenolic compounds against insects that are pests of crops (Simmonds *et al.*, 1990). *Lonchocarpus* is well known for its insecticidal and pesticidal properties, according to Borges-Argáez *et al.*, (2007).

Dos-Santos *et al.*, (2009) claim that *Lonchocarpus* species have also been employed as fish poisons, antileprosy medications, antidiarrheal, cough suppressants, antigonorrheal and anthelmintics. *Lonchocarpus cyanescens* (LC) is a medicinal plant that is frequently combined with other ingredients in traditional Nigerian recipes for the treatment of mental diseases. The main ingredient in the Nigerian formula for treating psychosis is *lonchocarpus cyanescens* (Sonibare *et al.*, 2012).

#### ***Lonchocarpus eriocalyx* (Harms)**

The Fabaceae family, which produces a wide variety of flavonoids with insecticidal and other antimicrobial actions, includes *Lonchocarpus eriocalyx* (Ceres *et al.*, 1981). In a prior investigation, *L. eriocalyx* root bark crude extract shown antiplasmodial efficacy against *P. falciparum* strains that were chloroquine-sensitive (W2) and chloroquine-resistant (D6). (Tuwei, 2006). Additionally, this extract exhibited larvicidal action against *A. aegypti* mosquito larvae. Lupeol, a lupane-type triterpene, was the only chemical from *L. eriocalyx* that was isolated, and had good antiplasmodial activity (Yenesew *et al.*, 2004; Tuwei, 2006).

#### ***Lonchocarpus cyanescens* (LC)**

According to Perkin and Thomas (1909), the aerial parts produce an indigo that has been used as a valuable dye for clothing in West Africa from ancient times (adire/gara). It is customary and usual for chiefs to employ woven fabric called as "country cloth" dyed with "gara" (using both artificial and natural dyes) for court penalties, ceremonial costumes, burial clothes, bridal dowries and presents for significant guests. The "gara" leaf recovered from LC is the source of this dye (Cardon, 2003; Spencer, 1996; Polakoff, 1980). In the industrial sphere, "gara" is a product that is traded widely; dried LC is exported from Liberia and other West African countries to Europe, the US, the UK, and a significant number of other African countries (Cardon, 2003; Spencer, 1996; Polakoff, 1980).

The plant has historically been utilized for medical purposes. In Senegal, the leaves are served as a side dish with couscous. It is believed in Ghana that LC roots are more effective than leaves for treating skin disorders and ulcers. In Sierra Leone and Guinea-Bissau, leprosy has also

been thought to be treatable using the leaves and roots of this plant. Laxatives can be made from leaves (Spencer, 1996). Leaf sap is consumed in Benin to treat diarrhea and gastrointestinal problems. Women are given a decoction of leafy twigs and roots during or after childbirth, and it is also used as an aphrodisiac. This concoction is used to cure diarrhea, venereal illnesses, and rheumatic ailments in Nigeria. Yaws are treated with ground root, and sores are treated by washing in water containing powdered root (Irvine, 1961; Spencer, 1996; Jukema *et al.*, 1991; Iwu *et al.*, 2014). In Akwa Ibom State, Nigeria, fishermen have long utilized the tropical plant LC to frighten and catch fish. A shrub with a habitat for twining, LC is a member of the Leguminosae natural order's Dalbergiae tribe (Iwu *et al.*, 2006).

According to Ajibesin *et al.*, (2008), it is included in the list of Akwa Ibom State's medicinal plants. Because it is used to make dye, LC is well-known. The indican-containing early sprouts and leaves are used to ferment the blue indigo dye, which is then used to color textiles and other materials (Ajibesin *et al.*, 2008). Indoxyl, found in the leaves of LC, produces indigotin, a component of indigo dye. The anti-inflammatory activities and treatment of peptic ulcers seen in LC are attributed to oleanane derivatives and glycyrrhetic acid (Cardon and Jarsen 2005; Iwu *et al.*, 2006; Ogbeide *et al.*, 1991; Promsattha *et al.*, 1987). The triterpenes have anti-arthritis properties (Cardon and Jarsen (2005); Iwu *et al.*, (2006); Ndukwe *et al.*, (2004). The taste effects used in flavoring are also caused by these natural ingredients (Ijichi and Seizo, 2005). *Lonchocarpus cyanescens'* bioactivity effects have been shown to be anti-inflammatory, anti-arthritic, and ulcer-relieving (Iwu *et al.*, 2006).

