

Article

EFFECT OF ORIJIN BITTERS, AQUEOUS EXTRACTS OF *HIBISCUS SABDARIFFA* AND *ZINGIBER OFFICINALE ROSCOE* ON THE KIDNEY OF ADULT WISTAR RATS

SARAH I. DAVID 

Department of Anatomy, Faculty of Basic Medical Sciences, College of Medicine and Allied Health Sciences, Bingham University, Karu, Nasarawa State

GODFREY DURU 

Department of Anatomy, Faculty of Basic Medical Sciences, College of Medicine and Allied Health Sciences, Bingham University, Karu, Nasarawa State

ABIGAIL ABRAHAM 

Department of Anatomy, Faculty of Basic Medical Sciences, College of Medicine and Allied Health Sciences, Bingham University, Karu, Nasarawa State

SAMUEL VICTOR ITA 

Department of Anatomy, Faculty of Basic Medical Sciences, College of Medicine and Allied Health Sciences, Bingham University, Karu, Nasarawa State

Corresponding Author: Sarah Ifudiya David E-mail: sarah.david@binghamuni.edu.ng

Received: 18/09/2024
Accepted: 20/11/2024

ABSTRACT

Orijin bitters, *Hibiscus sabdariffa* and *Zingiber officinale roscoe* have been reported to possess various medicinal properties. The aim of the study is to evaluate their effects on the kidney of adult wistar rats. Methodology: thirty rats were randomly divided into 6 groups, each having 5 rats. Group 1 received distilled water, group 2, 70cl/70kg/bw orijin bitters, group 3, orijin bitters and 200mg/kg/bw *Hibiscus sabdariffa* calyx aqueous extract, group 4, orijin bitters and 500mg/kg/bw *Hibiscus sabdariffa* calyx aqueous extract, group 5, orijin

bitters and 200mg/kg/bw *officinale* rhizome aqueous extract, group 6, orijin bitters and 500mg/kg/bw *Zingiber officinale* rhizome aqueous extract over a 21-day period. After administration, the rats were sacrificed and the kidney harvested for biochemical and histological analysis. Results: Orijin bitters altered renal function, indicated by elevated level of malondialdehyde and decreased level of superoxide dismutase, catalase and glutathione, along with histopathological changes such as glomerular atrophy and tubular degeneration compared to the control. The result was not statistically significant ($P < 0.05$). Conversely, aqueous extracts of *Hibiscus sabdariffa* calyx and *Zingiber officinale* rhizome exhibited antioxidant properties, reducing oxidative stress and mitigating renal damage compared to the orijin bitters group only. Although the result was not statistically significant ($P < 0.05$). Conclusion: Orijin bitters may have nephrotoxic effects, while *Hibiscus sabdariffa* and *Zingiber officinale* may offer protective benefits, due to their antioxidant properties.

Keywords: Orijin bitters, *Hibiscus sabdariffa*, *Zingiber officinale* Roscoe, Antioxidant and Histology

1. INTRODUCTION

The kidneys are bean like shaped organs, having a medial concavity, a lateral convexity, and situated retroperitoneal on the posterior abdominal wall (Soriano *et al.*, 2023). The kidney functions in the removal of metabolic waste from the blood and regulation of water and electrolyte balance in the body (Adjene *et al.*, 2013). The kidney's integrity and cellular membrane function can be impaired, when there is excessive production of reactive oxygen species (Agarwal *et al.*, 2008; Chukwuebuka *et al.*, 2020).

Diseases of the central nervous system, liver, kidney, lipid metabolism and cardiovascular are some adverse effects related alcohol consumption (Ruffle, 2014). Orijin bitters is a type of alcoholic bitters. Alcoholic bitters are traditionally prepared alcoholic flavoured drinks with botanical herb infusion that is characterized by a bitter, sour, or bittersweet flavour (Johnson *et al.*, 2021). In many developing countries including Nigeria many local populaces depend solely on herbal-based alcoholic beverages as a source of medication (Odey *et al.*, 2019). Their chronic consumption of locally produced alcoholic beverages pose a potential downstream physiologically and biochemically because, while deriving pleasure and recreation there is no consideration of the potential harmful effects of chronic intake of these beverages (Odey *et al.*, 2019). Alcoholic bitters are considered as a multipurpose medicine and their usage is without consideration of their effects on organs e.g. the kidneys (Waribo *et al.*, 2021). Kidney impairment is linked to the intake of alcoholic bitters as an important contributory factor with many people, young people especially using herbal remedies for the treatment of a wide range of diseases because of the claims of their efficacies by the manufacturers (Nwachuku & Elekima, 2018; Lee *et al.*, 2021; Yuan *et al.*, 2021). Some of these alcoholic beverages, fortified with diverse kinds of herbs and plant products are alomo bitters, action bitters, orijin bitters, 1960 bitters and local gin with claims suggesting their nutritional and medical importance as they are assumed to ameliorate several ailments like waist pain, menstrual cramps, cardiovascular disorders, digestive difficulties, malaria and males infertility linked to production of spermatocytes, and causes blood purification by the kidneys, regulate blood pressure through arterial dilatation, prevent kidney stones formation, cleanse the colon of impurities and possess antitumor, antiinflammatory, antibiotic and antifungal properties (Hoffmann, 2000; Mcdonald, 2014; Odey *et al.*, 2019; Johnson *et al.*, 2021). Some content of these bitters include orange peel, quinine and cassia (Ould *et al.*, 2017).

Roselle (*Hibiscus sabdariffa*) of the Malvaceae family is a medicinal plant used in Ayurveda, Siddha and Unani systems of medicine (Danapur *et al.*, 2009). *H. sabdariffa* dried or fresh, the calyces, seeds and leaves of are either eaten raw, as herbal medicines, beverages and fermented drinks (Da-Costa-Rocha *et al.*, 2014). The traditional usage of *H. sabdariffa* includes for diuretic, choleric, febrifugal, antihypertensive purpose, treatment of cardiac and nerve diseases, respiratory and genital problems, external wounds and abscesses, kidney and liver disorders and high blood pressure (Leung & Foster, 1996; Wilson *et al.*, 1996; Neuwinger *et al.*, 2002; Pegu *et al.*, 2021). Roselle calyx, seeds and leaves depending on the variety and geographical area, are rich in minerals, amino acids, organic acids, carotene, vitamin C and total sugar as well as in bioactive compounds such as anthocyanin and other flavonoids, organic acid, polysaccharides, triterpenoids, steroids and alkaloids. (Muller & Franz, 1992; Pegu *et al.*, 2021). These compounds are responsible for its antioxidant, antibacterial, anti-inflammatory, hepatoprotective and anticholesterol activities (Formagio *et al.*, 2015; Islam, 2019; Da-Costa-Rocha *et al.*, 2014). The calyces contain flavonoids such as gossypetine, hibiscetine and sabdaretine, a high amount of iron and are rich in organic acids (citric acid, malic acid, tartaric acid and hibiscus protocatechuic acid) (Khafaga *et al.*, 1980; Tseng *et al.*, 1996; Margesi *et al.*, 2013)

