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Mnemonic and neuroprotective properties of *Sclerocarya birrea* root bark decoction on mouse model of monosodium glutamate-induced neurotoxicity involve by its antioxidant activities

Renaud Nonmarmbaye [1, *], Nadège Kouemou [2], Sidiki Neteydji [1], Jacqueline Stephanie Kameni Njapdounke [1], Touo'yem Nkemmo Stéphane Willy [1] and Elisabeth Ngo Bum [1, 3]

[1] Department of Biological Sciences, Faculty of Sciences, University of Ngaoundere, P.O. Box 454, Ngaoundere, Cameroon.
[2] Department of Zoology and Animal Physiology, Faculty of Sciences, University of Buea, Cameroon, P.O. Box 63, Buea, Cameroon.
[3] Department of Biological Sciences, Faculty of Science, University of Maroua, P.O. Box 814, Maroua, Cameroon.

Abstract

Ethnopharmacological relevance: *Sclerocarya birrea* (A. Rich.) Hochst. (Anacardiaceae) is a medicinal plant known for the treatment of several diseases such as epilepsy, hypertension, inflammation and memory disorders in Cameroonian folk medicine.

Aim of the study: The aim of this work is to evaluate the memory improvement and neuroprotective effects of *Sclerocarya birrea* aqueous root bark extracts and investigate it antioxidant properties.

Materials and methods: T-maze and the object recognition test in an open field were used for behavioral testing to detect its neuroprotective and memory improvement properties. The DPPH test was used to predict antioxidant activities *in vitro*. The *in vivo* antioxidant activities of the aqueous extracts were investigated using the Monosodium glutamate induced oxidative stress and neurotoxicity mouse model. After the behavioral testing, animals were decapitated and the brains were removed for oxidative stress biomarkers determination.

Results: *Sclerocarya birrea* decreased the preferred arm choice latency and the time spent in the discriminated, in the T-maze. It increased exploration time and recognition index, and decreased the latency to explore the new object B. In addition, *Sclerocarya birrea* increased the superoxide dismutase and catalase activities, and reduced glutathione level.

Conclusion: These results suggest that *Sclerocarya birrea* possess neuroprotective and mnemonic activities in mice that might involve by its free radicals scavenging properties

Keywords: *Sclerocarya birrea*; Antioxidants; Neuroprotection; Memory; Folk medicine

1. Introduction

Memory is a combination of neurological processes allowing us to acquire, store and recall past experiences and information [1]. However, multiple aggressions of endogenous or exogenous origin often occurred. Glutamate, the most important excitatory neurotransmitter strongly involved in the higher brain functions, including memory [2]. But it can be toxic to neurons at high concentration [3]. Hassan and collaborators in 2014 observed that monosodium glutamate

* Corresponding author: Renaud Nonmarmbaye
Department of Biological Sciences, Faculty of Sciences, University of Ngaoundere, P.O. Box 454, Ngaoundere, Cameroon.

causes neurotoxicity in rodents such as those observed in Alzheimer's disease [4]. It also causes abnormalities in the neuroendocrine system, neurodegeneration as well as oxidative stress damage in various organs including the brain [5].

Recent studies showed the importance of natural antioxidants, because of their therapeutic properties and their accessibility. Indeed, a large majority of populations uses traditional medicine to solve their health problems [6-8]. Bioactive antioxidant agents in plants are selected to provide the first line of biological defense against oxidative stress. Some studies show that oxidative damage constitutes a mechanism of injury found in many age-related diseases [6-8]. The brain is extremely vulnerable to oxidative stress because it requires a high quantity of oxygen and content high level of polyunsaturated fatty acid susceptible to peroxidation. This result to an accumulation of oxidative damage and can cause neurodegenerative diseases such as Alzheimer's. Natural antioxidant substances from plants have been proposed as an alternative for prevention and treatment of these neurological diseases [8].

Sclerocarya birrea (A. Rich.) Hochst. (Anacardiaceae) is a traditional aromatic plant medicine used to treat neuropathic pain, hypertension, dysentery, epilepsy and inflammation. It has antidiarrheal, anti-inflammatory properties and is also used for asthenia [9-11]. The decoction prepared from the root bark of *Sclerocarya birrea* has been intensively used by the sudano-sahelian's zone traditional healers to treat epilepsy, anxiety and memory loss [10].

Previous studies performed indicated that the aqueous extracts of *Sclerocarya birrea* were shown to possess antioxidant and acetylcholiesterase inhibitory properties, and can constitutes a source of natural antioxidant and acetylcholinesterase inhibitor [9]; however, there is a substantial lack of systematic study of *Sclerocarya birrea* extracts and the involved signaling pharmacological pathway remains less elucidated. Therefore, the T-maze and object recognitions tests were used to examine the possible mnemonic and neuroprotective properties of *Sclerocarya birrea* in monosodium glutamate-induced neurotoxicity mouse model of Alzheimer disease. Additionally, a relationship between the behavioral properties of *Sclerocarya birrea* extracts and the oxidative stress biomarkers (catalase, superoxide dismutase, and reduced glutathione and malondialdehyde levels) variations in the tested animals were studied.

