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Phytochemical Screening, Study of Acute Toxicity and Hypoglycemic and Antihyperglycemic Activities of Silver Nanoparticles from *Guibourtia tessmannii* (Harms) J. Leonard (Caesalpiniaceae)

Ngoulé Charles Christian[1*], Eya'ane Meva François[1], Sone Enone Bertin[1], Ngo Nyobe Biwole Caroline[1], Tankeu Séverin Elisée[1,2], Songue Pascal[1], Nguene Jean Pierre[1], Etame-Loe Gisèle[1]

[1]Department of Pharmaceutical Sciences, Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon
[2]Department of Biology of Plant Organisms, Faculty of Sciences, University of Douala, Douala, Cameroon
Email: *xtiangoule@gmail.com

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Abstract

According to the World Health Organization, diabetes affects approximately 347 million people worldwide. Its management is not within the reach of all social classes, therefore medicinal plants are still the first resort for many populations in Africa. The biological material used in this study was the trunk bark of *Guibourtia tessmannii*. 50 g of trunk bark powder were decocted in 500 ml of distilled water for 5 minutes were carried out. The method used for the synthesis of silver nanoparticles (AgNps) was an organometallic bio-reduction of silver nitrate salts mediated by various secondary metabolites contained in the plant extract. The study of the toxicity acute was conducted according to guideline 423 of the OECD protocol. The pharmacological activities were each carried out with 28 female rats divided into 7 groups of four rats. It was a question for the hypoglycemic activity of administering various doses of silver nanoparticles and other substances to the rats thirty minutes after the carbohydrate intake and for the anti-hyperglycemic activity of administering the same substances to the rats thirty minutes before the carbohydrate intake. The extraction yield was 8.76%. Only the alkaloid test was negative. After acute toxicity study, the LD50 was greater than 2000 mg/kg. Blood sugar tests revealed that glibenclamide 5 mg/kg, which is the reference molecule, lowered blood sugar more than the other treatments applied in the other batches. It was followed by treatment with silver nanoparticles at a dose of 400 µg/kg in

both tests. It was therefore concluded that silver nanoparticles from *G. tessmannii* are good for the formulation of improved traditional medicines and bring up their afficacity.

Keywords

Guibourtia tessmannii, Nanoparticles, Hypoglycemia, Anti-Hyperglycemia

1. Introduction

Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin or the body does not properly use the insulin it produces. Insulin is a hormone that lowers blood glucose levels and promotes its use by body tissues. According to the World Health Organization (WHO), diabetes affects approximately 347 million people worldwide [1]. The prevalence of diabetes has almost doubled since 1980, from 4.7% to 8.5% in 2014, and this prevalence has increased more rapidly in low- and middle-income countries. This is expected to exceed 629 million in 2035 [2]. In Africa, 15.5 million adults have diabetes, *i.e.* a prevalence of 2.15% per region; this prevalence is estimated in Cameroon at 4.9% for a total of 515.28 million people with diabetes in 2014 [2]. Type 2 diabetes is the most common form. It has progressed in parallel with socio-cultural changes, it is estimated that 91% of adults are affected by type 2 diabetes. Diabetes and its complications are major causes of mortality in most countries [3]. The causes of this disease are the aging of the population, unbalanced diets, obesity, lack of sporting activities and a sedentary lifestyle. The management of diabetes is not within the reach of all classes, as a result, medicinal plants still remain the first recourse for many populations in developing countries, particularly in Africa where conventional medicines are almost inaccessible [4]. Several plants are used by African populations as having hypoglycemic and antihyperglycemic properties. The therapeutic effectiveness of these has pushed researchers to turn to traditional health practitioners to carry out work aimed at establishing a non-exhaustive list of plants with proven hypoglycemic and antihyperglycemic properties. This is the case for *Guibourtia tessmannii* of the Caesalpiniaceae family. Indeed, traditional medicine appears to be the most appropriate alternative to respond to the deficiencies of the modern system in terms of health needs to which populations aspire [5]. However, the use of this plant requires knowledge of its chemical composition and its lightness.