Ginger (*Zingiber officinale* Roscoe) belongs to the Zingiberaceae family (White, 2007). The rhizome is widely used as a spice in Chinese and ayurvedic medicine for centuries (Grzanna *et al.*, 2005) and herbal component in traditional medicine because it has been found to possess bioactive compounds such as phenolic compounds, flavonoid compounds, and essential oils which are responsible for pharmacological activities as well as other compounds such as polysaccharides, amino acids, organic acids, and minerals (Motawi *et al.*, 2011; Yeh *et al.*, 2014; Prasad & Tyagi, 2015; Liu *et al.*, 2019; Styawan *et al.*, 2022). The major phenolic compound in the ginger rhizome, gingerol, consists of shogaol, paradol, zingerol, gingerones, and gingerdiones (Ali *et al.*, 2008; Srinivasan, 2017; Arablou & Aryaeian, 2018; Styawan *et al.*, 2022). The biological activities of ginger provide health advantages such as antioxidant, antiinflammation, antibacterial, antiviral, antifungal, antihyperlipidemic, antiobesity, and hepatoprotective activities marking it suitable for food and beverages (Ali *et al.*, 2008; Srinivasan, 2017; Arablou & Aryaeian, 2018; Pourmasoumi *et al.*, 2018; Hasani *et al.*, 2019; Mahboubi, 2019; Mao *et al.*, 2019; Hajimoosayi *et al.*, 2020; Styawan *et al.*, 2022). The antioxidant properties of medicinal herbs are dependent on many factors during planting and harvesting, its environmental conditions, weather, seasonal changes, geographical area, degree of ripe and growth (Škrovánková *et al.*, 2012). Traditionally, ginger is employed in treatment to help digestion, treat colic, diarrhea, nausea, bleeding disorders, rheumatism, baldness, toothache, snakebite, and respiratory conditions (Bhatt *et al.*, 2013; Sharifi-Rad *et al.*, 2017).

The aim of the study is to evaluate the effect of orijin bitters, aqueous extracts of *Hibiscus sabdariffa* calyx and *Zingiber officinale* roscoe rhizome on the kidney of adult male wistar rats.

2. MATERIALS AND METHODS

Plant Procurement and Extraction

Roselle (*Hibiscus sabdariffa*) calyces and Ginger (*Zingiber officinale* Roscoe) rhizome were purchased from a local market, in Masaka, Nasarawa State, Nigeria. Extraction were carried out at the Chemistry Department, Bingham University, Karu, Nasarawa state, Nigeria. Aqueous extracts of Roselle (*Hibiscus sabdariffa*) calyces and Ginger (*Zingiber officinale* Roscoe) rhizome were obtained by the maceration procedure. The process of maceration softens and break the plants so as to release its phytochemicals. Roselle (*Hibiscus sabdariffa*) calyces and Ginger (*Zingiber officinale* Roscoe) rhizome were washed and air

dried to remove debris. After which they were soaked in distilled water for three (3) days stirring 3 times at an interval of 6 hours. After 3 days, the extracts were filtered using a sieve, the filtrate was dehydrated in an oven and stored under room temperature.

Ethical clearance

All protocols and treatment procedures were in accordance to the Animal Care and Use Committee guidelines (National Institute of health, 2011) and as approved by the Faculty of Basic Medical Sciences Ethics Review Committee Bingham University, Karu, Nasarawa State, Nigeria. The approval number is BHUAUC/2024/012.

Experimental design

Thirty (30) adult male wistar rats (80-170g) was obtained from the animal house of the Faculty of Basic Medical Sciences, Bingham University, Karu, Nasarawa State. They were housed in well ventilated cages at room temperature in a hygienic condition under 12 hours' daylight cycle. They were maintained on a regular common rat feed and water *ad libitum*. After two (2) weeks of acclimatization, they were randomly chosen and grouped into six (6), five (5) rats in each. The experiment lasted for 21 days. The animals were fasted overnight and sacrificed after exposure to chloroform. The kidneys were excised and were fixed in 10% formalin and phosphate buffer for histological and biochemical analysis respectively. Table 1 shows the experimental design.

Table 1: Grouping and administration dosage

Groups	Treatment and daily dose
I (Control)	70cl/75kg/bw Distilled water
II	70cl/75kg/bw Orijin bitters
III	70cl/75kg/bw Orijin bitters + 200mg/kg/bw aqueous extract of (<i>Hibiscus sabdariffa</i>) calyces
IV	70cl/75kg/bw Orijin bitters + 500mg/kg/bw aqueous extract of (<i>Hibiscus sabdariffa</i>) calyces
V	70cl/75kg/bw Orijin bitters + 200mg/kg/bw aqueous extract of (<i>Zingiber officinale roscoe</i>) rhizome
VI	70cl/75kg/bw Orijin bitters + 500mg/kg/bw aqueous extract of (<i>Zingiber officinale roscoe</i>) rhizome

The administration was done orally via gavage and once daily. The administration of Orijin bitters was adopted from Johnson *et al.*, 2021.

Biochemical analysis

Animals were sacrificed and the kidneys were harvested into an organ bottle with phosphate buffer. The tissues were homogenized and centrifuged at 3000 rpm for 10 min. The supernatant obtained was utilized for the estimation of the activities of malondialdehyde (MDA), catalase (CAT), superoxide dismutase (SOD) and glutathione (GSH). Nwoguzze *et al.* (2021) method was adopted.

Histological Analysis

Histological examination of the kidneys was conducted following specific procedures. The dissected kidney portions were first placed in 10% formalin within organ bottles to prevent tissue autolysis. Subsequently, the tissues were dehydrated using an automated tissue processor, progressing through 70% graded alcohol for initial dehydration and 90% alcohol for complete dehydration. They were then cleared in xylene, impregnated with paraffin wax and embedded. Thin sections, approximately five microns thick, were prepared using a rotatory microtome and mounted onto albumenized slides, left to dry on a hot plate. The slides were then dewaxed sequentially using xylene, absolute alcohol,

70% alcohol and 50% alcohol, followed by a water rinse. Finally, the sections were stained using Hematoxylin and Eosin and Periodic Acid Schiff techniques. After which the slides were observed under a microscope at 400x magnification. (Obasi & Ogugua, 2020).

Statistical Analysis

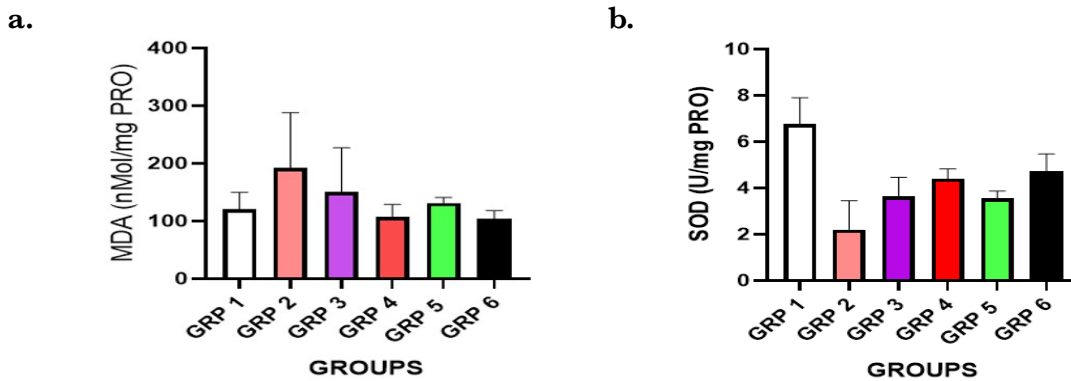
The data obtained were expressed as mean \pm standard error of the mean (SEM). One-way analysis of variance (ANOVA) was used to compare the result using SPSS (Statistical Package for the Social Sciences) and followed by Tukey post-hoc test using Graph pad prism. $P < 0.05$ was considered statistically significant.