2. Material and methods

2.1. Plant material

The root of *Sclerocarya birrea* used for the experiments was harvested on 17 April 2020 in Moundou (Logone Occidental - Chad). The area of study did not involve endangered or protected species. The collected species was identified by National Herbarium of Yaoundé (Cameroon), where a voucher was deposited (2748SFR).

2.2. Preparation of Sclerocarya birrea aqueous extracts

The root bark of *Sclerocarya birrea* was ground, and 2.5 g of the obtained powder was introduced in 100 mL of distilled water. The obtained mixture was boiled for 20 minutes duration and the supernatant was filtered using Whatman No 1 filter paper. The resulting decoctions were then administered orally to mice in a volume of 10 mL/kg. The decoctions of *Sclerocarya birrea* were prepared daily according to Traditional Healer's instructions. In another set of experiment the decoction was concentrated using a rotary vacuum evaporator under reduced pressure at 50°C, and from this procedure the yield of extraction (37.74%) was calculated. The stock solution of *Sclerocarya birrea* extract (decoction, 41 mg/mL), were diluted in distilled water, and two less concentration solutions (10.25 and 20.5 mg/mL) were obtained.

2.3. Determination of the in vitro antioxidants activities

Free radicals are molecules that can cause damage if their levels become too high in the body; compounds that are able to maintain their concentrations at the non-cytotoxicological cell level are call anti-free radicals [13]. Free radical scavenging capacity of the extracts was tested by DPPH radical scavenging assay as described by Blois [14]. The hydrogen atom donating ability of the plant decoction was determined by the decolorization of methanol solution of 2,2-diphenyl-1-picrylhydrazyl (DPPH). DPPH produces violet/purple color in methanol solution and fades to shade of yellow color in the presence of antioxidants. A solution of 0.1 mM DPPH in methanol was prepared, and 2.4 mL of this solution was mixed with 1.6 mL of extract in methanol at different concentrations (12.5–150 µg/mL). The reaction mixture was vortexed thoroughly and left in the dark at RT for 30 min. The absorbance of the mixture was measured spectrophotometrically at 517 nm [15]. Vitamin C was used as reference. Percentage of DPPH free radical scavenging activity was calculated by the following equation [16]:

$$IP(\%) = ((A_0 - A_1)/A_0)) \times 100$$

Where IP is DPPH radical scavenging activity; A_0 is the absorbance of the control, and A_1 is the absorbance of the plant.

2.4. Chemicals

Monosodium glutamate was purchased from local market. Vitamin C and the others reagents used for the quantification of brain activity were purchased from Sigma Chemical, USA.

2.5. Animals

Adult male Swiss mice weighting 20 – 25 g were obtained from the National Veterinary Laboratory, Garoua, Cameroon, and used throughout these experiments. They were housed in standard Plexiglas cages with food and water *ad libitum*. The animal house was maintained constantly at 25°C on a 12 h light-dark cycle. The protocols were performed in concordance with the International Guide for the Care and Use of Laboratory Animal (National Institute of Health; publication No. 85-23, revised 1996) and the Cameroon National Ethical Committee, Yaounde (No. FW-IRB00001954). In addition, the protocols for pharmacological studies were also realized in compliance with the recommendations provided in the Animal Research: Reporting of *In vivo* Experiment (ARRIVE) guidelines published online in PLOS Biology [17], and the general guidelines for experimental research and screening of traditional medicine as promulgated by WHO [18].

2.6. Behavioral testing for the evaluation of mnemonics properties

2.6.1. T- maze test

The T- maze consists of three arms (30 cm × 10 cm × 25 cm): one starting arm, a central corridor and two goal arms perpendicular to the central corridor. Opaque guillotine doors placed at the exit of the departure arm and at the entrance of each of the two goal arms allow to control the access to the different arms of the maze. At the end of each goal arm, there is a food that can facilitate the animal's choice. Rewarded alternation is performed for three days and has three phases: habituation, acquisition and retention. During the habituation phase (day 1), the mice were placed in the starting arm of the maze and 15 seconds later, all the guillotine doors were opened. The animal was then allowed to choose an arrival arm of the apparatus indicating its preference, the arm choice at first is called preferred arm [19]. Mice were familiarized with the maze for 5 minutes. The following parameters were recorded for each mouse: latency to choose an arm, number of entries in the preferred and discriminated arms, time spent in the preferred and discriminated arms, and number of returns to the starting arm. During the acquisition phase (day 2), the maze arm discriminated by the animal was closed. The mouse was placed in the starting arm and left to move to the open arm (preferred arm during habituation). The following parameters were recorded: latency to enter the preferred arm, number of entries into the preferred arm, time spent in the preferred arm and number of returns to the starting arm. The retention phase (day 3) was identical to the habituation phase.