2. Material and Methods

2.1. Material

The biological material was the bark of the trunk of *G. tessmannii* (**Figure 1**). This bark was harvested then cut and dried away from light for 4 weeks. It was then ground to obtain a powder. The technical equipment consisted of extraction

Figure 1. Bark of the trunk of *Guibourtia tessmannii* (Photography realized by author).

equipment, phytochemical screening equipment, silver nanoparticle synthesis equipment, equipment for studying toxicities, biological activities, laboratory equipment, glassware, consumables, reagents and solvents.

2.2. Methodology

Extraction: 50 g of *G. tessmannii* trunk bark powder were decocted in 500 ml of distilled water for 5 minutes. The decoction obtained was filtered on Wattman No 1 paper and placed in a tray for drying in an oven at 45˚C (Mangano & Williamson, 2010). After complete drying, the extract was weighed and the extraction yield (RE) was calculated according to the formula (Figure 2):

Phytochemical screening: Tests for the detection of large groups of phytochemical compounds were carried out with the aqueous extract. A set of qualitative techniques making it possible to highlight certain chemical compounds through the formation of insoluble complexes or colored reactions has been carried out.

- **Phenol testing** (ferric chloride test): This is a coloring reaction, to 5 ml of compound dissolved in ethanol, a few drops of ferric chloride are added. The formation of a blue or purple-colored complex indicates the presence of phenols.
- **Flavonoid testing** (Schinoda test): This is a coloring reaction. To an alcoholic solution of the product, add a few magnesium shavings and then a few drops of concentrated hydrochloric acid. The purple or red-orange color testifying to the presence of flavonoids.
- **Alkaloid test** (Dragendorff test): it is a precipitation reaction. Prepare a solution from 1.7 g of bismuth nitrate and 20 g of acetic acid dissolved in 80 ml of water. This solution will be mixed with a solution containing 16 g of potassium iodide and 40 ml of water. The presence of alkaloids is indicated by the formation of a yellow-orange to red precipitate in a test tube.
- **Coumarin test** (potash reaction): it is a coloring reaction. To 5 ml of an alcoholic solution of the product, add a few drops of 10% potash. The appearance of a color varying from blue to purple-yellow reflects the presence of coumarins.

$$RE = \frac{\text{Extract mass}}{\text{Initial powder mass}} * 100$$

Figure 2. Extraction yield (RE) [6].

- **Saponin test:** This test is carried out based on the determination of the foam index. Dissolve a quantity (2 ml) of the extract in distilled water. The solution obtained is stirred for 1 minute. The presence of saponin results in the persistent formation of a column of foam at least 1 cm high.
- **Triterpene and steroid test** (Liebermann-buchard reaction): it is a coloring reaction. Dissolve the product to be analyzed in chloroform then add acetic anhydride then concentrated sulfuric acid in the proportions 2:1. If a purple color is observed which turns dark green, we are in the presence of sterols or steroids; if, on the other hand, the initial brick-red coloring turns purple, then it is a triterpene.
- **Reducing sugars:** it is a precipitation and coloring reaction. To 0.5 ml of extract add 1 ml of distilled water, 5 to 8 drops of Fehling liqueur A and B and heat. The appearance of a brick-red color or precipitation indicates the presence of reducing sugars.

Synthesis of silver nanoparticles: The method used for the synthesis of silver nanoparticles (AgNps) was an organometallic bio-reduction of silver nitrate salts mediated by various secondary metabolites contained in the plant extract. It consisted of adding the aqueous extract to 50 ml of an aqueous solution of silver nitrate according to the optimum parameters obtained. The preparation was subsequently incubated at room temperature and centrifuged at 6000 rpm for 20 min. it was then washed twice with distilled water and once with 95% ethanol. The purified granules were placed in dry tubes, and then dried in an oven at 60˚C for 24 hours [7].

