

## Review Article

# Pharmacological effects of *Sesbania sesban*: a systematic review

Michael Nyongesa Walekhwa<sup>1\*</sup>, Teresa Kerubo Ogeto<sup>1</sup>, Mary Kanyiri Murithi<sup>2</sup>,  
Zablon Lister Malago<sup>3</sup>

<sup>1</sup>Department of Biomedical Sciences, School of Medicine and Health Sciences, Kabarak University, Nakuru, Kenya

<sup>2</sup>Department of Pre-Clinical, School of Pharmacy, Kabarak University, Nakuru, Kenya

<sup>3</sup>Department of Pharmacology and Pharmacognosy, School of Pharmacy, Kabarak University, Nakuru, Kenya

**Received:** 14 January 2020

**Revised:** 27 January 2020

**Accepted:** 07 February 2020

### \*Correspondence:

Dr. Michael Nyongesa Walekhwa,  
E-mail: walekhwam@gmail.com

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## ABSTRACT

The cost, side effects and imitation associated with conventional drugs have driven a substantial number of global citizens to resort to complementary medicine. Although largely informal and unregulated, the practice of herbal medicine is more engrained in low and middle income than in industrialized countries. *Sesbania sesban*, a plant which grows generously across most parts of the world, has been a major target by most traditional health practitioners. The effects so far reported include antimicrobial, anti-fertility, anti-diabetic, anti-inflammatory among others. No study has reviewed the scholarly works published and jointly reported results. Authros systematically reviewed papers available in different databases to give a hybrid report on the pharmacological effects of *Sesbania sesban*. A total of three data bases were searched using key terms like: *Sesbania sesban*, ethno-botany, phytochemical analysis, pharmacological effects etc. A total of 860 papers were initially recovered and further subjected to abstract and title examination which filtered them down to 40 papers. The 40 papers were assessed more against a set of criteria like: in-vivo and in-vitro studies biased to pharmacological effects of the plant, studies that were less than 15 years old and studies that used experimental design. This further scrutiny reduced the number of papers to 25. Most studies reported *Sesbania sesban* as having great anti-microbial, anti-fungal, anti-inflammatory and anti-diabetic qualities. No study reported any adverse effect of the plant. Authors recommend a dose-effect assessment and mechanism of action of the plant extracts especially with regard to the antimicrobial, anti-inflammatory and anti-fertility qualities.

**Keywords:** Anti-fertility and Pharmacological effects, Anti-inflammatory, Antimicrobial, *Sesbania sesban*, Systematic review

## INTRODUCTION

Averagely 50% of the world population relies on herbal medicines for therapeutic and preventive purposes.<sup>1</sup> The dependence is premier in Low and Middle Income Countries (LMICs) where most of the world's infectious and non-communicable diseases are uncontestably hosted.<sup>2</sup> Further, occurrence of Antimicrobial Resistance

(AMR) in this region is a major threat to public health yet access to conventional medicines is a real bottleneck.<sup>3</sup>

The dissimilarity between practice of herbal medicine in developed and developing continents like Europe and Africa respectively, is that the former has proper guidelines that regulate the practice of herbal medicine while the latter is yet to clearly develop and implement these policies.<sup>4</sup> The chief pre-disposing factors to the

rampant and unregulated practice of traditional medicine in LMICs include: poverty and prohibitive cost of conventional medicine.<sup>5</sup> The results of such illicit practice are obvious; the desolate but productive population gets exposed to more adverse than desired effects. *Sesbania sesban*, a plant which grows charitably in most parts of Australia, India and more importantly Africa, has been a major target of most herbalists across the globe.<sup>6</sup> According to Desaegeer and Rao this plant grows natively in most parts of Kenya.<sup>7</sup> Leaves, roots, bark, and flower petals are among the parts of this plant that have been described over-time to host medicinal effects. The plant which belongs to the family Fabaceae is “believed” to domicile a range of therapeutic qualities.