Alkaloids, flavonoids, saponins, phytates, glycosides, and oxalates were found in *L. cyanescens* bark aqueous extracts, according to the results of a phytoconstituents study. Oxalates were abundant, but alkaloids, flavonoids, and glycosides were only marginally prevalent. Only minor amounts of phytates and saponins were also found (Xueqin *et al.*, 2011).

### ***Lonchocarpus sericeus* (Poir.)**

*Lonchocarpus sericeus* (*Papilionaceae*), often known as Cube root or Senegal lilac, is a dry deciduous tree that may reach a height of 16 meters that is frequently observed growing naturally in Nigeria and Ghana. The bark is mostly used as a stomachic and laxative in traditional African medicine, particularly in young children. It is also widely used to treat convulsions and back discomfort (Burkill, 1995). It is perfect for presentations because of its blossoms, which have numerous racemes of purple flowers hanging from them. The blossoms have a distinctive scent that is almost vanilla-like. It is frequently planted in gardens and as a shade tree in communities. According to Kojs *et al.*, (2004) and Adewuyi *et al.*, (2012), the wood has an olive-green heartwood and is transparent yellow with occasional marbling. In Nigeria, the bark is used to manage bodily aches, arthritis, rheumatism, cutaneous and subcutaneous parasite infection, malnutrition, debility, paralysis, and convulsions while the leaves are used for generalized healing, laxatives and fish poisons. Leprosy is treated with the roots. The fruit and seeds are utilized as andarachnicides, which are insect repellents (Burkill, 1985). It is also used as cosmetics (body cream).

### **CONCLUSION**

*Lonchocarpus* species are abundant sources of polyphenolic chemicals. According to phytochemical studies, *Lonchocarpus* is a rich source of several different kinds of polyphenolic compounds such as chalcones, flavans, Aurones, dibenzoylmethane derivatives, rotenoids, pterocarpanes, flavanones, flavanols, flavones, isoflavones, and flavonols. The plant genus *Lonchocarpus* has a variety of compounds with a wide range of diverse functions, although a complete investigation has not yet been carried out. In Africa, *Lonchocarpus sericeus* is used as a

laxative, to cure epilepsy, to treat stomach disorders, and to stimulate hunger. Other traditional uses for *Lonchocarpus* exist. The leaves and bark are occasionally used in traditional medicine to cure various conditions. *Lonchocarpus cyanescens*, *Lonchocarpus laxiflorus*, *Lonchocarpus bussei* and *Lonchocarpus sericeus* are four of the *Lonchocarpus* species that are present. Despite the fact that many *Lonchocarpus* species contain tannins, flavonoids, rotenoids and isoflavonoids, *L. laxiflorus* has not received much research attention. These phytochemicals contribute to the medicinal properties and traditional uses of *Lonchocarpus* species in various indigenous systems of medicine. Therefore, further research and analysis are necessary to fully elucidate the phytochemical profile of *Lonchocarpus* series and its specific constituents, mechanisms of action and potential side effects of these compounds in humans.