2.6.2. Object recognition test in the open

The open field used in these experiments consist of a wooden square box (40 × 40 × 45 cm), and the floor of this apparatus was divided into 16 smaller squares (10 × 10 cm) of equal dimensions [20]. Described by Ennaceur and Delacour [21], the object recognition test is based on the natural tendency of rodents to explore a new object more than a familiar one. It involves short-term memory processes and tests short-term recognition memory [22].

This test was performed for 3 days and consisted of three phases: habituation, acquisition and retention. To reduce stress due to neophobia, during habituation (day 1), mice were individually familiarized with the open arena for 5 minutes [23]. During acquisition (day 2), animals were placed in the presence of two identical objects (A+A'). The retention phase (day 3) was performed as in the acquisition phase, except one of the objects (A') was replaced by a new object (B). The time that mouse explore each objects A and B were recorded and noted tA and tB respectively [24]. The animal is considered to be exploring when it directs its snout towards the object at least 2 cm away from it. The latency time to discover object A and B, the number of visits to object A and B and the time to explore object A and B were recorded during 5 minutes. The percentage of Recognition Index (%IR) of the new object was defined as the percentage of the exploration time of the new object to the total exploration time of both objects. The larger this index is, the better the memory performance in mice [25, 26]. The percentage of the new object recognition index is calculated as follow:

$$\%IR = (tB/tB+tA) \text{ X } 100$$

2.6.3. Biochemical estimation of MDA and reduced glutathione concentration and SOD and catalase activities in the brain of tested animals

Concentration of MDA and reduced glutathione, SOD and catalase activities in the brain homogenate was quantified as follow: SOD activity was determined by the Oyanagui method [27], catalase (CAT) activity was determined by the method of Aebi [28]. The level of GR was done according to the method of Mizumo and Ohta [29] and the concentration of MDA was determined according to the method described by Nourooz-Zadeh [30].

2.7. Statistical analysis

Data are shown as means ± Standard Error of the Mean (S.E.M.). Statistical analysis of significance was carried out using analysis of variance (ANOVA) followed by Tukey's post hoc multiple comparison tests.

P values less than 0.05 were considered as significant

3. Results

3.1. *In vitro* antioxidants activities *Sclerocarya birrea* root bark aqueous extracts

The DPPH radical scavenging activities *Sclerocarya birrea* root bark aqueous extracts are presented figure 1 and table 1. Free radical scavenging activity using DPPH as the indicator is a basic antioxidant assay. As shown in figure 1 and Table 1, scavenging activities of is 95.78. The *Sclerocarya birrea* root bark aqueous extracts scavenging activity ranging at 89.46%. Moreover, the IC50 were 6.52 and 5.51 respectively for vitamin C and the plan extract.
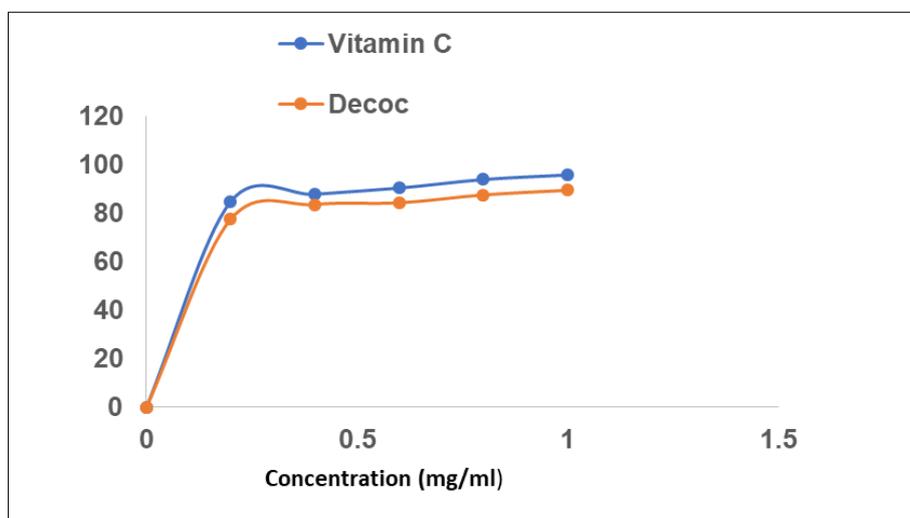
Figure 1 Curve showing the percentage inhibition of Sclerocarya birrea decoction and Vitamin C

Table 1 Percentage inhibition (%) and IC50 (mg/ml)

Decoction and reference compound	Percentage of Inhibition (%)	IC50 (mg/ml)	(R²)
Vitamin C	95,78 ± 0,00	6,52	0,95
Decoction of *S. birrea*	89,46 ± 0,02	5,51	0,96