Acute Toxicity Assessment: The acute oral toxicity experiment was conducted following guideline 423 of the Organization for Economic Cooperation and Development (OECD) protocol [8]. Randomly selected female rats, aged between 8 and 12 weeks, were deprived of food but not water for 12 hours before the test, after which they were weighed and divided into two groups of three rats. Each, then the test substance was administered orally using an orogastric tube. Lot 1 (control) only received distilled water and lot 2 received the nanoparticles at a dose of 2000 mg/kg body weight then the animals were observed for 14 days. Observations focused on changes in skin, hair, somato-motor activity and behavior. The animals were weighed every two days during the experiment.

Evaluation of hypoglycemic activity: A total of 28 healthy female rats, chosen at random and divided into seven groups of four rats each, were deprived of food but not water 12 hours before the experiment. After fasting, each rat was weighed to determine the amount of substance to be administered to each rat after administering glucose (2 g/kg body mass). Thirty minutes after carbohydrate intake, other substances (distilled water, glibenclamide, silver nanopar-

ticles at a dose of 100 mg/kg, 200 mg/kg and 400 mg/kg and a dose of the extract aqueous at 400 mg/kg) were administered orally using an orogastric tube following the distribution:

Batch 1: neutral controls receiving distilled water 10 ml/kg body weight only;

Batch 2: negative controls receiving 2 g/Kg of body weight of glucose;

Batch 3: positive control receiving 5 mg/kg of body weight of glibenclamide (reference substance) 30 minutes after having received 2 g/kg of body weight of glucose;

Batch 4: receiving 100 µg/kg of body weight of silver nanoparticles 30 minutes after receiving 2 g/kg of body weight of glucose;

Batch 5: receiving 200 µg/kg of body weight of silver nanoparticles 30 minutes after receiving 2 g/kg of body weight of glucose;

Batch 6: receiving 400 µg/kg of body weight of silver nanoparticles 30 minutes after receiving 2 g/kg of body weight of glucose;

Batch 7: receiving 400 mg/kg of body weight of simple aqueous extract 30 minutes after receiving 2 g/Kg of body weight of glucose.

Evaluation of antihyperglycemic activity: A total of 28 healthy female rats, chosen at random and divided into seven groups of four rats each, were deprived of food but not water 12 hours before the experiment. After fasting, each rat was weighed to determine the amount of substance to administer to each. Then glucose was administered (2 g/kg body weight). Thirty minutes before carbohydrate intake, other substances (distilled water, glibenclamide, silver nanoparticles at a dose of 100 mg/kg, 200 mg/kg and 400 mg/kg and a dose of the extract aqueous at 400 mg/kg) were administered orally using an orogastric tube following the distribution:

Batch 1: neutral control rats receiving distilled water 10 ml/kg body weight only;

Batch 2: negative control rats receiving 2 g/Kg of body weight of glucose;

Batch 3: positive control rats receiving 5 mg/kg of body weight of glibenclamide (reference substance) and 30 minutes after 2 g/kg of body weight of glucose;

Batch 4: rats receiving 100 µg/kg of body weight of silver nanoparticles and 30 minutes after 2 g/kg of body weight of glucose;

Batch 5: rats receiving 200 µg/kg of body weight of silver nanoparticles and 30 minutes after 2 g/kg of body weight of glucose;

Batch 6: rats receiving 400 µg/kg of body weight of silver nanoparticles and 30 minutes after 2 g/kg of body weight of glucose;

Batch 7: rats receiving 400 mg/kg of body weight of simple aqueous extract and 30 minutes after 2 g/Kg of body weight of glucose.

Statistical analyses: The data were entered into Excel software version 2016 for the calculation of means, standard deviations and the drawing of curves and histograms. ANOVA tests were applied at the 5% threshold to establish the differences between the values of the parameters observed using the Graphpad stat software.