#### **CONFLICT OF INTEREST**

The authors declared that conflict of interest do not exist

#### **REFERENCES**

- Abdullahi SM, Musa AM, Abdullahi MI, Sule MI, Sani YM. Isolation of Lupeol from the stem-bark of *Lonchocarpus sericeus* (Papilionaceae) Sch Acad J Bios. 2013;3:18–19.
- Adewuyi, R. A. Oderinde, B. V. S. K. Rao and R. B. N. Prasad, “Chemical Composition and Molecular Speciation of the Triacylglycerol of the Oils of *Lonchocarpus sericeus* and *Lonchocarpus cyanescens*,” Natural Product Research, 2012; 26(20):1954-1956.
- Ajibesin, K.K., B.A. Ekpo, D.N. Bala, E.E. Essien and S.A. Adesanya., Ethnobotanical survey of Akwa Ibom State of Nigeria. J. Ethnopharmacol. 2008; 115: 387-408.
- Alavez-Solano, D., Reyes-Chilpa, R., Jimenez-Estrada, M., Gomez-Garibay, F., ChavezUribe, I., Sousa-Sanchez, M. Flavanones and 3-hydroxyflavanones from *Lonchocarpus oaxacensis*. Phytochemistry, 2000; 55: 953-957
- Bentjee, H. (1994). Kenyan Trees, Shrubs and Lianas. National Museums of Kenya, Nairobi. p 102-110,296.
- Blatt, C.T.T.; Chávez, D.; Chai, H.; Graham, J.G.; Cabieses, F.; Farnsworth, N.R.; Cordell, G.A.; Pezzuto, J.M.; Kinghorn, A.D. Cytotoxic flavonoids from the stem bark of *Lonchocarpus* aff. *fluvialis*. Phytother. Res. 2002, 16, 320-325.
- Borges-Argáez, R.; Balnbury, L.; Flowers, A.; Giménez-Turba, A.; Ruiz, G.; Waterman, P.G.; Peña-Rodríguez, L.M. Cytotoxic and antiprotozoal activity of flavonoids from *Lonchocarpus* spp. Phytomedicine 2007, 14, 530-533.
- Borges-Argáez, R.; Peña-Rodríguez, L.M.; Waterman, P.G. Flavonoids from the stem bark of *Lonchocarpus xuul*. Phytochemistry 2000, 54, 611-614.
- Borges-Argáez, R.; Peña-Rodríguez, L.M.; Waterman, P.G. Flavonoids from two *Lonchocarpus* species of the Yucatan peninsula. Phytochemistry 2002, 60, 533-540.
- Borges-Argáez, R.; Vela-Catzín, T.; Yam-Puc, A.; Chan-Bacab, M.J.; Moo-Puc, R.E.; Cáceres-Farfán, M. Antiprotozoal and cytotoxic studies on some isocordoin derivatives. Planta Med. 2009, 75, 1336-1338.
- Boumendjel, A. Aurones: a subclass of flavones with promising biological potential. Curr. Med. Chem. 2003, 10(23), 2621-2630.
- Braz Filho, R.; Gottlieb, O.R.; Mourão, A.P.; Da Rocha, A.I.; Oliveira, F.S. Flavonoids from *Derris* species. Phytochemistry 1975, 14, 1454-1456.
- Burkill, H. M., (1995), The Useful Plants of West Tropical Africa, Second Edition, Vol. 3 Royal Botanic Gardens, Kew. United Kingdom.