3. RESULTS

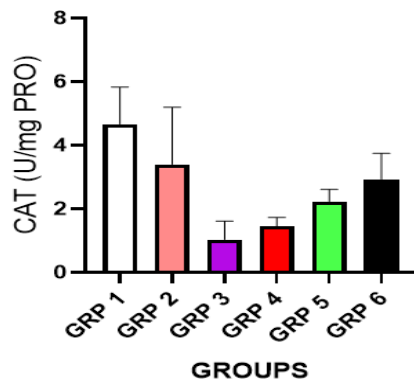
Biochemical Analysis

Following the administration of orijin bitters, aqueous extracts of *Hibiscus sabdariffa* and *Zingiber officinale roscoe*, the activities of antioxidant enzymes, malondialdehyde (MDA), catalase (CAT), superoxide dismutase (SOD) and glutathione (GSH) of the kidney of adult Wistar rats were investigated (Figure 1). MDA activity was highest in group II, followed by III and V (Fig. 1a). There was increase in SOD activity in group IV and VI higher than group II but lower than group I (Fig. 1b). CAT was highest in group I, followed by group II and VI (Fig. 1c). GSH activity was highest in group 1, followed by group 6 (Fig. 1d). All the results showed no statistical significance ($P < 0.05$).

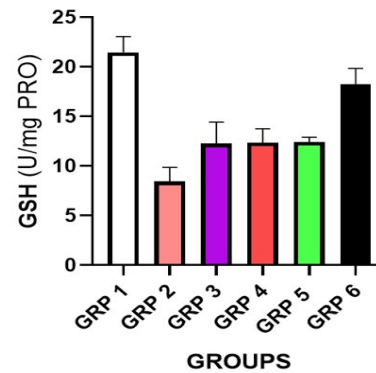
Figure 1: Biochemical activities of Malondialdehyde (MDA), Superoxide Dismutase (SOD), Catalase (CAT) and Glutathione (GSH) after administration of orijin bitters, aqueous extracts of *Hibiscus sabdariffa* and *Zingiber officinale roscoe* on the kidney of adult wistar rats



c.



d.



GRP 1 = control (distilled water), GRP 2 = 70cl/75kg/bw orijin bitters, GRP 3 = 70cl/75kg/bw orijin bitters and 200mg/kg/bw aqueous extract of *Hibiscus sabdariffa* calyces, GRP4 = 70cl/75kg/bw orijin bitters and 500mg/kg/bw aqueous extract of *Hibiscus sabdariffa* calyces, GRP 5 = 70cl/75kg/bw and 200mg/kg/bw aqueous extract of *Zingiber officinale roscoe* rhizome, GRP 6 = 70cl/75kg/bw origin bitters and 500mg/kg/bw aqueous extract of *Zingiber officinale roscoe* rhizome. Result was presented in Mean \pm SEM. $P < 0.05$ was considered statistically significant.

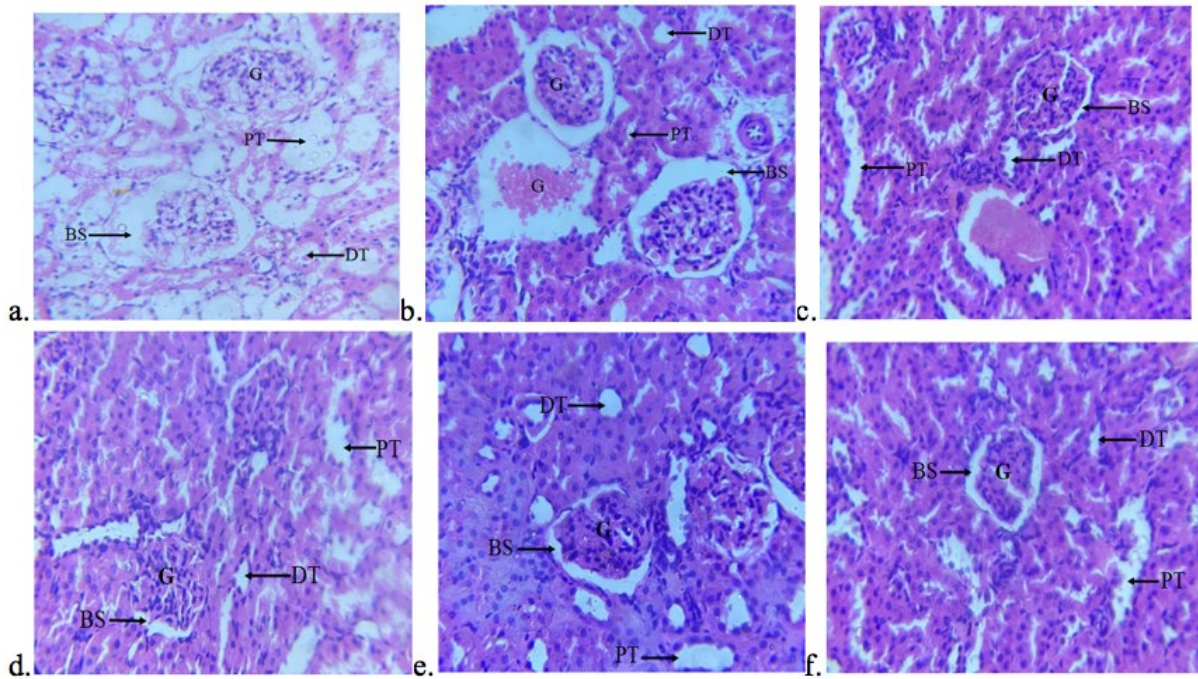
Histological Analysis

The histological analysis of the kidney was observed after staining with Haematoxylin and Eosin (H & E) and Periodic Acid Schiff (PAS) stains. Photomicrograph are presented in (Fig. 2 and 3).

Haematoxylin and Eosin (H & E) stain

Histological profile of rat kidneys for group I which received distilled water showed normal histoarchitecture (Fig. 2a). Photomicrograph for group II (Fig. 2b) which were administered 70cl/75kg/bw Orijin bitters only, showed glomerular atrophy. Group III and IV, administered and 200mg/kg/bw and 500mg/kg/bw aqueous extract aqueous extract of *Hibiscus sabdariffa* calyces together with 70cl/75kg/bw Orijin bitters, showed glomerular atrophy, narrowing of the bowman's space, alteration in the histoarchitecture of the proximal tubule and distal tubule (Fig. 2c and 2d respectively). The glomerulus appeared shrunken in group IV (Fig. 2d). The photomicrograph for group V (Fig. 2e) and VI (Fig. 2f), which received 200mg/kg/bw aqueous extract of *Zingiber officinale roscoe* rhizome and 500mg/kg/bw aqueous extract of *Zingiber officinale roscoe* rhizome together with 70cl/75kg/bw Orijin bitters respectively, showed restoration of the histoarchitecture compared to groups II, III and IV.