Correlation coefficient
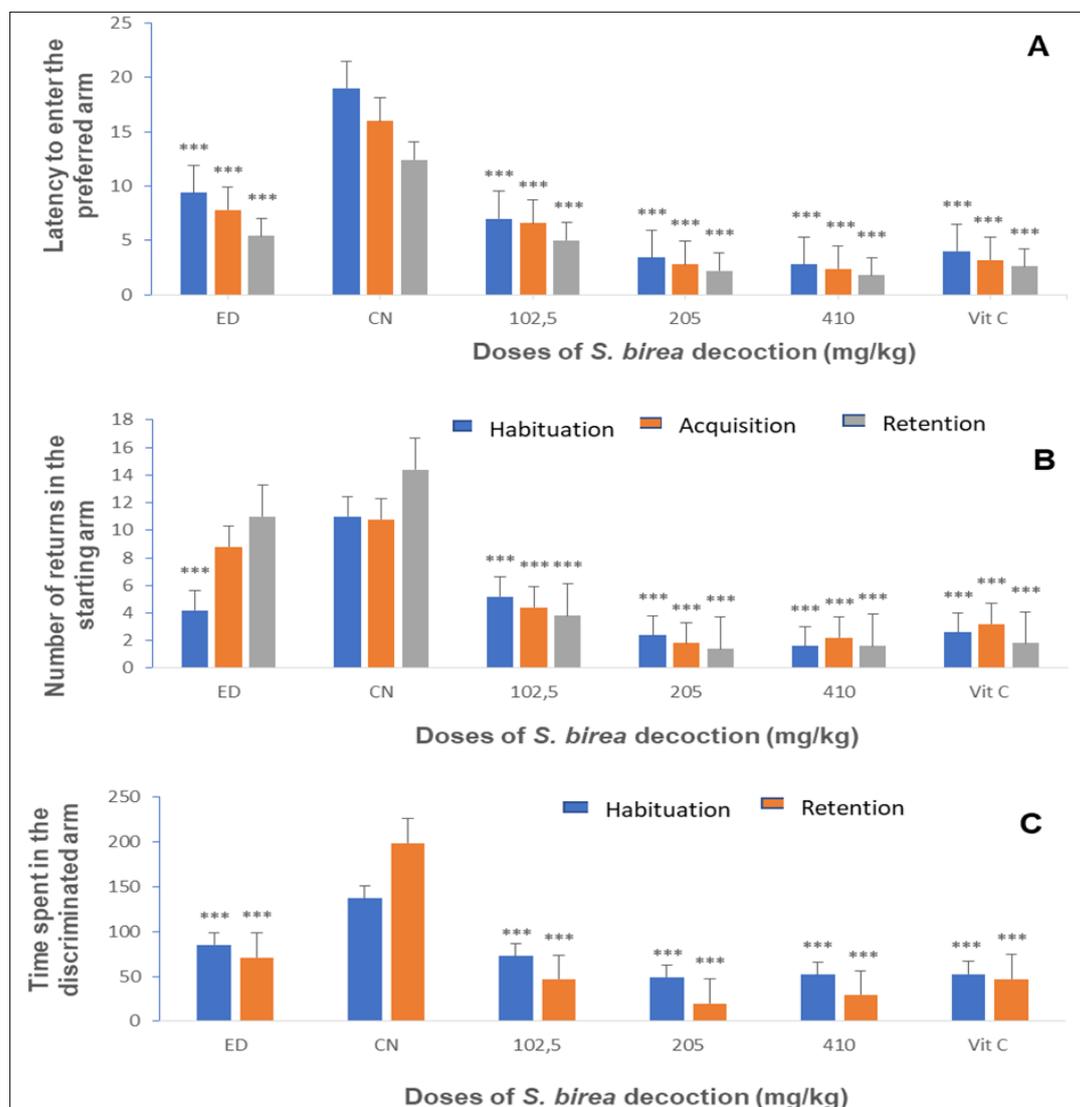
3.2. Effects of *Sclerocarya birrea* root bark aqueous extracts on behavioral parameters in the T- maze test

3.2.1. Effects of Sclerocarya birrea root bark aqueous extracts on the preferred arm enter latency, Time spent in the discriminated arm and Number of returns to the starting arm.

Administration of *Sclerocarya birrea* aqueous extracts to mice significantly decreased during habituation, the preferred arm choice latency (fig. 2A) [F (5, 24) = 23.25; P<0.001] ranging from 19 ± 1 sec for the negative control group to 7 ± 1.4 ; 3.4 ± 1.5 and 2.8 ± 0 sec for 102.5; 205 and 410 mg/kg doses of decoction respectively. Similarly, during acquisition

the latency also decrease, from 16 ± 2 sec for the negative control group to 6.6 ± 1.5; 2.8 ± 0.5 and 2.4 ± 0.5 sec for 102.5; 205 and 410 mg/kg dose of the decoction respectively [F (5, 24) = 24.10; P <0.001]. During retention, this number continues to decrease varying from 12.4 ± 0.5 sec for the negative control group to 5 ± 1.5; 2.2 ± 0.5 and 1.8 ± 0 sec for 102.5; 205 and 410 mg/kg doses of the decoction respectively [F (5, 24) = 38 ; P<0.001].