3. Results

3.1. Extraction Yield

50 g of *G. tessmannii* trunk bark powder were decocted in 500 ml of distilled water for 5 minutes. The mass of crude extract obtained was 4.8 g, for an extraction yield of 8.76% (Table 1).

3.2. Phytochemical Screening

Numerous phytochemical compounds have been demonstrated in the trunk bark of *G. tessmannii*. Apart from the alkaloids for which the test was negative, the tests for flavonoids, tannins, anthocyanins, anthraquinones, coumarins, saponins, sterols and terpenes were positive (Table 2).

3.3. Assessment of Acute Toxicity

The study of acute toxicity focused on the observation of changes in the physiological parameters of white albino rats of the Wistar strain. At the end of the fourteen days of observation, no anomalies were noted in the parameters studied except for the aggressiveness and vomiting of the rats during the first day. No deaths have been recorded. The LD50 is therefore greater than 2000 mg/kg (Table 3).

3.4. Variation in Average Weight Masses of Rat Batches

The average body masses of the two groups of rats increased during the experiment. That of batch 1 (control) increased from 125 g on the initial day (D0), to

Table 1. Extraction yield of bark powders from the trunk of *G. tessmannii*.

Species studied	Mass of dry powder used (g)	Mass of crude extract obtained (g)	Extraction yield (%)
G. tessmannii	50	4.38	8.76

Table 2. Phytochemical compounds from the trunk bark of *G. tessmannii*.

Secondary metabolites	Observations
Alkaloids	−
Flavonoids	+
Tanins	+
Anthocyanins	+
Anthraquinones	+
Coumarins	+
Saponins	+
Sterols and terpenes	+
Reducing sugars	+

(+) presence; (−) absence.

Table 3. Acute toxicity of the aqueous extract of the trunk bark of *G. tessmannii*.

	Control lot (Distilled water at 10 ml/kg)	Study batch (AgNps at 2000 mg/kg)
Mobility	N	N
Aggressiveness	A	A
Stool condition	N	N
Pain sensitivity	N	N
Vomiting	A	A
Hairiness	N	N
Tail Condition	N	N
Vigilance	N	N
Number of deaths	00	00

A = absence; N = normal; AgNps = silver nanoparticles.

145 g on the last day (D14), *i.e.* a mass gain of 20 g. That of batch 2 (test batch) increased from 121 g on the initial day (D0), to 146 g on the last day (D14), *i.e.* a mass gain of 25 g. The comparison of the body masses of the same batch on day zero and day fourteen using the ANOVA test revealed very significant differences regardless of the batch chosen (**Figure 3**).

3.5. Autopsy and Weighing of the Internal Organs of Rats Following the Acute Toxicity Study

After 14 days necessary for the observation of the behaviors of the batches of rats relating to the study of acute mildness, the rats were sacrificed, and the autopsy of the internal organs revealed similar characteristics between the rats of the treated batch and rats from the control group. After the autopsy, the internal organs were weighed. The average mass of the liver of the rats in the control group was 5.43 g and that of the rats in the test group was 5.42 g, a non-significant difference of 0.01 g ($p > 0.05$). The average mass of the kidneys of the rats in the control group was 0.83 g and that of the rats in the test group was 0.88 g, a very insignificant difference of 0.05 g ($p < 0.05$). The average mass of the heart of the rats in the control group was 0.46 g and that of the rats in the test group was 0.46 g. The average mass of the lungs of the rats in the control group was 1.45 g and that of the rats in the test group was 1.15 g, a significant difference of 0.3 g ($p < 0.01$). The average mass of the rats in the control group was 0.32 g and that of the rats in the test group was 0.31 g, a non-significant difference of 0.01 g ($p > 0.05$) (**Figure 4**).