They include antimicrobial activity, anti-inflammatory, anti-fertility in both males and females and anti-diabetic among others.<sup>8-10</sup> While *Sesbania sesban* has been proven to comprise colossal therapeutic effects, other studies have documented adverse effects associated with the plant. For instance, Vitti and colleagues reported that the plant contains phenolic compounds like saponins that harbor spermicidal and hemolytic effects.<sup>11</sup> Other scholars like Oosting and colleagues in their experiments observed that inclusion of about 10% of *Sesbania sesban* components to poultry feeds was lethal to chicks less than three months of age.<sup>12</sup> What is more intriguing is that some studies have reported that components of *Sesbania sesban* leaves and roots are highly detrimental to hepatocytes; a postulate which has to be appropriately profiled and documented.<sup>7,13</sup> Although this plant may contain a raft of medicinal benefits at least according to various studies, its adverse effects to human health may far widely out do the former. It is therefore pertinent that the pharmacological effects of *Sesbania sesban* are precisely and generously profiled and reported. A gap which this systematic review sought to fill.

## REVIEW OF LITERATURE

To deeply understand pharmacological effects of *Sesbania sesban* on humans, authors reviewed published literature as shown in table 1.

### Methodology

#### Inclusion and exclusion criteria

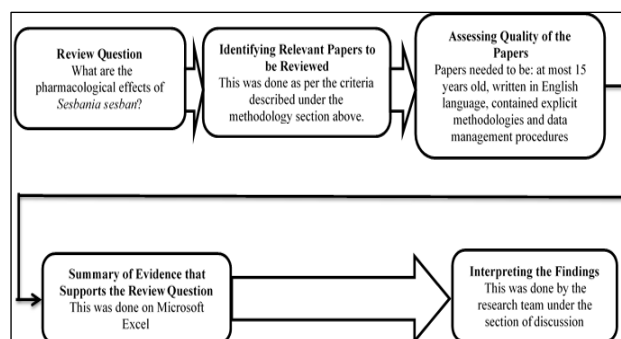
In order to identify relevant papers that qualify the criteria for assessing pharmacological effects of *Sesbania sesban*, a systematic search of the following electronic databases was done: Hinari, AJOL and Google Scholar. The search strategy for this review included some key terms. They include: *Sesbania sesban*, ethno-botany, phytochemical analysis, pharmacological effects etc.

The search for relevant articles was limited to English language papers with an exception of one which had two languages used in the abstract and title, but the rest of the body was done in English language. Reviewed papers

were required to demonstrate clear methodological quality features. These included: well defined objectives, justified samples sizes, well placed and described control groups, results and data that were well statistically described. Three papers did not explicitly indicate the quantity of the plant powder used. However, the papers were included in the review because they were analysing both adverse and therapeutic qualities of *Sesbania sesban*. Overall, articles included in the review contained updated information, had well designed and described methodologies and had properly analysed and reported data.

### Methodological evaluation

The search as described above generated a total of 860 papers. Titles and abstracts for all the generated papers were subjected to further evaluation to establish precise aptness. After this evaluation, a total of 40 papers remained; titles and abstracts in these articles were closely related to this review question. The 40 articles were retrieved and examined further to determine their fitness for inclusion in this review as follows: in-vivo and in-vitro studies which were biased to pharmacological effects of *Sesbania sesban*, studies that were done within 15 years preceding this review, studies that used experimental research design and the general quality of methodology. Following this further filtration, the articles reduced to 25 which were analysed to answer the review question (Figure 1).



**Figure 1: Schematic representation of how this study was organized and executed by the authors.**

### Findings

To understand the pharmacological effects of *Sesbania sesban* a total of 18 papers were reviewed and aggregate results reported in Table 1. The methodology detailing the solvent and extraction method, part of the plant containing the active component and the pharmacological qualities are reported.

## DISCUSSION

On the basis of this review, authors report that *Sesbania sesban* hosts a myriad of pharmacological abilities. They include antimicrobial, anti-inflammatory, molluscicide,

anti-diabetic, nephroprotective, CNS-stimulant, anti-nociceptive and spermicidal properties. Different scholarly works done using different parts of the plant obtained from different parts of the world have documented converging and sometimes varying findings on these qualities. The various reviewed studies utilized different solvents during the extraction of the active compounds of *Sesbania sesban* which in some circumstances may explain the disparate findings.