During probe test or retention, it also appears a reduction of the number of returns to the starting arm (Figure 2B) varying from 14.4 ± 2 for the negative control group to 3.8 ± 1.5; 1.4 ± 0.5 and 1.6 ± 1 for 102.5; 205 and 410 mg/kg doses of the decoction respectively [F (5, 24) = 61.92; P<0.001]. Concerning the time spent in discriminated arm, it also appear a reduction(Figure 2C) from 199 ± 1 sec for the negative control group to 47 ± 5.5; 20 ± 2 and 29.4 ± 3 sec corresponding to the 102.5; 205 and 410 mg/kg doses of the plant respectively [F (5, 24) = 116.6; P<0.001].
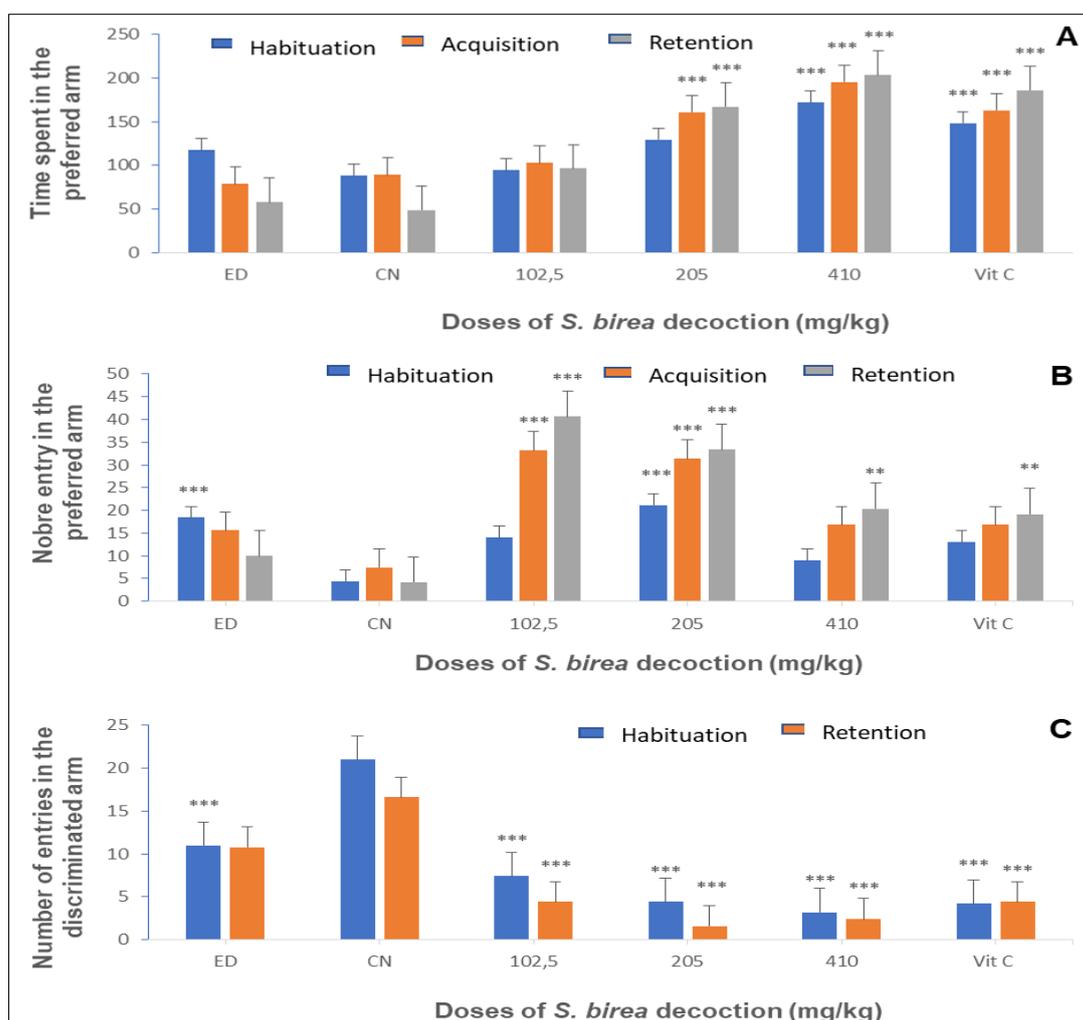

Figure 2 Effects of *Sclerocarya birrea* root bark aqueous extracts on the preferred arm enter latency, Time spent in the discriminated arm and Number of returns to the starting arm on the T-maze

(A) Latency to enter the preferred arm. (B) Number of returns to the starting arm. (C) Time spent in the discriminated arm. Each bar represents the mean ±SEM; n = 5, *** p ≤ 0.001, significant difference from the negative control that received monosodium glutamate. ED = distilled water (normal control), CN = negative control (treated only with monosodium glutamate at 4 mg/kg) and VIT C = vitamin C at 100 mg/kg (positive control), S. birea = *Sclerocarya birrea*.

3.2.2. Effects of Sclerocarya birrea root bark aqueous extracts on time spent in the preferred arm, number of entries in the preferred arm and number of entries in the discriminated arm on the T-maze.