3.6. Hypoglycemic Activity

Except for rats from batch 2 (negative control), the blood glucose levels of rats from all other batches decreased at the end of the study. The blood glucose level

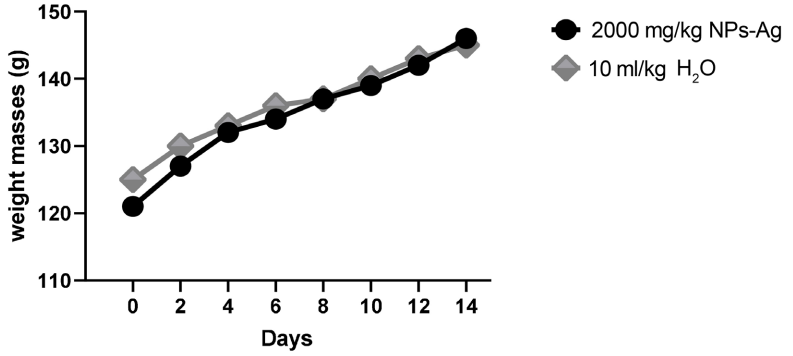

Figure 3. Variation in average weight masses of rat batches.

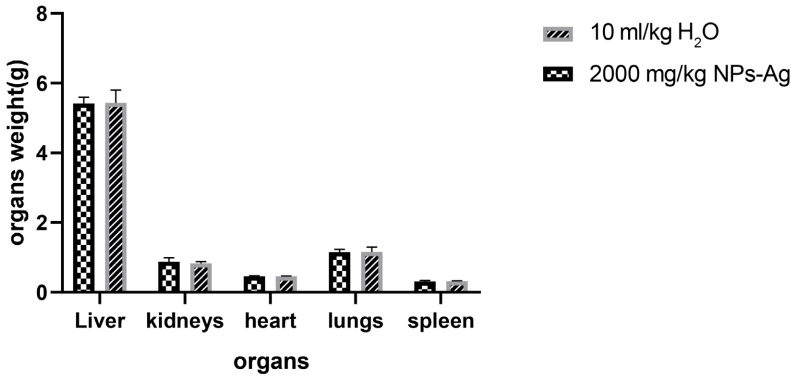

Figure 4. Internal organ masses of rat batches.

of batch 1 (neutral control) increased from 90.25 mg/dl at the initial time to 79 mg/dl at the 180th minute, *i.e.* a rate of change of −11.25 mg/dl. The blood glucose of batch 2 (negative control) increased from 94.5 mg/dl at the initial time to 97.75 mg/dl at the 180th minute, *i.e.* a rate of change of +3.25 mg/dl. The blood glucose of batch 3 (positive control) increased from 100.25 mg/dl at the initial time to 43.5 mg/dl at the 180th minute, *i.e.* a rate of change of −56.75 mg/dl. The blood glucose of batch 4 (nanoparticles 100 µg/kg) increased from 90.25 mg/dl at the initial time to 81.25 mg/dl at the 180th minute, *i.e.* a rate of change of −9 mg/dl. Blood glucose level of batch 5 (200 µg/kg nanoparticles) increased from 92.25 mg/dl at the initial time to 76.5 mg/dl at the 180th minute, *i.e.* a rate of change of −15.75 mg/dl. The blood glucose of batch 6 (400 µg/kg nanoparticles) increased from 92.25 mg/dl at the initial time to 76.5 mg/dl at the 180th minute, *i.e.* a rate of change of −28.75 mg/dl. The blood glucose of batch 7 (400 µg/kg extract) increased from 88.75 mg/dl at the initial time to 75.75 mg/dl at the 180th minute, *i.e.* a rate of change of −13 mg/dl. However, it should be noted that glibenclamide 5 mg/kg which is the reference molecule lowered blood sugar levels more than the other treatments applied in the other batches (−56.75 mg/dl). It was followed by the extract treated with silver nanoparticles at a dose of 400 µg/kg which lowered blood sugar levels by 28.75 mg/dl. Comparison of these two values using the ANOVA test revealed a very significant difference ($p < 0.001$) (Table 4).

Table 4. Variations in blood glucose levels in batches of rats following the hypoglycemic test.