### **Antimicrobial properties**

Four studies reporting on antimicrobial activity of *Sesbania sesban* were reviewed. The four studies reviewed for antimicrobial qualities utilized different laboratory models for extraction of active compounds. The parts of the plant used were also different.<sup>10</sup> In one study, extracts from flower petals were utilized while the rest used leaf extracts. In addition to leaves,<sup>14</sup> also used active compounds from stem and root extracts. Three studies used the agar-well diffusion method to measure sensitivities of different microorganisms to the various active compounds obtained from different parts of *Sesbania sesban* except that by Hossain and colleagues who used the disk diffusion method.<sup>15</sup> Although some studies used the same plant parts and extracts to assess the degree of antimicrobial activity, it was challenging for us to compare results as some didn't report the concentrations used. All studies reviewed tested the antimicrobial activity in both gram-positive and gram-negative bacteria except for Manickam who tested the antimicrobial activity on gram-negative bacteria only.<sup>10</sup>

Manickam reported that methanolic extracts had antimicrobial effects against gram-positive and not gram-negative bacteria.<sup>10</sup> These findings contradicted those of Hossain and colleagues, Ramalingam and Nirosha who reported antimicrobial effects on both gram-positive and gram-negative bacteria.<sup>14-16</sup> These differences could be attributed to the fact that the various studies reviewed used extracts from different parts of the plant. The antimicrobial activity of the various extracts can be credited to phytochemical compounds such as flavonoids, phenols, tannins and saponins. These findings explain why *S. sesban* has overtime been unconventionally used in the treatment of diarrheal, typhoid and skin infections whose etiology is majorly bacteria. Extracts from the *S. sesban* stem were reported by the various studies to have an effect on the following fungi: *Aspergillus fumigatus* and *Aspergillus niger*. This explains why these extracts have been locally used in the management of most opportunistic infections.

### **Anti-inflammatory properties**

To establish the anti-inflammatory effect of *S. sesban*, four studies done by different scholars at diverse time periods were reviewed. In-vivo experiments were done in all the investigations using albino wistar rats. Inflammation was uniformly induced using Carrageenan

compound across all the studies reviewed. Three studies used extracts from the plant leaves while one study used extracts from the bark of the plant. In two studies petroleum ether, chloroform and methanol were used while the remaining two used saponins as extraction solvents. The ones that utilized saponins demonstrated anti-inflammatory activity owing to the observed decreased Carrageenan Induced Edema.

The other two studies which utilized petroleum ether, chloroform and methanol as extraction solvents used different plant parts which demonstrated disparate results. For instance, Rageeb who used the bark of the plant reported petroleum ether extract having exhibited higher anti-inflammatory activity as compared to chloroform and methanol-based extracts.<sup>9</sup>

On the other hand, Sajid demonstrated that the methanolic extract had a high anti-inflammatory activity compared to the petroleum ether and chloroform extracts.<sup>17</sup> Both findings were demonstrated through the reduced rat paw edema. Only one study reported on *S. sesban*' anti-arthritis properties. Sajid and colleagues used Freund's adjuvant to induce arthritis in the adult female albino wistar rats.<sup>17</sup> Arthritis was measured by assessing primary and secondary paw swelling, changes in the thymus, spleen and body weight of the rats. The petroleum ether bark extracts of *S. sesban* demonstrated significant anti-arthritis activity. Authors noted one study which utilized varying methods to induce both acute and chronic inflammation. Tatiya and colleagues used both in-vivo and in-vitro methods to assess the effect of saponin extracts on acute and chronic inflammation.<sup>18</sup> They found out that at a dose of 500 mg/kg, crude saponin extracts demonstrated significant activity on inflammation both in-vivo and in-vitro. They postulated that the anti-inflammatory effects may be due to triterpenoid and steroidal components.