It also appears that the administration of *Sclerocarya birrea* aqueous extracts to mice significantly increased during retention the time spent in the preferred arm (Figure 3A) ranging from 49 ± 1.5 sec for the negative control group to 167.4 ± 2.5 and 203.6 ± 2.5 sec for the 205 and 410 mg/kg doses of the decoction [F (5, 24) = 37.28; P< 0.001]. similarly, *Sclerocarya birrea* decoction significantly increased the number of entries in the preferred arm (Figure 3B) going from 4.2 ± 0.5 for the negative control group to 40.6 ± 16 ; 33.4 ± 3.5 and 20.4 ± 0.5 corresponding to 102.5; 205 and 410 mg/kg of decoction respectively [F (5, 24) = 24.76; P<0.001].

Dissimilarly, *Sclerocarya birrea* decoction significantly reduced the number of entries in the discriminated arm (Figure 3C) varying from 16.6 ± 0.5 for the CN group to 4.4 ± 0.5; 1.6 ± 0 and 2.4 ± 0.5 corresponding to 102.5; 205 and 410 mg/kg of decoction respectively [F (5, 24) = 16.66; P<0.001].
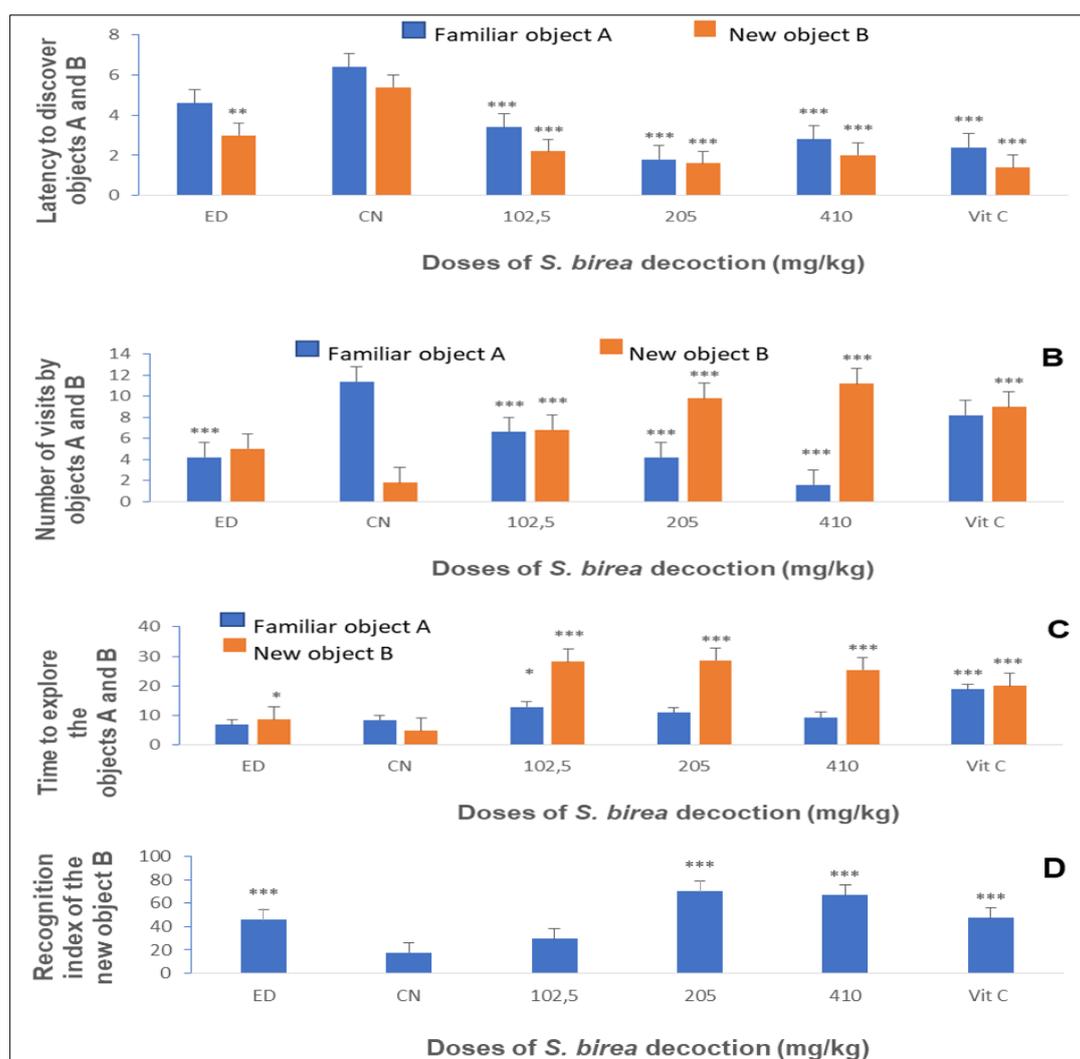

Figure 3 Effects of *Sclerocarya birrea* root bark aqueous extracts on time spent in the preferred arm, number of entries in the preferred arm and number of entries in the discriminated arm on the T-maze

(A) Time spent in the preferred arm. (B) Number of entries in the preferred arm. (C) Number of entries in the discriminated arm. Each bar represents the mean ± SEM; n = 5, ** p ≤ 0.01, *** p ≤ 0.001, significant difference from the negative control that received monosodium glutamate. ED = distilled water (normal control), CN = negative control (treated only with monosodium glutamate at 4 mg/kg) and VIT C = vitamin C at 100 mg/kg (positive control), S. birea = *Sclerocarya birrea*.