- Burkill, H.M., (1985). Entry for *Lasiurus hirsutus* (Forssk) Boiss [Family Poaceae]. In: The Useful Plants of West Tropical Africa, 2nd Edn., Burkill, H.M. (Ed.), Royal Botanical Garden, Kew, UK
- Caboni, P., Sherer, T., Zhang, B., Taylor, G., Grenamyre, J., Timothy, C., John, E (2004). Rotenone, deguelin and their metabolites. *Chemical Research in Toxicology*, 17 (11): 1540-1548.
- Cardon D. and P. C. M. Jarsen, "Philenoptera cyanescens (Schumach. & Thonn.) Roberty," In: P. C. M. Jarsen and D. Cardon, Eds., PROTA 3: Dyes and Tannins/Colorants et Tannins, PROTA, Wageningen, 2005.
- Cardon, D. "Le Monde des Teintures Naturelles," Belin, Paris, 2003, p. 586.
- Cassidy, E., Caittlni, N., William, S. (2011). Lonchocarpus Polyphenolics and their Biological activities. *The Natural Products Journal*, 1 (2): 75-104
- Ceres, M., Gottlieb, R., Giovanni, B., Marini, B., France, D., Roger, P. Seven flavonoids from some Irarian angiosperms. *Biochem. Syst. Ecol.* 1981; 9(2-3), 129-147.
- Correa, M.P. (1984). *Dicionário das plantas úteis do Brasil e das exóticas cultivadas..* IBDF, Ministério da Agricultura, Rio de Janeiro, 149.
- Cseke, L. J.; Kirakosyan, A.; Kaufman, P. B.; Warber, S.; Duke, J. A.; Brielmann, H. L. *Natural products from plants*, 2nd ed.; CRC Press, Boca Raton, FL, 2006.
- De-Andrade Cunha, G.M.; Fontenele, J.B.; Nobre Júnior, H.V.; de Sousa, F.C.M.; Silveira, E.R.; Nogueira, N.A.P.; de Moraes, M.O.; Viana, G.S.B.; Costa-Lotufo, L.V. Cytotoxic activity of chalcones isolated from *Lonchocarpus sericeus* (Pocr.) Kunth. *Phytother. Res.* 2003, 17, 155-159.
- Dorcas. O. Moronkola; Ibrahim. A. Oladosu., Chemical Compositions of *Lonchocarpus cyanescens* Benth., (Fabaceae)—Case Study of Its Volatile Oils, and Two Triterpenoids. *American Journal of Plant Sciences*, 2013, 4, 1653-1659  
<http://dx.doi.org/10.4236/ajps.2013.48199>. <http://www.scirp.org/journal/ajps>.
- Dos-Santos, D.A.P.; Braga, P.A.C.; da Silva, M.F.G.F.; Fernandes, J.B.; Vieira, P.C.; Magalhães, A.F.; Magalhães, E.G.; Marsaioli, A.J.; Moraes, V.R.S.; Rattray, L.; Croft, S.L. Anti-African trypanocidal and antimalaria activity of natural flavonoids, dibenzoylmethanes, and synthetic analogues. *J. Pharm. Pharmacol.* 2009, 61, 257-266.
- Fang, N.; Casida, J.E. New bioactive flavonoids and stilbenes in cube resin insecticide. *J. Nat. Prod.* 1999, 62(2), 205-210.
- Fontenele, J.B.; Leal, L.K.A.M.; Félix, F.H.C.; Silveira, E.R.; Viana, G.S.B. Studies on the anti-oedematogenic properties of a fraction rich in lonchocarpin and derricin isolated from *Lonchocarpus sericeus*. *Nat. Prod. Res.* 2009, 23(18), 1677-1688.
- Fontenele, J.B.; Leal, L.K.A.M.; Ferreira, M.A.D.; Silveira, E.R.; Viana, G.S.B. Antiplatelet effect of lonchocarpin, and derricin isolated from *Lonchocarpus sericeus*. *Pharm. Biol.* 2005, 43(8), 726-731.
- Fransworth N.R., Akerele O., Bingel A.S., Soejarto D.D., Guo Z. Medicinal plants in therapy. *Bull. WHO.* 1985;63:965–981. doi: 10.1016/0378-8741(87)90016-X.
- Fukami, H., Nakajima, M., (1971). *Rotenone and rotenoids: Naturally occurring insecticides.* Marcel Dekker Inc. New York p. 71.
- Gomes, C.M.R.; Gottlieb, O.R.; Bettolo, G.B.M.; Delle Monache, F.; Polhill, R.M. Systematic significance of flavonoids in *Derris* and *Lonchocarpus*. *Biochem. Syst. Ecol.* 1981, 9(2/3), 129-147.