### **Molluscicidal activity**

Two papers reviewed the molluscicidal activity of *S. sesban* leaf extracts.<sup>19,20</sup> The studies used different snail species: *Bulinus truncatus* and *Biomphalaria alexandrina*. The two snail species were infected with miracidia of *Schistosoma haematobium* and *Schistosoma mansoni* respectively. The miracidia infected *Bulinus truncatus* was treated with methanolic extracts while *Biomphalaria alexandrina* species was treated with aqueous extracts. The extracts significantly lowered the infection rates of the snails. Furthermore, the extracts had molluscicidal activity in the two snail species. Saponins are some of the secondary metabolites that are synthesized by many plants. Molluscicidal activity of *Sesbania sesban* can be attributed to saponins whose mode of action is believed to cause cell membrane rupture causing water and ions to flow uncontrollably into and out of the cell.<sup>21</sup> This causes the cell to lose integrity leading to death of the snails.

### Anti-diabetic activity

Two studies reviewed reported on the anti-diabetic effects of *S. sesban* leaves and root extracts.<sup>22,23</sup> Streptozocin was used to induce diabetes in Swiss Albino Mice and Albino Wistar rats. Aggarwal and colleagues obtained crude extracts from the *S. sesban* roots using petroleum ether while Pandhare and colleagues used aqueous extracts from the leaves.

Both treatment models manifested antidiabetic potentials characterized by the following observations: decreased FBG levels, increased body weight, decreased food intake, decreased total triacyl glycerides, total cholesterol, low density and high-density lipoprotein. In addition, there were restored glycogen levels. The effects mentioned were attributed to probable increased production of insulin by the beta cells of the pancreas.<sup>22,23</sup>

Another study by Pandhare and colleagues postulated that there were improved dose-dependent nephroprotective effects on streptozocin diabetic induced male wistar albino rats. In addition to reduced blood FBG, they reported reduced glycated hemoglobin levels which is a result of increased insulin secretion.

Similarly, all the three studies exhibited improved nephroprotective effects as there were decreased: urine volumes, water intake, serum albumin, creatinine, urea and total protein.<sup>24</sup>

### CNS-stimulation versus sleep induction activity

Out of the total papers reviewed, only one reported on the CNS stimulation activity of *S. sesban*. The study used petroleum ether, chloroform, alcohol and water bark extracts. Male Swiss albino mice were used. Using elevated plus maze, dark and light experimental models the bark extracts of *S. sesban* were observed to possess CNS stimulation activity. Compared to the effect of caffeine a known stimulant, the aqueous extract of *S. sesban* bark demonstrated equal CNS stimulation capacity.<sup>25</sup> It was also interesting to note that methanol extracts from the *S. sesban* leaves and bark had antagonistic effects on the capacity to induce sleep.<sup>26</sup> For instance, extracts obtained from the leaves had melatonin which is a sleeping aid.

### Anti-fertility properties

Two studies reported on the anti-fertility activity of *S. sesban* on both male and female albino wistar rats. The study by Dande and colleagues used saponin extracts from the plant leaves and reported that the extracts had implantation inhibitory qualities and could induce abortion.<sup>27</sup> It was also established that the leave saponin extracts had potential to elongate the estrous cycle. Another study by Das and colleagues showed that the oleanolic acid 3-beta D-glucuronoid an active component of *S. sesban* root extracts had spermicidal activity in adult Sprague Dawley rats.<sup>28</sup>