Figure 2: Photomicrographs of Haematoxylin and Eosin (H & E) stain after administration of orijin bitters, aqueous extracts of *Hibiscus sabdariffa* and *Zingiber officinale* roscoe on the kidney of adult wistar rats.



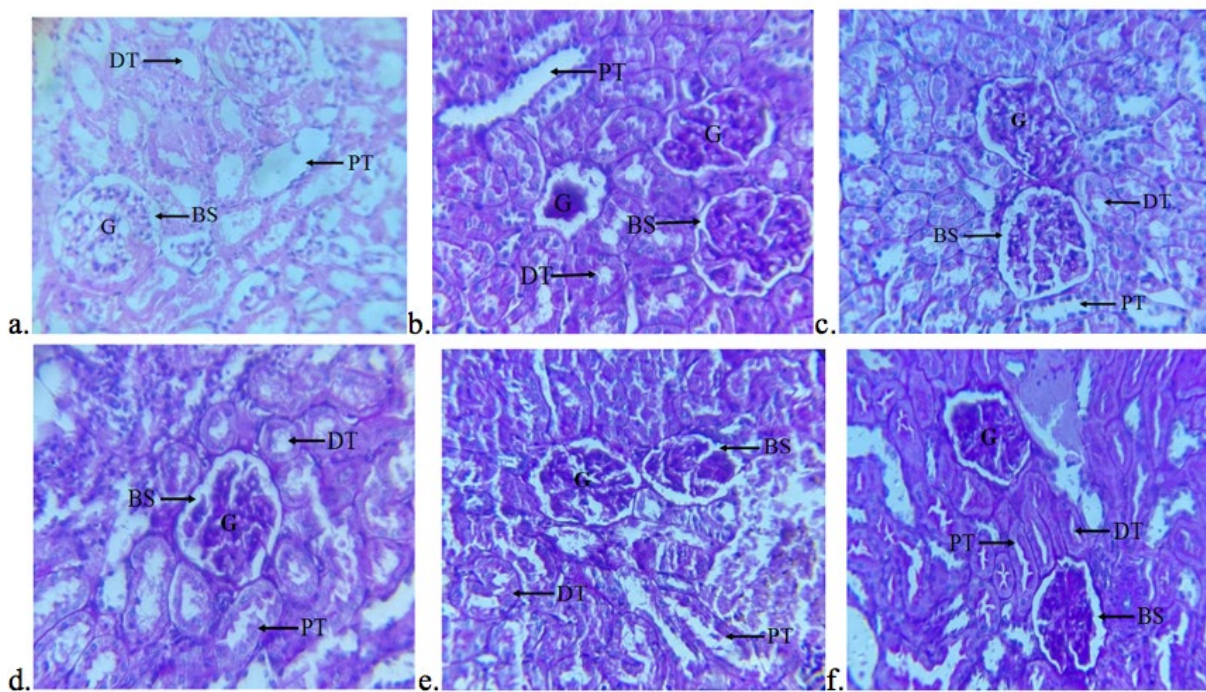
(a) Control group showed normal bowman's capsule with glomerulus, bowman space, proximal tubule and distal tubule. (b) rat kidney administered 70cl/75kg/bw orijin bitters only showed presence of glomerular atrophy. (c) rat kidney administered 70cl/75kg/bw orijin bitters and 200mg/kg/bw aqueous extract of *Hibiscus sabdariffa* calyces showed presence of glomerular atrophy, narrowing of the bowman's space, alteration in the histoarchitecture of the proximal tubule and distal tubule. (d) rat kidney administered 70cl/75kg/bw orijin bitters and 500mg/kg/bw aqueous extract of *Hibiscus sabdariffa* calyces showed presence of alteration in the histoarchitecture, glomerulus appeared shrunken. (e) and (f) rat kidney administered and 200mg/kg/bw and 500mg/kg/bw aqueous extract of *Zingiber officinale roscoe* rhizome together with 70cl/75kg/bw orijin bitters respectively showed restoration of the histoarchitecture compared to groups (a), (c) and (d). Proximal tubule, BS= Bowman capsule, DT = Distal tubule (H&E, x400).

Periodic Acid Schiff (PAS) stain

The histological profile of rat kidney for group I, which was administered distilled water showed negative PAS intensity in the bowman's capsule, proximal and distal tubules (Fig. 3a). Glycogen deposition on the kidney tissue was absent. Group II, which was administered 70cl/75kg/bw orijin bitters showed a high PAS intensity in the capsular membrane of the bowman's capsule and the basement membrane of the proximal and distal tubules with increased glycogen deposition on the kidney tissue (Fig. 2b) which indicates tissue damage. Group III, which was administered 70cl/75kg/bw orijin bitters and 200mg/kg/bw aqueous extract of *Hibiscus sabdariffa* calyces showed a faint PAS intensity in the glomerulus and reduction in glycogen deposition on the kidney tissue (Fig. 3c) indicating tissue regeneration. Group IV, which was administered 70cl/75kg/bw orijin bitters and 500mg/kg/bw aqueous extract of *Hibiscus sabdariffa* calyces exhibited a slight reduction in PAS intensity in the

capsular membrane of the bowman's capsule with the glomerulus and in the basement membrane of the proximal and distal tubules (Fig. 3d) when compared to group II (Fig. 3b). Slightly reduced glycogen deposits on the kidney tissue was also observed, indicating tissue regeneration. Group V, which was administered 70cl/75kg/bw orijin bitters and 200mg/kg/bw aqueous extract of *Zingiber officinale roscoe* rhizome showed alterations in the bowman's capsule, renal tubules and exhibited a high PAS intensity in the capsular membrane of the bowman's capsule (Fig. 3e). There was increased glycogen deposition on the kidney tissue which indicating tissue damage. Group 6, which was administered 70cl/75kg/bw orijin bitters and 500mg/kg/bw aqueous extract of *Zingiber officinale roscoe* rhizome exhibited a slight reduction in PAS intensity in the capsular membrane of the bowman's capsule with the glomerulus (Fig. 3f). There was reduced glycogen deposits on the kidney tissue indicating tissue regeneration.