- Haegnauer, R., Grayer-Barkmeijer R. (1993). Relevance of seed polysaccharides and flavonoids for the classification of the leguminosaea: A chemotaxonomic approach. *Phytochemistry*, 34: 3-16.
- Hatti, K.S.; Diwakar, L.; Rao, G.V.; Kush, A.; Reddy, G.C. Abyssinones and related flavonoids as potential steroidogenesis modulators. *Bioinformation* 2009, 3(9), 399-402.
- Hebert, K., Paul D. N., Penton, L., Erin, H., Burns, K., Janzen, M., Daniel, H., Hallawachs, W., Beier, J. C., Perkins, P. V., Onyango, F.K. (2004). Ten species in one: DNA barcoding reveals cryptic species in the semi-tropical skipper butterfly *Astraptes fulgerator*: *Proceedings of National Academy of Science*, 101 (41): 14812-13817.
- Ijichi S. and T. Seizo, "Molecular Design of Sweet Tasting Compounds Based on  $\beta$ -Amino-3 $\beta$ -Deoxy-18 $\beta$ -Glycyrrhetic Acid: Amido Functionality Eliciting Tremendous Sweetness," *Chemistry Letters*, 2005; **34**. 356. doi:10.1246/cl.2005.356
- Ingham, J.L.; Tahara, S.; Dziedzic, S.Z. Major Flavanones from *Lonchocarpus guatemalensis*. *Z. Naturforsch.* 1988, 43c, 818-822.
- Irvine, F. R. "Woody Plants of Ghana, with Special Reference to Their Uses," Oxford University Press, London, 1961, p. 868.
- Iwu M. M., Pharmacognostical profile of selected medicinal plants, in: *Handbook African Med, Plants* CRC Press Florida, 2014, pp. 251–252.
- Iwu, M. M., "Comparative Estimation of Glycyrrhetic Acid Content of *L. cyanescens* and *glycyrrhiza* Roots," *Journal of Pharmaceutical Science*, 2006; 71(12):1412-1413. doi:10.1002/jps.2600711227.
- Jaganath, I.B.; Crozier, A. Dietary flavonoids and phenolic compounds. In *Plant Phenolics and Human Health*; Fraga, C.G., Ed.; John Wiley and Sons, Inc.: Hoboken, New Jersey, 2010; p 2.
- Jain, P. S. and Bari, S. B., 'Isolation of Lupeol, Stigmasterol and Campesterol from Petroleum Ether Extract of Woody Stem-Bark of *Wightia tinctoria*', *Asian Journal of Plant Sciences*, 2010; 9(3):163- 167.
- Jean-Robert, I., Andrew, M., Mahabir, P. G., Kurt H. Five new prenylated stilbenes from the root of *Lonchocarpus chiricanus*. *Journal of Natural Products*, 2001; 64 (60): 710-715.
- Jukema, J N. Wulijarni-Soetjpto, R. H. Lemmens and J. W. Hildebrand, "Minor Dye and Tannin-Producing Plants," In: R. H. Lemmens and N. Wulijarni-Soetjpto, Eds., *Plant Resources of South-East Asia No 3. Dye and Tannin Producing Plants*, Pudoc, Wageningen, 1991, p. 132- 142.
- Julianeli, T., Jackson, R.G., Kelly, S.A., Sílvia, S.C., Celso, S.C., José Maria, B.F. Selective spasmolytic effect of a new furanoflavoquinone derivative from diplotropin on guinea-pig trachea. *Journal of Chemical and Pharmaceutical Research*, 2011; 3 (1): 249-258.
- Kareru, P.G., Kenji, G.M., Gachanja, A.N., Keriko, J.M., Mungai, G. Traditional Medicines among the Embu and Mbeere people of Kenya. *African Journal of Traditional, Complementary and Alternative Medicines*, 2007; 4 (1): 75-86.
- Kojs P, Włoch, W, Rusin A. Rearrangement of cells in storeyed cambium of *Lonchocarpus sericeus* (Poir) DC connected with formation of interlocked grain in the xylem. *Trees*. 2004;18:136–144.
- Kokwaro, J.O. (2009). *Medicinal Plants of East Africa*, 3rd edition, University of Nairobi Press, Nairobi, Kenya: 134-137.
- Lawson, M.A.; Kaouadji, M.; Chulia, A.J. A single chalcone and additional rotenoids from *Lonchocarpus nicou*. *Tetrahedron Lett.* 2010, 51, 6116-6119.