**Table 1: Review of literature on pharmacological effects of *Sesbania sesban*.**

| Study objective  | Pharmacological effects                 | Methods  | Findings   | References |
|--|---|--|--|------------|
| To investigate antimicrobial activity of Ss extract against common pathogens | Antibacterial activity                  | The methanolic extracts of flower petals were tested against the following micro-organisms: <i>Escherichia coli</i> , <i>Klebsiella pneumoniae</i> , <i>Klebsiella oxytoca</i> , <i>Proteus vulgaris</i> , <i>Streptococcus pyogenes</i> , <i>Pseudomonas aeruginosa</i> , <i>Enterococcus faecalis</i> , <i>Staphylococcus aureus</i> and <i>Staphylococcus saprophyticus</i> . The agar-well diffusion method done using Muller Hinton Agar was used | The methanolic extracts were found to have antibacterial effects against the following two-gram positive organisms: <i>Staphylococcus aureus</i> and <i>Staphylococcus saprophyticus</i> and not on gram negative organisms tested.                  | 10         |
| To test for antimicrobial activity of Ss                                     | Anti-bacterial and anti-fungal activity | The leaves of <i>S. sesban</i> were extracted using methanol and a portion fractionated into n-hexane, carbon tetrachloride and chloroform. The anti-bacterial and anti-fungal activity of the extractives was determined by the disc diffusion method.  | The methanolic fractions: n-hexane, carbon tetrachloride and chloroform showed inhibitory activity against the sampled gram positive and gram-negative bacteria. The extracts also demonstrated strong inhibition against <i>Aspergillus niger</i> . | 15         |
| To establish antimicrobial activity of organic leaf                          | Anti-bacterial Activity                 | Leaves of <i>S. sesban</i> were used for this study. The solvents used for extraction were methanol, ethanol and aqueous. The extracts were  | All the three selected concentrations of ethanol / methanol/ aqueous (50µl, 100µl, 150µl) showed   | 16         |

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| <p>extracts of <i>Sesbania sesban</i> against gram negative pathogenic bacteria</p>  |  | <p>thereafter tested against a range of microbes.</p>  | <p>significant inhibition of <i>E. coli</i>, <i>P. aeruginosa</i> and <i>Klebsiella pneumoniae</i>. But in each case the inhibition caused by ethanol extract of the plant was noticed to be significantly higher than that caused by methanol and aqueous extract. In each case the magnitude of inhibition is directly proportional to the level of concentration.</p>  |
| <p>To profile phytochemical properties and antimicrobial activity of <i>Sesbania sesban</i></p>                                      | <p>Anti-fungal and anti-bacterial activity</p>       | <p>The plant leaves, stem and roots were extracted using percolation method by the following solvents: n-hexane, chloroform, methanol, ethanol and water. The agar well diffusion method was used for testing the antimicrobial activity against the following bacteria: <i>Staphylococcus aureus</i>, <i>Escherichia coli</i>, <i>Salmonella typhi</i>, <i>Enterococcus faecalis</i>, <i>Erwinia amylovora</i>, <i>Proteus vulgaris</i>, <i>Pseudomonas aeruginosa</i>, <i>Klebsiella pneumoniae</i>, <i>Shigella dysenteriae</i> and <i>Bacillus subtilis</i>.</p> <p>The antifungal activity was performed by Poison plate method on the following fungi: <i>Aspergillus fumigatus</i>, <i>Curvularia lunata</i>, <i>Verticillium glaucum</i>, <i>Fusarium oxysporum</i> and <i>Curvularia lunata</i></p> | <p>Highly significant degree of activity was observed against both gram positive and gram bacteria. The carbon tetrachloride partitionate of the methanol leaf extract showed inhibitory activity against <i>E. coli</i>.</p> <p>In the case of <i>Aspergillus fumigatus</i>, <i>Curvularia lunata</i>, and <i>Verticillium glaucum</i> a higher degree of inhibition was obtained with 500 µg/ml of the methanol stem extract. <i>Fusarium oxysporum</i> and <i>Curvularia lunata</i> were inhibited completely at 100 µg/ml and 500 µg/ml of the extract.</p> |
| <p>To evaluate topical anti-inflammatory activity of crude saponins extracts from leaves of <i>Sesbania sesban</i></p>               | <p>Anti-inflammatory Activity</p>                    | <p>Powdered leaves of <i>S. sesban</i> were extracted by successive use of Soxhlet apparatus using petroleum ether and methanol solvents. The methanol extract was further fractionated with butanol and water. In order to get saponins, butanol and water extracts were further precipitated in solvent ether. Albino Wistar rats were used for this experiment.</p>   | <p>The crude saponin extracts showed significant anti-inflammatory activity.</p>  |
| <p>To evaluate effects of <i>S. sesban</i> bark on carrageenan induced acute inflammation and adjuvant-induced arthritis in rats</p> | <p>Anti-inflammatory and Anti-arthritis activity</p> | <p>The barks of <i>S. sesban</i> were used for this study. Petroleum ether, chloroform and methanol extraction solvents were used. Carrageenan powder was used to induce inflammation while Freund's adjuvant was used to induce arthritis in adult female albino Wistar rats. The rats were treated with extracts and both anti-inflammatory response and anti-arthritis responses were measured.</p>   | <p>The petroleum ether extracts of the bark of <i>S. sesban</i> exhibited significant anti-inflammatory activity as compared to chloroform and methanolic extracts. The Petroleum ether extracts from the bark of <i>S. sesban</i> were found to display significant anti-arthritis activity.</p>   |