3.3. Effects of *Sclerocarya birrea* root bark aqueous extracts on the latency time to discover object A and B, Time spent with objects A and B, Number of visits to objects A and B and Percentage of the Recognition Index in the object recognition in an open field

Interestingly, like vitamin C, *Sclerocarya birrea* daily treatment of animals significantly reduced the latency to discover the new object B (Figure 4A) which varied from 5.4 ± 1.12 sec for the negative control group to 2.2 ± 0.64; 1.6 ± 0.72 and 2 ± 0.40 sec corresponding to 102.5; 205 and 410 mg/kg doses of the decoction, respectively and $1,40 \pm 0.46$ for vitamin C [$F_{(5, 24)} = 14.30$; $P<0.001$]. Similarly, *Sclerocarya birrea* decoction significantly reduced the latency to discover the familiar object A (Figure 4A) from 6.4 ± 0.88 sec for the negative control group to 3.4 ± 0.88; 1.8 ± 0.64 and 2.8 ± 0.64 sec corresponding to 102.5; 205 and 410 mg/kg of the decoction, respectively [$F_{(5, 24)} = 16.70$; $P<0.001$].

In contrast, *Sclerocarya birrea* decoction significantly increased the exploration frequencies of the new object B (Figure 4B) from 1.8 ± 0.64 for the negative control group to 6.8 ± 1.44; 9.8 ± 1.36 and 11.2 ± 1.44 corresponding to 102.5; 205 and 410 mg/kg of the decoction, respectively [$F_{(5, 24)} = 22.84$; $P<0.001$]. It appears from this figure a significant reduction of the exploration frequencies in familiar object A (Figure 4B) ranging from 11.4 ± 12.58 for the negative control group to 6.6 ± 0.88; 4.2 ± 1.82 and 1.6 ± 0.48 corresponding to 102.5; 205 and 410 mg/kg of the decoction, respectively [$F_{(5, 24)} = 24.08$; $P<0.001$].

Figure 4 Effects of *Sclerocarya birrea* root bark aqueous extracts on the latency time to discover object A and B, Time spent with objects A and B, Number of visits to objects A and B and Percentage of the Recognition Index in the object recognition on an open field

Sclerocarya birrea decoction also significantly increased the exploration time of object B (Figure 4C) from 4.8 ± 1.36 sec for the negative control group to 28.2 ± 1.04; 28.6 ± 1.52 and 25.4 ± 0.88 sec corresponding to 102.5; 205 and 410 mg/kg of the decoction, respectively [$F_{(5, 24)} = 183.2$; $P<0.001$]. Similarly, the plant extract decoction increased the

exploration time of object A (Figure 4C) from 8.4 ± 1.28 sec for the negative control group to 12.8 ± 1.44 sec for the 102.5 mg/kg dose of the decoction [F (5, 24) = 21.62; P<0.001]. The different doses of *Sclerocarya birrea* decoction significantly increased the recognition index of the new object B (Figure 4D), ranging from 17.68 ± 1.77 in negative control group mice to 70.3 ± 5.36 and 66.96 ± 4.72 in those treated with 205.

(A) Latency time to discover object A and B. (B) Number of visits to objects A and B. (C) Time spent with objects A and B. (D) Percentage of the Recognition Index of the novel object. Each bar represents the mean ± SEM; n = 5, * p ≤ 0.05, ** p ≤ 0.01, *** p ≤ 0.001, significant difference from the negative control that received monosodium glutamate. ED = distilled water (normal control), CN = negative control (treated only with monosodium glutamate at 4 mg/kg) and VIT C = vitamin C at 100 mg/kg (positive control), S. birea = *Sclerocarya birrea*.

3.4. Effects of *Sclerocarya birrea* root bark aqueous extracts on super oxide dismutase and catalase activities, and in reduced glutathione and malondialdehyde levels in the brain of monosodium glutamate treated mice

As present in table 2, exposure of animals to MSG for 15 days significantly increased the concentration of MDA and significantly reduced the amount of CAT, GR and SOD in the negative control group compared to the normal control. However, *Sclerocarya birrea* decoction significantly antagonized the oxidative damage induced by MSG by reducing the levels of MDA and increasing the concentration of CAT, GR, SOD compared to negative control and normal respectively [F (5, 24) = 755.8; P<0.001] ; [F (5, 24) = 7.921; P<0.001] ; [F (5, 24) = 105.8; P<0.001] and [F (5, 24) = 4.667; P<0.004].