Batches of rats studied	Glycemia (mg/dl)						
	T0	T30	T60	T90	T120	150	T180
Batch 1: Neutral control (distilled water)	90.25 ± 1.10	88 ± 1.47	86.5 ± 1.55	83 ± 1.41	83.5 ± 1.93	82 ± 2.48	79 ± 1.68
Variation rate	**0**	**−2.25**	**−3.75**	**−7.25**	**−6.75**	**−8.25**	**−11.25**
Batch 2: Negative control (glucose 2 g/kg)	94.5 ± 0.64	136.25 ± 5.39	129.75 ± 4.64	118.75 ± 6.99	109.75 ± 5.13	103.5 ± 5.61	97.75 ± 4.93
Variation rate	**0**	**+41.75**	**+35.25**	**+24.25**	**+15.25**	**+9**	**+3.25**
Batch 3: Positive control (glibenclamide 5 mg/kg)	100.25 ± 8.93	131.75 ± 8.29	99.25 ± 1.97	80.25 ± 8.50	64.5 ± 5.63	52.75 ± 1.65	43.5 ± 1.55
Variation rate	**0**	**+31.5**	**−1**	**−20**	**−35.75**	**−47.5**	**−56.75**
Batch 4: Nanoparticles 100 µg/kg	90.25 ± 2.86	127.25 ± 7.12	117.25 ± 5.93	100.75 ± 2.56	94 ± 0.70	85.5 ± 1.93	81.25 ± 2.28
Variation rate	**0**	**+37**	**+27**	**+10.5**	**+3.75**	**−4.75**	**−9**
Batch 5: Nanoparticles 200 µg/kg	92.25 ± 2.80	120.25 ± 9.29	108 ± 11.75	100.5 ± 11.75	86.25 ± 7.56	80.5 ± 5.04	76.5 ± 3.88
Variation rate	**0**	**+28**	**+15.75**	**+8.25**	**−6**	**−11.75**	**−15.75**
Batch 6: Nanoparticles 400 µg/kg	100.5 ± 7.23	128.5 ± 6.130	106.5 ± 3.61	93.75 ± 2.39	81.75 ± 3.63	77 ± 2.34	71.75 ± 2.21
Variation rate	**0**	**+28**	**+6**	**−6.75**	**−18.75**	**−23.5**	**−28.75**
Batch 7: Extract 400 mg/kg	88.75 ± 1.93	122 ± 3.93	107.75 ± 2.17	92.75 ± 3.17	88.5 ± 3.09	81 ± 2.27	75.75 ± 2.71
Variation rate	**0**	**+33.25**	**+19**	**+4**	**−0.25**	**−7.75**	**−13**

3.7. Antihyperglycemic Activity

The antihyperglycemic activity tests were revealed in three batches of rats (batches 1, 3 and 6) in which blood sugar levels decreased and four groups in which blood sugar levels increased after the 180 minutes of study. The blood glucose level of batch 1 (neutral control) increased from 84.5 mg/dl at the initial time to 77 mg/dl at the 180th minute, *i.e.* a rate of change of −7.5 mg/dl. The blood glucose of batch 2 (negative control) increased from 85 mg/dl at the initial time to 105 mg/dl at the 180th minute, *i.e.* a rate of change of +20 mg/dl. The blood glucose of batch 3 (positive control) increased from 82 mg/dl at the initial time to 45.25 mg/dl at the 180th minute, *i.e.* a rate of change of −36.75 mg/dl. The blood glucose of batch 4 (100 µg/kg nanoparticles) increased from 84.25 mg/dl at the initial time to 99.25 mg/dl at the 180th minute, *i.e.* a rate of change of +15 mg/dl. The blood glucose of batch 5 (200 µg/kg nanoparticles) increased from 82 mg/dl at the initial time to 86.75 mg/dl at the 180th minute, *i.e.* a rate of change of +4.75 mg/dl. The blood glucose of batch 6 (nanoparticles 400 µg/kg) increased from 83.5 mg/dl at the initial time to 70.5 mg/dl at the 180th minute,