Figure 3: Photomicrographs of **Periodic Acid Schiff (PAS) stain** after administration of orijin bitters, aqueous extracts of *Hibiscus sabdariffa* and *Zingiber officinale roscoe* on the kidney of adult wistar rats



(a) Control group kidney administered distilled water showed negative PAS intensity in the bowman's capsule and in the proximal and distal tubules indicating absence of glycogen deposits on the kidney tissue. (b) rat kidney administered 70cl/75kg/bw orijin bitters showed high PAS intensity in the capsular membrane of the bowman's capsule and the basement membrane of the proximal and distal tubules indicating increased glycogen deposits on the kidney tissue which indicate tissue damage. (c) rat kidney administered 70cl/75kg/bw orijin bitters and 200mg/kg/bw aqueous extract of *Hibiscus sabdariffa* calyces showed faint PAS intensity in the glomerulus indicating reduction in glycogen deposits on the kidney tissue which indicate tissue regeneration. (d) rat kidney administered 70cl/75kg/bw orijin bitters and 500mg/kg/bw aqueous extract of *Hibiscus sabdariffa* calyces showed slight reduction in PAS intensity in the capsular membrane of the bowman's capsule with the glomerulus and in the basement membrane of the proximal and distal tubules when compared to (b)

indicating slightly reduced glycogen deposits on the kidney tissue which indicate tissue regeneration. (e) rat kidney administered 70cl/75kg/bw orijin bitters and 200mg/kg/bw aqueous extract of *Zingiber officinale roscoe* rhizome showed alteration in the bowman's capsule, renal tubules and a high PAS intensity in the capsular membrane of the bowman's capsule indicating increased glycogen deposits on the kidney tissue which indicate tissue damage. (f) rat kidney administered 70cl/75kg/bw orijin bitters and 500mg/kg/bw aqueous extract of *Zingiber officinale roscoe* rhizome showed slight reduction in PAS intensity in the capsular membrane of the bowman's capsule containing and the glomerulus indicating reduced glycogen deposits on the kidney tissue indicate tissue regeneration. G= Glomerulus, BS= Bowman's space, DT= Distal tubule, PT= Proximal tubule (PAS x400).

4. DISCUSSION

The present study was carried out to evaluate the effect of Orijin bitters, aqueous extracts of *Hibiscus sabdariffa* and *Zingiber officinale roscoe* on the kidneys of adult wistar rats. Numerous natural products such as fruits, vegetables, cereal grains, edible flowers, medicinal plants, and herbal infusions have been identified to possess antioxidant potential, ginger (*Zingiber officinale roscoe*) rhizome and roselle (*Hibiscus sabdariffa*) calyces inclusive (Darekar *et al.*, 2023). Natural antioxidants from plants hold great promise than synthetic antioxidants more so, they are less expensive alternatives (Anwar *et al.*, 2018).

The onset of many chronic illnesses have been associated to the overproduction of reactive oxygen species (ROS) (Darekar *et al.*, 2023) leading to oxidative stress. Oxidative stress is an imbalance occurring in an organism between free radicals produced and the levels of antioxidative systems such that the imbalance favours oxidative radicals (Sarandol *et al.*, 2007). Oxidative stress is linked to increased cellular damage (Ishii *et al.*, 2014; Nwoguzie *et al.*, 2021). The antioxidant activity of a compound is its protective property to inhibit oxidative mechanisms by scavenging and neutralizing reactive oxygen and free radicals in humans, rodents and other species (Tremellen, 2008; Pegu *et al.*, 2021). Many studies have found that ginger has a high level of antioxidant activity (Ji *et al.*, 2017). Ginger's antioxidant activity is mainly linked with its polyphenolic contents, which play a role in eliminating free radicals (Lobo *et al.*, 2010; Indiarito *et al.*, 2019; Darekar *et al.*, 2023). The calyces of *H. sabdariffa* have been studied repeatedly whether *in vitro* and *in vivo* and have been shown to have positive health effects as well as contain potent antioxidants such as polyphenolic acid, flavonoids and anthocyanins (Da-Costa-Rocha *et al.*, 2014; Pegu *et al.*, 2021). Because the phenolic contents are soluble in polar solvents; the use of water is important in the extraction of anthocyanin (Khoo *et al.*, 2017). Hence the use of aqueous extract of both (*Zingiber officinale roscoe*) rhizome and roselle (*Hibiscus sabdariffa*) calyces for the study.

This study evaluated the effects of orijin bitters, aqueous extracts of *Hibiscus sabdariffa* and *Zingiber officinale roscoe* on malondialdehyde (MDA), superoxide dismutase (SOD), catalase (CAT) and glutathione (GSH) levels. There was increase in MDA level and decrease in SOD, CAT and GSH by orijin bitters compared to the control suggesting the potential of this alcohol bitter to result in kidney damage. Elevation of MDA levels suggests enhanced lipid peroxidation, leading to tissue damage and failure of antioxidant defense mechanism to prevent excessive free radicals (Himakar *et al.*, 2010). Uncontrolled lipid peroxidation causes disruption of membrane, lipids and cellular organelles damage and oxidative stress (Mahboob *et al.*, 2005; Rao *et al.*, 2011). The increase in kidney MDA level may be as a result of the alcohol content and possibly that the herbal content may not be sufficient to ameliorate its insult. Alcohol is known to result in tissue damage (Befrits *et al.*, 1995; Shanmugam *et al.*, 2020). Decreased GSH level in the kidney tissue is linked to lower peroxidase activity, alteration of kidney membrane integrity and hepatotoxicity (Nwoguzie *et al.*, 2021).

The treatment group of both low and high doses of the aqueous extracts of ginger (*Zingiber officinale roscoe*) rhizome and roselle (*Hibiscus sabdariffa*) calyces showed positive response for MDA, SOD and GSH when compared to orijin bitters alone. Although the result was not statistically significant, this suggests the potency of both plants ability to reduce the activity of reactive oxygen species induced by orijin bitters due to their antioxidant properties (Ji *et al.*, 2017; Indiarito *et al.*, 2021; Darekar *et al.*, 2023). *H. sabdariffa* extracts have been shown to possess antioxidant activity on lipid peroxidation with the calyces having higher effect than the leaf (Ochani & D'Mello, 2009; Suhaili & Manshoor, 2022). According to Geng *et al.*, 2012, ginger extract therapeutic effect is shown in the increase in DNA repair, increase in antioxidants level, reduction of lipid peroxidase, and decrease in DNA damage in a bid to maintain the immune system of the body. Also, ginger improvement of renal function and structure by reducing lipid accumulation in kidney tissues has been shown by Xu *et al.* (2018) and Ramudu *et al.* (2011). SOD is an important antioxidant that protects the cell against oxidative damages by scavenging superoxide anion from hydrogen peroxide leading to the reduction in the toxic effects and maintaining integrity of cell membranes (Brock, 2007; Khan *et al.*, 2012; Bhatt *et al.*, 2013). Shanmugam *et al.* (2020) reported increased levels of SOD and GSH that is linked to the presence of bioactive compounds in ginger when albino rats were administered ethanolic extract of ginger alone or together with alcohol supporting the idea that ginger is protective against kidney tissue damage induced by orijin bitters. Catalase is a key component of the antioxidant defense system whose protective mechanism inhibition, enhances the sensitivity to free radical induced cellular damage by breaking down potentially harmful hydrogen peroxide in the cells to glutathione peroxidase (Young *et al.*, 2001; Bhatt *et al.*, 2013).