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|   |                            | Reduction in the paw volume was considered as anti-inflammatory response. Arthritis was assessed by measuring primary and secondary paw swelling and changes in thymus, spleen and body weight of the rats.   |   |    |
| To investigate anti-inflammatory activity of <i>S. sesban</i>   | Anti-inflammatory activity | The wistar strain albino rats were used for anti-inflammatory testing. Powdered Leaves of <i>S. sesban</i> were extracted using the following solvents: petroleum ether, chloroform and methanol. The injection of carrageenan solution was done into sub plantar region of the hind paw of each rat so as to induce inflammation. The paw edema volume was measured using plethysmometer.  | The methanolic extract significantly reduced rat paw edema compared to controls but the petroleum and chloroform extracts did not show any significant reduction in rat paw edema.        | 17 |
| To investigate the effects of saponins from <i>S. sesban</i> on acute and chronic inflammation in experimental induced animals                      | Anti-inflammatory activity | The extracts of <i>S. sesban</i> leaves were obtained using methanol. The methanol extract was further fractionated in butanol and water (1:1), concentrated extracts and saponins were precipitated by adding solvent ether to get crude saponin. Male wistar rats and Swiss albino mice were used for this experiment.<br><br>Carrageenan solvent was used to induce inflammation. The paw volume was measured after treatment. | Saponins significantly decreased the carrageenan-induced edema. It was observed that the crude saponins exhibited comparable results with that of standard indomethacin.                  | 18 |
| To investigate Biological and physiological parameters of <i>Bulinus truncatus</i> snails exposed to methanol extract of the <i>S. sesban</i> plant | Molluscicidal activity     | <i>Bulinus truncatus</i> snails were used. Myracidia of Schistosoma haematobium were used in bioassay and infection tests. The methanolic crude extracts from the leaves of <i>S. sesban</i> were used to treat the snails  | The methanolic extracts of <i>S. sesban</i> exhibited toxic effects against the snails <i>B. truncatus</i> .  | 19 |
| To investigate Biological and biochemical parameters of <i>Biomphalaria alexandrina</i> snails exposed to <i>S. sesban</i>                          | Molluscicidal activity     | <i>B. alexandrina</i> snails were infected with myracidia of <i>S. mansoni</i> . The infected snails were exposed to aqueous plant extracts to assess the infection rates.  | The aqueous extracts of <i>S. sesban</i> had molluscicidal activity.  | 20 |
| To profile the effect of petroleum ether extract of <i>S. sesban</i> roots in streptozocin induced  | Hypoglycaemic effects      | Healthy adult Swiss albino mice of either sex of Wistar strain were used. Crude extract from the roots of <i>S. sesban</i> were obtained using petroleum ether. The effects of three doses of the extracts; 250 mg/kg, 500 mg/kg and 1000 mg/kg   | Daily treatment of extract of <i>S. sesban</i> led to dose dependent fall in Fasting Blood Glucose (FBG) levels by about 50%. The decrease in glucose level was significant at doses (500 | 23 |