Table 2 Effects of *Sclerocarya birrea* root bark aqueous extracts on super oxide dismutase and catalase activities, and in reduced glutathione and malondialdehyde levels in the brain of monosodium glutamate treated mice

treatment15 days	MDA	CAT	GR	SOD
ED	4.95 ± 0.027***	13.55 ± 0.50**	0.06 ± 0.00***	4.48 ± 0.15
ED + MSG	10.62 ± 0.14	10.73 ± 0.37	0.03 ± 0.00	4.07 ± 0.48
102.5 + MSG	8.56 ± 0.10a***	13.80 ± 0.42**	0.05 ± 0.00a***	5.15 ± 0.34**
205 + MSG	9.81 ± 0.15a***	11.83 ± 0.57	0.06 ± 0.00***	4.76 ± 0.36
410 + MSG	10.75 ± 0.17a	11.39 ± 0.37c	0.03 ± 0.00a	4.86 ± 0.20
VIT C + MSG	5.12 ± 0.19a***	13.92 ± 1.39**	0.07± 0.00c***	5.16 ± 0.08**

Each value represents the mean ± SEM; n = 5. ** p ≤ 0.01, *** p ≤ 0.001, significant difference from CN. cp ≤ 0.05, bp ≤ 0.01, ap ≤ 0.001 significant difference from normal control (ED), ED = distilled water (normal control), CN = negative control (monosodium glutamate), VIT C = vitamin C (100 mg/kg), MSG = monosodium glutamate, MDA = malondialdehyde, CAT = catalase, GR = glutathione reductase, and SOD = superoxide dismutase.

4. Discussion

The mnemonic and neuroprotective effect of *Sclerocarya birrea* root bark decoction was determined in this study. From the analysis, it was found that the decoction of *Sclerocarya birrea* root barks has a percentage of inhibition of 89.46 ± 0.02 and the IC50 value is about 5.51 mg/mL, significantly lower than those of vitamin C with the percentage of inhibition of 95.78 ± 0.00 and the IC50 is about 6.52 mg/mL. This indicates that *Sclerocarya birrea* decoction has a very high antiradical activity compared to vitamin C with a very low IC50 value suggesting the massive presence of phenolic compounds in the decoction. These results are similar to those obtained by Koto-te-Nyiwa [31] who stated that the antioxidant power of plant extracts is related to the presence of phenolic compounds. Similarly, *Sclerocarya birrea* decoction significantly decreased the latency of choosing the preferred arm and the number of return to the starting arm indicate the increase in cognitive performance [32], the number of return to the starting arm suggests the exploration and protection of memory [33]. Varying the number and time spent in the preferred and discriminated arm elicits improved memory as well as increased exploration [34]. We observed a decrease in latency to find object B compared to object A during the object recognition test. The number and duration of exploration of object B is higher than that of object A, indicating the natural tendency of rodents to explore a novel object more compared to a familiar object [35]. Recognition of the novel object was significantly higher in mice given the decoction and vitamin C compared to those in the CN group. These results show that the decoction of *Sclerocarya birrea* root barks has memetic and neuroprotective effects that involve short-term memory processes, verifying the recognition of the new object compared to the familiar object [36]. These results corroborate those of Chemero and Heyser who had shown that ethanol increases exploration of the new object relative to the familiar object [37].

Glutamate is the most important excitatory neurotransmitter in the mammalian brain. However, deregulation of glutamatergic neurotransmission leads to neurodegeneration, neurotoxicity and oxidative stress damage in the brain [3].

The determination of oxidative stress markers in this study shows that MSG significantly increases the concentration of MDA, and reduces the activity of CAT, GR and SOD in the brain of mice, suggesting an increase in oxidative stress. Oxidative stress is caused by the accumulation of reactive oxygen species in cells or their incomplete degradation. Thus, the prolonged treatment of animals with MSG generates the massive destruction of neuronal cells by the accumulation of reactive oxygen species, leading to memory loss [38]. On the other hand, administration of *Sclerocarya birrea* root bark decoction inhibits the action of MSG, significantly increases the concentration of GR, SOD, CAT activity and decreases the concentration of MDA resulting in a significant reduction of oxidative stress and thus an increase in learning capacity and memory. Furthermore, the reduction of stress improves the proper functioning of memory [33]. Hence we can affirm that the decoction of *Sclerocarya birrea* root bark inhibits the effects of oxidative stress while boosting learning and memory capacities.

5. Conclusion

In sum, the present work allowed us to find that the decoction of *Sclerocarya birrea* root barks has the inhibitory power on MSG. These results show that the decoction of *Sclerocarya birrea* root barks has antioxidant and neuroprotective properties, justifying its use in traditional medicine in the treatment of neurodegenerative diseases such as Alzheimer's, Parkinson's and memory disorders. For a better understanding of the neuroprotective effects of S. birrea, it would be wise to consider further studies that could identify and characterize its active ingredients and their mechanism of action.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

Statement of ethical approval

The protocols were performed in concordance with the International Guide for the Care and Use of Laboratory Animal (National Institute of Health; publication No. 85-23, revised 1996) and the Cameroon National Ethical Committee, Yaoundé (No. FW-IRB00001954)

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