Histological analysis showed normal histoarchitecture for the control group for both haematoxylin and eosin (H&E), and periodic acid schiff stain (PAS). There was distortion in the histoarchitecture and high PAS intensity following the administration of orijin bitters indicating tissue damage. Alcohol treated rats induced damage to the glomeruli and renal tubules while ginger restored the damage (Shanmugam *et al.*, 2020). Oforibika & Uzor, (2020) reported minimal negative side effects on kidney of albino rats administered some herbal bitters (confam, G. winco and 1960 roots) when used at moderate dose concentrations between 10 and 21 days. The result of this study for orijin bitters however showed no corroboration. Although, low and high doses of aqueous extract of *Hibiscus Sabdariffa* calyces together with orijin bitters showed damage to the tissue for H&E, the reduced intensity of PAS stain for both groups compared to orijin bitters alone indicated tissue regeneration. Low and high dose of aqueous extract of *Zingiber officinale roscoe* rhizome together with orijin bitters resulted in tissue regeneration especially in the high dose. Studies have shown the beneficial effects of ginger on the histomorphology of the kidney with improvement in repairs of kidney damage and restoration of membrane integrity in renal tissue and structural derangement (Rehman *et al.*, 2019), cell apoptosis (Hajhosieni *et al.* 2014), and bleeding in the cortical area of the kidney (Khaki *et al.*, 2010).

5. CONCLUSION

The study concludes that Orijin bitters may have a toxic effect on the kidney as observed in the decrease of antioxidant enzymes and damage to the histoarchitecture of the kidney. Aqueous extracts of *Hibiscus sabdariffa* and *Zingiber officinale roscoe* possess the ability to eliminate the effect of Orijin bitters due to the phytochemicals and antioxidants that are found in them.

ACKNOWLEDGEMENTS

Special thanks goes to the Department of Anatomy, Bingham University, Karu, Nasarawa state for the opportunity to use its facilities.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

- Adjene, J. O., Awhin, P. E. & Avbunudiogba, J. A. (2013) Morphological effects of chronic consumption of zobo drinks on the kidney of adult wistar rats. *Nigerian Journal of Science and Environment*, 12(2): 1-7.
- Agarwal, A., Gupta, S., Sekhon, L. & Shah, R. (2008) Redox considerations in female reproductive function and assisted reproduction: From molecular mechanisms to health implications. *Antioxid. Redox Signal.* 10, 1375–1403
- Ali, B. H., Blunden, G., Tanira, M. O. & Nemmar, A. (2008) Some phytochemical, pharmacological and toxicological properties of ginger (*Zingiber officinale* Roscoe): A review of recent research. *Food and Chemical Toxicology*, 46(2): 409-420. <https://doi.org/10.1016/j.fct.2007.09.085>
- Anwar, H., Hussain, G. & Mustafa, I. (2018). Antioxidants from natural sources. In: Shalaby, E. & Azzam, G. M. eds. *Antioxidants in Foods and its Applications*. London, UK: IntechOpen. doi: 10.5772/intechopen.75961.
- Arablou, T. & Aryaician, N. (2018) The effect of ginger (*Zingiber Officinale*) as an ancient medicinal plant on improving blood lipids. *Journal of Herbal Medicine*, 12: 11–15. <https://doi.org/10.1016/j.hermed.2017.09.005>
- Befrits, R., Hedman, M., Blomquist, L., Allander, T., Grillner, L., Kinnman, N., Rubio, C. & Hultcrantz, R. (1995) Chronic hepatitis C in alcoholic patients: Prevalence, genotypes and correlation to liver disease. *Scand J Gastroenterol*, 30: 1113
- Bhatt, N., Waly, M. I., Essa, M. M. & Ali, A. (2013) Ginger: a functional herb. <https://www.researchgate.net/publication/257416254>
- Brock C. (2007) Herb Monograph. www.westernherbalcare.co.uk
- Chukwuebuka, N. B. et al. (2020) Stress-induced morphological changes of ovarian histology in female Wistar rats. *Biomed. Pharmacol. J.* 13(4), 1625–1643
- Da-Costa-Rocha, I., Bonnlaender, B., Sievers, H., Pischel, I. & Heinrich, M. (2014) Hibiscus sabdariffa L. – A phytochemical and pharmacological review. *Food Chemistry*, 165: 424-443.
- Danapur, V., Sringswara, A. N. & Venu Gopal, R.B. (2009) Pharmacognostic Studies on Hibiscus Sabdariffa - A Potential Anti-Obesity Drug. *International Journal of Applied Research on Medicinal Plants*, 2:111
- Darekar, S. U., Nagrale, S. N., Babar, B. V. & Pondkule, A. (2023) Review on ginger: Chemical constituents and biological effects. *Journal of Pharmacognosy and Phytochemistry*, 12(6): 267-271 DOI: <https://doi.org/10.22271/phyto.2023.v12.i6c.14792>

- Formagio, A. S. N., Ramos, D. D., Vieira, M. C., Ramalho, S. R., Silva, M. M. et al., (2015) Phenolic compounds of *Hibiscus sabdariffa* and influence of organic residues on its antioxidant and antitumoral properties. *Braz. J. Biol.*, 75(1): 69-76.
- Geng, Y., Du, X., Cao, X., Chen, Y., Zhang, H. & Liu, H. (2012) The therapeutic effects of *Zingiber officinale* extract on mice irradiated by ^{60}Co γ -ray. *Journal of Medicinal Plants Research*, 6(13): 2590-2600. <https://doi.org/10.5897/JMPR11.767>
- Grzanna, R., Lindmark, L. & Frondoza, C. G. (2005) Ginger—an herbal medicinal product with broad anti-inflammatory actions. *J Med Food*, 8(2):125–32.
- Hajhosieni, L., Rostami, F. F. & Khaki, A. (2014) Bioflavonoids Effects of Ginger on Glomerular Podocyte Apoptosis in Streptozotocin-Induced Diabetic Rat. *Crescent J Med Biol Sci.*, 1(2): 42–5.
- Hajimoosayi, F., Sadatmahalleh, S. J., Kazemnejad, A. & Pirjani, R. (2020) Effect of ginger on the blood glucose level of women with gestational diabetes mellitus (GDM) with impaired glucose tolerance test (GTT): A randomized doubleblind placebo-controlled trial. *BMC Complementary Medicine Therapy*, 20(1): 116–122. <https://doi.org/10.1186/s12906-020-02908-5>
- Hasani, H., Arab, A., Hadi, A., Pourmasoumi, M., Ghavami, A. & Miraghajani, M. (2019) Does ginger supplementation lower blood pressure? A systematic review and meta-analysis of clinical trials. *Phytotherapy Research*, 33(6): 1639–1647. <https://doi.org/10.1002/ptr.6362>
- Himakar, Y., Babu, V. V., Ramalingeswara Rao, S. D. V. S., Padmavathi, P., Madhu Sudhana Chetty, C., & Gopi, M. (2010) Protective effect of *Trianthema portulacastrum* L. on gentamicin-induced nephrotoxicity and oxidative damage in rats. *Food and Chemical Toxicology*, 48(1): 61-66.
- Hoffmann D. (2000) *Healthy Digestion: A Natural Approach to Relieving Indigestion, Gas, Heartburn, Constipation, Colitis & More.* Storey Publishing. ISBN: 9781612128290.
- Indiarto, R., Pranoto, Y., Santoso, U. & Supriyanto. (2019) In vitro antioxidant activity and profile of polyphenol compounds extracts and their fractions on cacao beans. *Pakistan Journal of Biological Sciences*, 22(1): 34–44. <https://doi.org/10.3923/pjbs.2019.34.44>
- Indiarto, R., Subroto, E., Angeline & Selly (2021) Ginger rhizomes (*Zingiber officinale*) functionality in food and health perspective: a review. *Food Research*, 5(1): 497-505
- Ishii, T. et al. (2014) Genetically induced oxidative stress in mice causes thrombocytosis, splenomegaly and placental angiodysplasia that leads to recurrent abortion. *Redox Biol.* 2: 679–685
- Islam, M. M. (2019) Food and Medicinal Values of Roselle (*Hibiscus sabdariffa* L.) Plant Parts: A Review. *Open J Nutr Food Sci.*, 1(1): 1003.
- Ji, K., Fang, L., Zhao, H., Li, Q., Shi, Y., Xu, C., et al. (2017) Ginger oleoresin alleviated gamma-ray irradiation-induced reactive oxygen species via the Nrf2 protective response in human mesenchymal stem cells. *Oxid Med Cell Longev*, 1480294. DOI: 10.1155/2017/1480294.
- Johnson, J. T., Okafor, E. O. & Ifeakor, O. D. (2021) Effects of various alcoholic bitters on the haematological parameters of albino wistar rats. *Asian Journal of Biomedical and Pharmaceutical Sciences*, 11(80): 1-5. ISSN 2249-622X
- Khafaga, E. R., Koch, H., Afry, M. M. F. E. & Prinz, D. (1980) Stage of maturity and quality of karkadeh (*Hibiscus sabdariffa* L. var. *sabdariffa*). 1. organicacids. 2. anthocyanins. 3. mucilage, pectin and carbohydrates. 4. improved drying and harvesting systems. *Angewandte Botanik*, 54 (5/6): 287-318.

