Evaluation of the Lipid Profile of *Plasmodium berghei* rats treated with aqueous Bark Extract of *Cassia spectabilis*

Abstract

The aim of this work was to evaluate the lipid profile of *Plasmodium berghei* rats treated with aqueous extract of *Cassia spectabilis*. Twenty five (25) adult male wistar rats were divided into five (5) groups of five (5) rats per group. Group I was the normal control fed only rat chow and water, Group II was infected with the parasite without treatment with aqueous extract of *Cassia spectabilis*. Groups III and IV were infected with *Plasmodium berghei* and afterwards treated with 200 mg/kg and 400 mg/kg of aqueous extract of *Cassia spectabilis* respectively, while Group V was infected and treated with a standard drug (chloroquine). Treatment lasted for 7 days after which animals were sacrificed and blood sample collected. Evaluation of lipid profile was performed by standard procedures. *Plasmodium berghei* infection significantly ($P<0.05$) increased Total Cholesterol (TC), Triacylglyceride (TG) and Low Density Lipoprotein (LDL) but significantly ($P<0.05$) decreased High Density Lipoprotein (HDL) an observation which was reversed with the aqueous extract of *Cassia spectabilis* in a dose dependent manner. In conclusion, extract of the said plant wields the potential to recover a stable lipid profile in *Plasmodium berghei* infected rats.

Keywords: *Plasmodium berghei*, Cassia spectabilis, Lipid, Chloroquine, Lipoprotein

Introduction

P. berghei is one of the plasmodium genus and intraerythrocytic protozoa that cause malaria a known debilitating ailment endemic in the tropics [1]. Its impact on the population is of public health significance globally [2]. An estimated 229 million malaria cases were reported worldwide in 87 endemic countries in 2019 [3].

Movement of lipids in and out of body tissues in form of lipoprotein results to energy generation. The plasma is predominantly made up of low-density lipoproteins (LDL), high-density lipoproteins (HDL), chylomicrons, very-low-density lipoproteins (VLDL) all of which are notable examples of lipoprotein synthesized in the liver which under ideal physiological conditions ensures homeostasis of lipid and lipoprotein metabolism which can be distorted following hepatic damage resulting from severe and acute *Plasmodium* malaria infection leading to changes in plasma lipid and lipoprotein patterns [4] which in turn translates to endothelial functional abnormality, a predisposing factor for atherosclerosis such as coronary artery disease, peripheral vascular diseases and cerebrovascular disease [5].

Aside the conventional adverse side effects, decreased pharmacological efficacy resulting from drug resistance and product adulteration, synthetic drugs used in the treatment of malaria are expensive and often times beyond the reach of the poor who are more susceptible to plasmodium infection.

C. spectabilis commonly called Golden cassia is a legume and a member of the Fabaceae family [6]. The leaves are ever green, flower showy and yellow and the bark gray and smooth [7].

The plant is a source of medicinal products which are used as laxative, purgative and traditionally in the treatment of flu and cold [8]. Extracts from different parts of the plant wield antioxidant property [6]. Although its anti-plasmodia activity had been established, effect on the lipid profile of plasmodium infected rats is yet unknown, hence the imperativeness of this study is consolidated.

Materials and Methods

Collection of Plant Material

Fresh bark of *C. spectabilis* obtained locally from Ikare Akoko Ondo State, Nigeria was identified and authenticated at the herbarium unit of the Department of Biological Science, Faculty of Life Science, Ahmadu Bello University, Zaria.

Extraction of Plant Material

Freshly harvested bark of *C. spectabilis* was thoroughly washed with tap water, after which it was chopped into small pieces before being air dried for 6 days. The dried bark was ground into fine powder. 500 g of the powder plant sample was extracted thrice with distilled water under

reflux at 60°C for 3 h. Subsequently, the extract was filtered using Whatman no. 1 filter paper and then concentrated to dryness with the aid of rotary evaporator.

Animals

Albino rats were obtained from the Animal House of the Department of Biochemistry, Federal poly Nasarawa, Nasarawa state. Animals were housed in transparent plastic cages at room temperature were allowed access to food (standard pellet diet) and water *ad-libitum.*

Plasmodium berghei

The artesunate-sensitive strain of the rodent parasite *P. berghei* NK-65 was obtained and used for the study. The strain was maintained in the laboratory for the period of the study by in vivo serial blood passage from mouse to mouse. A set of mice parasitized with *P. berghei* NK-65 was anaesthetized after 6 days having shown clinical symptoms of malaria and confirmed microscopically (>2 × 10^7 *P. berghei* parasitized erythrocytes). Samples of blood were collected by cardiac puncture using a sterile needle and syringe. The samples was diluted in normal saline (1 ml of blood in 10 ml of normal saline), and 0.2 ml of blood containing 1×10^7 *P. berghei* infected erythrocytes was used to infect each of the experimental mice intraperitoneally.