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| <p>diabetes in mice</p>  |  | <p>were further studied in streptozocin induced diabetic mice following 15 days of treatment. Blood samples were withdrawn from the tail vein and the blood glucose levels were determined by using one touch electronic glucometer, using glucose strips.</p>  |
| <p>To establish the anti-diabetic activity of aqueous leaves extract of <i>S. sesban</i> in Streptozocin induced diabetic rats</p> | <p>Anti-diabetic activity</p>                        | <p>Healthy adult male albino wistar rats were used. Diabetes was induced in rats by single intra peritoneal injection of streptozocin. Crude extracts from leaves was obtained using water. The effects of two doses of the extracts; 250 mg/kg and 500 mg/kg were studied. Blood glucose levels and body weights were measured on 1<sup>st</sup>, 10<sup>th</sup>, 20<sup>th</sup> and 30<sup>th</sup> days of the study. Blood glucose levels, serum insulin, liver glycogen and glycosylated haemoglobin were measured.</p> <p>The aqueous extract of <i>S. sesban</i> leaves at 250 and 500 mg/kg reduced the blood glucose level. At the end of 30 days treatment, the body weight of normal rats, aqueous extract and standard drug treated group increased significantly, whereas body weight of diabetic control group decreased. After 30 days treatment period it was observed that animals treated with aqueous extract showed a significant increase in the serum insulin level, liver glycogen level and decrease in glycosylated haemoglobin level as compared to serum insulin levels in normal groups</p> |
| <p>To investigate the central nervous system stimulant effect of extracts obtained from the barks of <i>S. sesban</i></p>          | <p>Central Nervous System (CNS) stimulant effect</p> | <p>The active constituents from the bark of <i>S. sesban</i> were extracted successively in a soxhlet apparatus using petroleum ether, chloroform, alcohol and water as solvents and later dissolved in normal saline. Swiss albino mice were used. The animals were treated with the different extracts. Elevated plus maze (EPM) and Light-Dark Test (LDT) were used to test for the time spent in the open arm, percent entries in the open and closed arms and time spent in each illuminated and dark place respectively.</p> <p>The crude extracts showed significant CNS stimulation activity as compared to caffeine which was used as a positive control.</p>  |
| <p>To establish Antinociceptive activity of <i>S. sesban</i> wood extracts</p>   | <p>Antinociceptive activity</p>                      | <p>Powered wood of <i>S. Sesban</i> was extracted using the following solvents: petroleum ether, chloroform, ethyl acetate, absolute ethanol and aqueous successively using soxhlet apparatus. The marc which was left was flashed with water to obtain an aqueous extract. Male Swiss albino mice were used. The extracts were suspended into minimum amount of dimethyl sulfoxide (DMSO) and the volume adjusted with saline water. Hot plate test was used to test for central nociceptive activity. Latency of nociceptive response such as</p> <p>Petroleum ether, chloroform and ethyl acetate extracts showed significant results in the central nociceptive test. A the extracts (50 and 100 mg/kg) produced significant inhibition of writhing retractor induced by acetic acid compared to control group. Inhibition of writhings by the various extracts was in the following order: ethyl acetate petroleum ether, chloroform, ethanol and aqueous extract. Similarly, there was significant delay in the onset of</p>  |