i.e. a rate of change of −13 mg/dl. The blood glucose of batch 7 (400 µg/kg extract) increased from 84.75 mg/dl at the initial time to 85 mg/dl at the 180th minute, *i.e.* a rate of variation of +0.25 mg/dl. However, it should be noted that glibenclamide 5 mg/kg which is the reference molecule lowered blood glucose levels more than the other treatments applied in the other batches (−36.75 mg/dl). It was followed by the extract treated with silver nanoparticles at a dose of 400 µg/kg which lowered blood glucose levels by 13 mg/dl. Comparison of these two values using the ANOVA test revealed a very significant difference ($p < 0.001$) (Table 5).

4. Discussion

The mass of crude extract obtained after condensation of the prepared decoction was 4.8 g, for an extraction yield of 8.76%. The polarity of the solvent, the plant organ used and the extraction method would influence the extraction yield. Tankeu *et al.*, (2020) [9] obtained a yield of 14% with the aqueous extract of the fruits of *Picralima nitida* and a yield of 4.65% with the aqueous extract of the bark of the trunk of *Musanga cecropioides*, all prepared by maceration.

Table 5. Variations in blood glucose levels in groups of rats following the antihyperglycemic test.

Batches of rats studied	Glycemia (mg/dl)						
	T0	T30	T60	T90	T120	150	T180
Batch 1: Neutral control (distilled water)	84.5 ± 1.44	83 ± 1.22	81.5 ± 0.86	79 ± 1.15	78.75 ± 1.65	77 ± 1.08	77 ± 2.04
Variation rate	**0**	**−1.77**	**−3**	**−5.5**	**−5.75**	**−7.5**	**−7.5**
Batch 2: Negative control (glucose 2 g/kg)	85 ± 2.79	82.5 ± 2.72	156.5 ± 2.59	139.25 ± 3.35	130 ± 2.04	117.75 ± 2.68	105 ± 2.04
Variation rate	**0**	**−2.5**	**+71.5**	**+54.25**	**+45**	**+32.75**	**+20**
Batch 3: Positive control (glibenclamide 5 mg/kg)	82 ± 1.68	73.75 ± 1.31	116 ± 2.64	94 ± 3.18	76.25 ± 1.65	58.25 ± 3.40	45.25 ± 2.71
Variation rate	**0**	**−8.25**	**+34**	**+12**	**−5.75**	**−23.75**	**−36.75**
Batch 4: Nanoparticles 100 µg/kg	84.25 ± 2.46	80.75 ± 1.79	148 ± 6.32	139 ± 4.84	128.75 ± 5.55	120 ± 5.65	99.25 ± 5.10
Variation rate	**0**	**−3.5**	**+63.75**	**+54.75**	**+44.5**	**+35.75**	**+15**
Batch 5: Nanoparticles 200 µg/kg	82 ± 1.82	77.25 ± 1.03	133.5 ± 3.66	129 ± 2.04	110 ± 2.34	100 ± 1.82	86.75 ± 2.78
Variation rate	**0**	**−4.75**	**+51.5**	**+47**	**+28**	**+18**	**+4.75**
Batch 6: Nanoparticles 400 µg/kg	83.5 ± 3.70	77.75 ± 3.32	128.25 ± 1.49	102 ± 1.3	82.25 ± 1.10	73.75 ± 1.31	70.5 ± 0.64
Variation rate	**0**	**−5.75**	**+45**	**+18.5**	**−1.25**	**−9.75**	**−13**
Batch 7: Extract 400 mg/kg	84.75 ± 2.65	80.5 ± 2.53	139 ± 2.8	123.5 ± 1.55	104.75 ± 1.65	94 ± 1.58	85 ± 2.04
Variation rate	**0**	**−4.25**	**+54.25**	**+38.75**	**+20**	**+9.25**	**+0.25**

The aqueous extract of the trunk bark of *Guibourtia tessmannii* revealed the presence of flavonoids, tannins, coumarins and saponins. It was reported by Owolabi *et al.*, (2010) [10] that these substances have antidiabetic activities. A study by Akouah *et al.*, (2015) [11] showed that the flavonoids present in the roots of *Rauvolfiavomitoria* have hypoglycemic and anti-hyperglycemic activity. The secondary metabolites present in plant extracts are believed to be at the origin of their numerous pharmacological properties.