- Khaki, A., Khaki, A., Ahmadi-Ashtiani, H., Rastegar, H., Rezazadeh, S., Babazadeh, D., Zahedi, A. & Ghanbari, Z. (2010) Treatment effects of ginger rhizome & extract of carrot seed on diabetic nephropathy in rat. *J Med Plants*, 9(33): 75–80.
- Khan, M. A., Ashfaq, M., Khan, M. T. H. & Qamar, A. Y. (2012) Antioxidant enzymes and their role in human diseases. In *Oxidative Stress and Chronic Degenerative Diseases - A Role for Antioxidants*. 83-106.
- Khoo, H. E., Azlan, A., Tang, S. T. & Lim, S. M. (2017) Anthocyanidins and anthocyanins: coloured pigments as food, pharmaceutical ingredients, and the potential health benefits. *Food Nutr Res.*, 61(1): 1361779. doi: 10.1080/16546628.2017.1361779.
- Lee, Y. J., Cho, S., & Kim, S. R. (2021) Effect of alcohol consumption on kidney function: population-based cohort study. *Science Report*, 11(1): 2381-2382.
- Leung, A. Y. & Foster, S. (1996) *Encyclopedia of common natural ingredients used in food, drugs, and cosmetics*. 2 ed. New York, John Wiley and Sons.
- Liu, Y., Liu, J. & Zhang, Y. (2019) Research progress on chemical constituents of *Zingiber officinale* Roscoe. *Biomed Research International*, 5: 5370823. <https://doi.org/10.1155/2019/5370823>
- Lobo, V., Patil, A., Phatak, A. & Chandra, N. (2010) Free radicals, antioxidants and functional foods: Impact on human health. *Pharmacognosy Reviews*, 4(8): 118–126. <https://doi.org/10.4103/0973-7847.70902>
- Mahboob, M., Shireen, K. F., & Atkinson, A. (2001) Lipid peroxidation and antioxidant enzyme activity in different organs of mice exposed to low level of mercury. *Journal of Environmental Science and Health, Part A*, 36(4): 687–697
- Mahboubi, M. (2019) *Zingiber officinale* Rosc. essential oil, a review on its composition and bioactivity. *Clinical Phytoscience*, 5(1): 1-12. <https://doi.org/10.1186/s40816-018-0097-4>
- Mao, Q., Xu, X. Y., Cao, S. Y., Gan, R. Y., Corke, H. & Li, H. B. (2019) Bioactive compounds and bioactivities of ginger (*Zingiber officinale* Roscoe). *Foods*, 8(6): 1–21. <https://doi.org/10.3390/foods8060185>
- Margesi, S., Kagashe, G. & Dhokia, D. (2013) Determination of iron contents in *Hibiscus sabdariffa* calyces and *Kigelia Africana* fruit. *Scholars Academic Journal of Biosciences (SAJB)*, 1(4): 108–111.
- Mcdonald J. (2014) *Blessed bitters*.; 141-154.
- Motawi, T. K., Hamed, M. A., Shabana, M. H., Hashem, R. M. & Aboul-Naser, A. F. (2011) *Zingiber officinale* acts as a nutraceutical agent against liver fibrosis. *Nutrition and Metabolism*, 8: 40–46. <https://doi.org/10.1186/1743-7075-8-40>
- Muller, B. M. & Franz, G. (1992) Chemical structure and biological activity of polysaccharides from *Hibiscus sabdariffa*. *PlantaMedica*, 58(1): 60-67.
- Neuwinger, H., Burnham, T., Wickersham, R. & Novak, K. (2002) *The review of natural products*. 3 ed. Facts and Comparisons. African traditional medicine.
- Nwachuku, E. O. & Elekima, I. (2018) Evaluation of the effect of action bitters (Herbal mixture) on some biochemical indices of albino rats. *Asian Journal of Research in Biochemistry*, 3(4):1-8.