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|   | <p>licking, flicking of the hind limbs or jumping was observed. The readings were taken at different intervals after treatment. Acetic acid induced writhing test was used to test for peripheral nociceptive activity. After acetic acid injection the mice were observed for onset of writhing and number of writhing responses for 30 minutes.</p>   | <p>writhing response as compared to control except ethanol and aqueous extracts.</p>   |
| <p>To investigate potent spermicidal effect of oleanolic acid 3-beta-D-glucuronide, an active principle isolated from the plant <i>S. sesban</i></p>                        | <p>Spermicidal activity</p> <p>Ethyl acetate and n-butanol extracts of <i>S. sesban</i> roots were obtained using 90% ethanol. The ethanolic extract was further successively extracted using ethyl acetate and n-butanol. The n-butanol extracts were purified using column chromatography to obtain Oleanolic Acid 3-O-β-D-Glucuronide (OAG). Sperm exudates of adult Sprague-Dawley rats were then suspended in BWW medium. The sperm were incubated in the medium for 30 minutes under oil cover in a CO<sub>2</sub> chamber. Sperm count was done using a Makler chamber. Highly motile sperm suspensions with a sperm count of 20-25×10<sup>6</sup>/ml were used. Barker's buffer was used to show total immobilization of the sperm after incubation for 60 minutes.</p> | <p>There was a dose-dependent increase in sperm immobilization with a surge in concentration of OAG. The minimum concentration of OAG that caused 100% immobilization of sperm within 20 seconds with no revival of motility after subsequent 60 minutes of incubation in Baker's buffer at 37°C was considered to be the Minimum Effective Concentration (MEC).</p> <p>28</p>   |
| <p>To profile the effect of aqueous extracts of the leaves of <i>S. sesban</i> in reduction of development of diabetic nephropathy in streptozocin-induced diabetic rat</p> | <p>Nephroprotective effect</p> <p>Aqueous crude extract of two doses 250 mg/kg and 500 mg/kg from the leaves of <i>S. sesban</i> were extracted using soxhlet apparatus and administered to streptozocin diabetic induced male Wistar albino rats after an overnight fast. Serum parameters like albumin, creatinine, urea and total protein were also estimated. Individual rats were placed in metabolic cages to obtain 24 hours urine collections and urinary protein, albumin and glucose excretion levels measured. Histopathological changes in kidneys of normal, diabetic untreated, diabetic treated with aqueous extract and compared with those treated with the standard (glibenclamide).</p>  | <p>In diabetic rats, body weight was decreased compared with normal rats and did not change compared with rats that were treated with glibenclamide or extract. Treatment of the diabetic rats with the extract produced a significant reduction in the albumin, creatinine, urea and total protein levels in both serum and urine. The urinary glucose, albumin and total protein levels were significantly higher in the untreated diabetic rats compared to those in normal rats. The renal tissue of Diabetic untreated rats revealed severe increase in mesangial cells and matrix of glomeruli. Hyaline thickening of some arteriole wall was also noted. With treatment with glibenclamide and aqueous extract, these pathologic changes were improved.</p> <p>24</p> |



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| To determine melatonin content in traditional Thai herbal remedies of <i>Sesbania sesban</i> | Sleeping Aid | Melatonin was extracted by using methanol and the extracts were dissolved in 4 mL of 5% methanol-water solution and loaded onto 5 mL solid phase extraction (SPE) cartridge. The retained melatonin was eluted at a low flowrate using 5 mL of 80% methanol-water solution, then stored at 4°C until High-Performance Liquid Chromatography (HPLC) or Enzyme Linked Immunosorbent Assay (ELISA) analysis. Melatonin was then quantified by a validated HPLC method with fluorescent detection. | Melatonin content in <i>Sesbania sesban</i> was sufficient in dry sample weight. The highest melatonin content was still present in <i>Sesbania sesban</i> and this identification was confirmed by ELISA. | 26 |
|--|--------------|--|--|----|

## CONCLUSION

It is clear that *Sesbania sesban* harbors a variety of pharmacological properties. This is owing to evidence from the enormous studies done on different parts of the plant. In addition, the extraction model and solvent play pivotal roles on effectiveness of the said qualities. Although the plant has been found to have a raft of positive effects, there mechanisms of action are yet to be explicitly elucidated. Authors therefore recommend further studies to best understand mechanisms of action and the effects alluded to in this review.

## ACKNOWLEDGEMENTS

Authors are grateful to Dr. Titus Suge for allowing us time and encouraging us to carry out this review. Authors acknowledge Dr. Richard Kagia for vividly reviewing this paper and making very fundamental corrections.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: Not required*

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**Cite this article as:** Walekhwa MN, Ogeto TK, Murithi MK, Malago ZL. Pharmacological effects of *Sesbania sesban*: a systematic review. *Int J Res Med Sci* 2020;8:1185-94.