According to Tankeu *et al.*, (2020) [9], a plant who's LD50 of its extract is greater than 2000 mg/kg of body weight is considered very low toxic for animal testing. Consequently, the aqueous extract of the trunk bark of *Guibourtia tessmannii* would be very non-toxic. The increase in body weights of the groups of rats during this study would be consistent with the non-toxicity of the aqueous extract of the trunk bark of *Guibourtia tessmannii*. This result supports that of the observation of physiological parameters which also showed that the aqueous extract of the bark of the trunk of *Guibourtia tessmannii* would be of low toxicity. Etame *et al.*, (2017) [12] found similar results. They showed that the weight growth of males and females increased overall regardless of the batch chosen.

Except for rats from batch 2 (negative control), the blood sugar levels of rats from all other batches decreased at the end of the hypoglycemic activity study. The antihyperglycemic activity revealed three groups of rats (batches 1, 3 and 6) in which blood sugar levels decreased and four groups in which blood sugar levels increased after the 180 minutes of study. However, glibenclamide 5 mg/kg which is the reference molecule lowered blood sugar levels more than the other treatments applied in the other batches in one or the other study case. These reductions would be due to the presence of flavonoids, tannins, coumarins and saponins in the silver nanoparticles. All of these molecules act by stimulating the production of insulin by the pancreas, which in turn causes a reduction in intestinal absorption of glucose. The blood sugar peaks that follow meals would thus be reduced. Wouegam *Sagouo* (2019) [13] found similar results in this work which focused on the evaluation of the hypoglycemic and antihyperglycemic activity of extracts of bark from the trunk of *Guibourtia demeusei*.

5. Conclusion

The objective of this work was to study the acute deficiency and the hypoglycemic and antihyperglycemic activities of silver nanoparticles from *Guibourtia tessmannii*. The mass of crude extract obtained after the decoction of 50 g of powders in 500 ml of distilled water was 4.8 g, for an extraction yield of 8.76%. Following the phytochemical screening of the trunk barks of *G. tessmannii*. Only the alkaloid test was negative. At the end of the fourteen days of acute dependence study, the LD50 was greater than 2000 mg/kg. The average body masses of the two groups of rats increased during the experiment. Autopsy of internal organs revealed similar characteristics between rats from the treated group and rats from the control group. All these parameters studied lead to the observation

that the aqueous extract of the bark of the trunk of *G. tessmannii* is very little toxic. The blood glucose levels of the different groups of rats experienced numerous fluctuations during the 180 minutes of study for both the hypoglycemic activity test and the antihyperglycemic activity. However, it should be noted that glibenclamide 5 mg/kg which is the reference molecule contributed to reducing blood sugar levels more than the other treatments applied in the other batches. It was followed by treatment with silver nanoparticles at a dose of 400 µg/kg in both tests. Following the study of Hémigène and the hypoglycemic and antihyperglycemic activities, the silver nanoparticles of *G. tessmannii* can be used after more in depth studies, for the optimized formulation of improved traditional drugs to fight against diabetes.

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Data Availability

All data generated or analyzed during this study was included in this Original Research Article.

Authors' Contributions

Ngoulé Charles Christian designed and carried out the study, Sone Enone Bertin, Tankeu Séverin Elisée, Songue Pascal, Ngo Nyobe Biwole Caroline and Jean-Pierre Nguene wrote the Original Research Article and Gisèle Loe Etame and Eya'ane Meva François supervised the work. All authors have read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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