- Lima, A.F., Ferreira, D.A., Monte, F.J. Flavonoids from *Lonchocarpus araripensis* (Leguminosae): Identification and Total <sup>1</sup>H and <sup>13</sup>C Resonance Assignment. *American International Journal of Contemporary Research*, 2014; 4 (2): 18-23.
- Lima, A.F.; Mileo, P.G.M.; Andrade-Neto, M.; Braz-Filho, R.; Silveira, E.R.; Pessoa, O.D.L. <sup>1</sup>H and <sup>13</sup>C NMR assignments of new methoxylated furanoflavonoids from *Lonchocarpus araripensis*. *Magn. Reson. Chem.* 2009, 47, 165-168.
- Magalhães, A.F.; Tozzi, A.M.G.A.; Magalhães, E.G.; Sannomiya, M.; Soriano, M.D.P.C.; Perez, M.A.F. Flavonoids of *Lonchocarpus montanus* A.M.G. Azevedo and biological activity. *An .Acad. Bras. Cienc.* 2007; 79(3), 351-367.
- Mannetje L., (2002). *Alysicarpus ovalifolius* (Schumacher); J. Leonard record from Protobase. Oyen L.P.A., and Lemmens R.H.J. (Editors). *Plant Resources of Tropical Africa. Bulletin du Jardin Botanique de l'État à Bruxelles*, 32 (4): 325–416.
- Mesía-Vela, S.; Sánchez, R.I.; Estrada-Muñiz, E.; Alavez-Solano, D.; Torres-Sosa, C.; Jiménez-Estrada, M.; Reyes-Chilpa, R.; Kauffman, F.C. Natural products isolated from Mexican medicinal plants: novel inhibitors of sulfotransferases, SULT1A1 and SULT2A1. *Phytomedicine* 2001, 8(6), 481-488.
- Monin, H.; Guo, Q.; Packer, L. Enzyme inhibition and protein-binding action of the procyanidin-rich French maritime pine bark extract, pycnogenol: effect on xanthine oxidase. *J. Agric. Food Chem.* 2000, 48, 5630-5639.
- Moronkola, D. O., Adedeji, A. A. Oyewole, I. O. Ogunwande I. A. and Oladosu, I. A., “Survey and Accounts of Anti-Malaria Ethnomedicinal Herbs Used In South-Western Nigeria and Vector Repellent Activities of Their Volatile Oils,” The African Network for Drugs and Diagnostics [ANDI], 2nd Stakeholders Meeting & Conference, Medical Research Council [MRC], Cape Town, 4-7 October 2009.
- Nascimento, M.C.; Vasconcellos Dias, R.L.; Mors, W.B. Flavonoids of *Derris obtusa*: auronones and auronols. *Phytochemistry* 1976, 15, 1554-1558.
- Ndukwe, K. C., Lamikanra and I. N. Okeke, “Antibacterial Activity in Plants Used as Chewing Sticks in Africa,” *Prous Science Drugs of the Future*. 2004; 29(12):1221. doi:10.1358/dof.2004.029.12.853766
- Neuwinger, D. *African Ethnobotany: Poisons and Drugs: Chemistry, Pharmacology, Toxicology*, CRC Press, 1996; 682-683.
- Okello, J., Ssegawa, P., Medicinal Plants used by communities of Ngai Subcounty, Apac District, Northern Uganda. *African Journal of Ecology*, 2007; 45 (1): 76-83.
- Perkin, A. G., and F. Thomas, “RSC Publishing Paper XC. Indican, Part II,” *Journal of the Chemical Society, Transactions*, 1909; 95; 793-807. doi:10.1039/ct9099500793
- Polakoff, C. “Into Indigo—African Textiles and Dyeing Techniques,” Anchor Books, Garden City, 1980, p. 243.
- Regnault-Roger, C.; Ribodeau, M.; Hamraoui, A.; Bateau, I.; Blanchard, P.; GilMunoz, M.I.; Barberan, F.T. Polyphenolic compounds of Mediterranean Lamiaceae and investigation of orientational effects on *Acanthoscelides obtectus* (Say). *J. Stored Products Res.* 2004, 40, 395-408.
- Reyes-Chilpa, R.; Baggio, C.H.; Alavez-Solano, D.; Estrada-Muñiz, E.; Kauffman, F.C.; Sanchez, R.I.; Mesia-Vela, S. Inhibition of gastric H<sup>+</sup>,K<sup>+</sup>-ATPase activity by flavonoids, coumarins, and xanthenes isolated from Mexican medicinal plants. *J. Ethnopharmacol.* 2006, 105, 167-172.