Experimental Design

Twenty five adult albino rats were evenly grouped according to their body weight into 6 groups of five rats. The passaged animals were sacrificed and their blood was collected into a blood bag containtaing anticoagulant. 0.2 ml of the blood was then injected intraperitoneally into the infects animals.

Animal Grouping

Group I: Animals were not infected with *P. berghei*

Group II: Animals were infected *P. berghei* without treatment

Group III: Animals were infected with *P. berghei* were treated with 200 mg/kg body weight of aqueous extract of *C. spectabilis.*

Group IV: The animals in this group were infected with the parasite, *P. berghei* and treated with 400 mg/kg body weight of the extract of *C. spectabilis*

Group V: The animals in this group were infected with the parasite, *P. berghei* and were treated with chloroquine (250 mg/kg body weight)

Lipid Profile Assays

Total cholesterol (TC), triacylglycerol (TG) and high-density lipoprotein cholesterol (HDL-C) were determined using commercial kits (Randox Laboratory Ltd., UK). LDL-C concentration was determined by difference according to the formula described by Friedewald *et al.* (1972) Very low-density lipoprotein cholesterol (VLDL-C) concentrations was estimated using the methods of Burnstein and Sammaille(1960) where the value in mg/dl is based on the assumption that in fasting subjects, the VLDL-C to total plasma TG ratio is relatively fixed at 1:5 [9].

Statistical Analysis

Data were analyzed using SPSS version 20. Analysis of Variance (ANOVA) and Duncan's multiple range tests were used to compare the mean differences among treatments. $P<0.05$ was considered significant.

Results and Discussion

Table 1: Lipid Profile of *P. berghei* infected rats treated with Aqueous Extract of *C. spectabilis*

Groups	TC (mg/dl)	TG (mg/dl)	HDL(mg/dl)	LDL (mg/dl)
Group I	203.33±2.17^{a}	63.33± 3.67^{a}	63.33±8.82^{b}	127.34±1.02^{a}
Group II	270.00±2.46^{c}	100.00±1.15^{c}	43.33±3.33^{a}	206.67±2.82^{c}
Group III	226.67±3.55^{b}	77.00±1.80^{ab}	70.33±15.60^{c}	140.94±1.99^{b}
Group IV	226.67±2.17^{b}	73.33±2.03^{b}	74.33±14.33 ^{cd}	139.67±3.44^{b}

Group V	200.00±2.00[a]	60.00±1.55[a]	60.00±5.77[b]	128.00±1.92[a]

Values are expressed as mean ± standard deviation of three determinations. Values with different superscript in a row are significantly($P<0.05$) different

Serum lipid changes have been observed during malaria infection and can also be relied upon as a potential adjuvant diagnostic tool for malaria [10]. Table 1 shows the lipid profile of *P. berghei* infected rats treated with aqueous extract of *C. spectabilis*. The total cholesterol (TC) level of infected; untreated rats was significantly ($P<0.05$) high (270.00±2.46 mg/dl). However, administration of 200 mg/kg and 400 mg/kg of aqueous extract of *C. spectabilis* bark significantly ($P<0.05$) reduced it to (226.67±3.55 mg/dl) and (226.67±2.17 mg/dl). Similarly, the triacylglyceride (TG) level of the untreated; infected rats was significantly ($P<0.05$) high

(100.00±1.15 mg/dl), this was significantly (P<0.05) reduced to (77.00±1.80 mg/dl) and (73.33±2.03 mg/dl) with 200 mg/kg and 400 mg/kg of aqueous extract of *C. spectabilis* respectively. High Density Lipoprotein was significantly (P<0.05) low in infected; untreated rats. A contrary observation was made on the infected; treated rats of groups III and IV which manifested marked elevation of (77.00±1.80 mg/dl) and (73.33±2.30 mg/dl) of HDL with 200 mg/kg and 400 mg/kg of aqueous extract of *C. spectabilis* respectively. On the other hand, the Low Density Lipoprotein (LDL) of the infected; untreated rats was significantly (P<0.05) high (206.67±2.82 mg/dl), while a reverse observation was made on their infected; treated counterpart which showed a significantly (P<0.05) lower levels of LDL (140.94±1.99 mg/dl) and (139.67±3.44 mg/dl) with 200 mg/kg and 400 mg/kg of aqueous extract of *C. spectabilis* respectively. The alterations in the lipid profiles of infected rats could be attributed to the fact that malaria parasite utilizes cholesterol and phospholipid from its host for the increase in surface area and volume of its internal membrane [11]. This is consistent with the work of Lambrecht et al. [12] who reported a transient lipid profile changes in six returning travelers with malaria caused by *p. vivax*.

Conclusion

The outcome of this research work indicates that the aqueous bark extract of *C. sepctabilis* wield the potential to restore a distorted lipid profile resulting from *P. berghei* owing to its ability to eliminate the said organism. However, it is recommended that a bioassay guided isolation and characterization of the active ingredient responsible for the aforementioned activity is performed on the extract.

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