- Reyes-Chilpa, R.; Viveros-Rodríguez, N.; Gómez-Garibay, F.; Alavez-Solano, D. Antitermitic activity of *Lonchocarpus castilloi* flavonoids and heartwood extracts. *J. Chem. Ecol.* 1995, 21(4), 455-463.
- Samwel, B., Adigun, O., Adaramoye, O. Bioassay-guided investigation of *Lonchocarpus cyanescens* Benth leaf extract for antioxidant activities. *African Journal of Biotechnology*, 2014; 13 (22): 2240-2247.
- Schrire, B.D.; Lewis, G.P.; Lavin, M. (2005). *Biogeography of the Leguminosae. Legumes of the world.* Kew, England: Royal Botanic Gardens. p.21–54
- Simmonds, M.J.S.; Blaney, W.M.; Delle Monache, F.; Marini-Bettolo, G.B. Insect antifeedant activity associated with compounds isolated from species of *Lonchocarpus* and *Tephrosia*. *J. Chem. Ecol.* 1990, 16(2), 365-380.
- Sonibare MA, Umukoro S, Shonibare ET. Antipsychotic property of aqueous and ethanolic extracts of *Lonchocarpus cyanescens* (Schumach and Thonn.) Benth. (Fabaceae) in rodents. *J Nat Med.* 2012; 66(1):127-32. doi: 10.1007/s11418-011-0562-6. Epub 2011 Jun 30. PMID: 21717088.
- Spencer, S. “Developing an Understanding of Science from the Sierra Leonean Traditional Gara Dyeing Process,” Gender and Science and Technology Association Conference, GASAT 8, Ahmedabad, January 1996.
- Tuwei, J.K. Larvicidal and antiplasmodial compounds from *Derris trifoliata*, *Lonchocarpus eriocalyx* and *Erythrina saculeuxii*, M.Sc. Thesis, Department of Chemistry, University of Nairobi. 2006.
- Udeani, G.O., Gerhauser, C.T., Cathy, F.M., Richard, C.K, Jerrome, W., Kinghorn, A.D., Moriarty, R.M. and Pezzuto, J.M. (1997). Cancer chemopreventive activity mediated by deguelin, a naturally occurring rotenoid. *Cancer Research* 57 (16): 3424-3428
- Vogler, B.; Cholewa, L.; Schmidt, J.; Setzer, W. Cytotoxic flavonoids from the bark of *Lonchocarpus haberi* from Monteverde, Costa Rica. *Pharmacologyonline* 2006,3, 850-855.
- Williams, C. A.; Grayer, R.J. Anthocyanins and other flavonoids. *Nat. Prod. Rep.* 2004, 21, 539-573.
- Wojciechowski, M.F.; Lavin, M.; Sanderson, M.J. (2004). A phylogeny of legumes (Leguminosae). *American Journal of Botany*, 91 (11): 1846–1862.
- Xueqin, M., Chengjian, Z., Khalid, R., Luping, Q. (2011). Fabaceae-traditional uses in Chinese medicine, phytochemistry and pharmacology. *Journal of Ethnopharmacology*, 138 (2): 314-332.
- Xueqin, M., Chengjian, Z., Khalid, R., Luping, Q., Fabaceae-traditional uses in Chinese medicine, phytochemistry and pharmacology. *Journal of Ethnopharmacology*, 2011; 138(2): 314-332.
- Yam-Puc, A.; Peña-Rodríguez, L.M. Isocordoin derivatives from the root extract of *Lonchocarpus xuul*. *J. Mex. Chem. Soc.* 2009, 53(1), 12-14.
- Yenesew, A., Induli, M., Derese, S., Midiwo, J.O., Heydenreich, M., Peter, M.G., Akala, H., Wangui, J., Liyala, P., Waters N.C. Antiplasmodial flavonoids from the stem bark of *Erythrina abyssynica*. *Phytochemistry*, 2004; 65: 3029-3032.