- Nwogueze, B. C. et al. (2021) Changes in antioxidant enzymes activities and lipid peroxidase level in tissues of stress-induced rats. *Biomed. Pharmacol. J.* 14(2): 583–596
- Nwogueze, B. C., Ojieh, A. E., Aloamaka, C. P., Igweh, J. C. & Onyesom, I. (2021) Levels of glutathione-related antioxidants in some tissues of stressed Wistar rats. *Indian J. Physiol. Pharmacol.* 65: 167–176.
- Obasi, D. C. & Ogugua, V. N. (2020) Effect of Ruzu Herbal Bitters on the kidney Function and Hematological Parameters of Alloxan-Induced Diabetic Rats. *International Journal of Scientific & Engineering Research*, 11(5): 63 ISSN 2229-5518
- Ochani, P. C. & D'Mello, P. (2009) Antioxidant and antihyperlipidemic activity of *Hibiscus sabdariffa* Linn. leaves and calyces extracts in rats. *Indian J Exp Biol.*, 47(4): 276-82.
- Odey, M. O., Ibor, O. R., Ujong, U. P., Chukwuka, A. V. & Andem, A. B. (2019) Modulation of biochemical responses in rats following consumption of some herbalized Nigerian alcoholic drinks. *African Journal of Biomedical Research*, 22(3): 353-362.
- Oforibika, G. A. & Uzor, C. A. (2020) Study of the renal function of wistar albino rat treated with three different herbal bitters (Confam, G. Winco and 1960 Roots). *Direct Research Journal of Public Health and Environmental Technology*, 5(1): 1-5. DOI: <https://doi.org/10.26765/DRJPHET85417040>
- Ould, Y. K., Ibr, K., Bouhadi, D., Hariri, A., Meddah, B. & Tir, T. A. (2017) The use of orange (*Citrus sinensis*) peel as antimicrobial and antioxidant agent. *Journal of Fundamental and Applied Sciences*, 9(3): 1351-1357.
- Pegu, F., Arpita, P., Abhinab, C., Md. & Kamaruz Z. (2021) An updated review on phytochemistry and therapeutic uses of *Hibiscus sabdariffa* L. *Current Trends in Pharmaceutical Research*, 8(1). ISSN: 2319-4820, 2582-4783
- Pourmasoumi, M., Hadi, A., Rafie, N., Najafgholizadeh, A., Mohammadi, H. & Rouhani, M. H. (2018) The effect of ginger supplementation on lipid profile: A systematic review and meta-analysis of clinical trials. *Phytomedicine*, 43: 28–36. <https://doi.org/10.1016/j.phymed.2018.03.043>
- Prasad, S. & Tyagi, A. K. (2015) Ginger and its constituents: Role in prevention and treatment of gastrointestinal cancer. *Gastroenterol Research and Practice*, 9: 142979. <https://doi.org/10.1155/2015/142979>
- Ramudu, S. K., Mallikarjuna, K. & Kesireddy, S. R. (2011) Efficacy of ethanolic extract of ginger on kidney lipid metabolic profiles in diabetic rats. *Int J Diabetes Developing Ctries.*, 31(2): 97–103.
- Rao, A. V. & Purohit, R. (2011) Oxidative stress and antioxidants in the risk of hearing loss: Role of N-acetyltransferase 2 polymorphisms. *Free Radical Research*, 45(6): 681-689.
- Rehman, M. U., Rashid, S. M., Rasool, S., Shakeel, S., Ahmad, B., Ahmad, S. B., Madkhali, H., Ganaie, M. A., Majid, S. & Bhat, S. A. (2019) Zingerone (4-(4-hydroxy-3-methylphenyl) butan-2-one) ameliorates renal function via controlling oxidative burst and inflammation in experimental diabetic nephropathy. *Arch Physiol Biochem.*, 125(3): 201–209.
- Ruffle, J. K. (2014) Molecular neurobiology of addiction: what's all the (Δ) FosB about? *American Journal of Drug and Alcohol Abuse*, 40: 428-437.

- Sarandol, A. et al. (2007) Major depressive disorder is accompanied with oxidative stress: Short-term antidepressant treatment does not alter oxidative-antioxidative systems. *Human Psychopharmacol.* 22(2): 67–73
- Shanmugam, K. R., Ramakrishna, C. H., Mallikarjuna, K. & Sathyavelu, R. K. (2010) Protective effect of ginger against alcohol-induced renal damage and antioxidant enzymes in male albino rats. *Indian Journal of Experimental Biology*, 48: 143-149.
- Sharifi-Rad, M., Varoni, E. M., Salehi, B., Sharifi-Rad, J., Matthews, K. R., Ayatollahi, S. A., Kobarfard, F., Ibrahim, S. A., Mnayer, D., Zakaria, Z. A., Sharifi-Rad, M., Yousaf, Z., Iriti, M., Basile, A. & Rigano, D. (2017) Plants of the genus zingiber as a source of bioactive phytochemicals: From tradition to pharmacy. *Molecules*, 22(12): 1-20. <https://doi.org/10.3390/molecules22122145>
- Škrovánková, S., Mišurcová, L. & Machů, L. (2012) Antioxidant activity and protecting health effects of common medicinal plants. *Adv Food Nutr Res.*, 67:75–139.
- Soriano, R. M., Penfold, D., & Leslie, S. W. (2023) *Anatomy, Abdomen and Pelvis: Kidneys.*
- Srinivasan, K. (2017) Ginger rhizomes (*Zingiber officinale*): A spice with multiple health beneficial potentials. *PharmaNutrition*, 5(1): 18-28. <https://doi.org/10.1016/j.phanu.2017.01.001>
- Styawan, A. A., Susidarti, R. A., Purwanto, Windarsih, A., Rahmawati, N., Sholikhah, I. K. M. & Rohman, A. (2022) Review on ginger (*Zingiber officinale* Roscoe): phytochemical composition, biological activities and authentication analysis. *Food Research*, 6(4): 443 – 454
- Suhaili, M. N. I. & Manshoor, N. (2022). Ethnomedicine, phytochemistry, and bioactivities of *Hibiscus sabdariffa* L. (Malvaceae). *J HerbmedPharmacol.*, 11(4): 451-460. <http://www.herbmedpharmacol.com>
- Tremellen, K. (2008) Oxidative stress and male infertility: A clinical perspective. *Hum. Reprod. Update.* 114: 243–258
- Tseng, T. H., Wang, C. J., Kao, E. S. & Chu, H. Y. (1996) Hibiscus protocatechuic acid protects against oxidative damage induced by tert-butyl hydroperoxide in rat primary hepatocytes. *Chemico-Biological Interactions*, 101(2): 137-148.
- Waribo, H. A., Edamisan, E., Elekima, I. and Bartimaesus, E-A. S. (2021) Effect of oral consumption of action bitters on renal indices of apparently healthy subjects in Port Harcourt metropolis *Asian Journal of Biochemistry, Genetics and Molecular Biology*, 9(3): 14-19. ISSN: 2582-3698
- White, B. (2007) Ginger: an overview. *Am Family Phys.*, 75(11):1689–91.
- Wilson, F. D. & Menzel, M. Y. (1996) Kenaf (*Hibiscus cannabinus*), roselle (*Hibiscus sabdariffa*). *Economic Botany*, 18(1): 80-91
- Xu, Y., Bai, L., Chen, X., Li, Y., Qin, Y., Meng, X. & Zhang, Q. (2018) 6-Shogaol ameliorates diabetic nephropathy through anti-inflammatory, hyperlipidemic, antioxidative activity in db/db mice. *Biomed Pharmacother*, 97: 633–41.
- Yeh, H., Yu, Chuang, C. C., Chen, H., Wan, C. J. and Chen, T. L. (2014) Bioactive components analysis of two various gingers (*Zingiber officinale* Roscoe) and antioxidant effect of ginger extracts. *LWT - Food Science and Technology*, 55(1): 329–334. <https://doi.org/10.1016/j.lwt.2013.08.003>
- Young, I. S. & Woodside, J. V. (2001) Antioxidants in health and disease. *Journal of Clinical Pathology*, 54(3): 176-186.

Yuan, H. C., Yu, Q. T., Bai, H., Xu, H. Z., Gu, P. & Chen, L. Y. (2021) Alcohol intake and the risk of chronic kidney disease: Results from a systematic review and dose-response meta-analysis. *European journal of Clinical Nutrition*. DOI: 10.1038/s41430-021-00873-x

RESUMEN

Se ha informado que Orijin bitters, Hibiscus sabdariffa y Zingiber officinale Roscoe poseen varias propiedades medicinales. El objetivo del estudio es evaluar sus efectos sobre el riñón de ratas adultas Wistar. Metodología: Treinta ratas fueron divididas aleatoriamente en 6 grupos, cada uno con 5 ratas. El grupo 1 recibió agua destilada, el grupo 2, 70 cl/70 kg/pc de Orijin bitters, el grupo 3, Orijin bitters y 200 mg/kg/pc de extracto acuoso de cáliz de Hibiscus sabdariffa, el grupo 4, Orijin bitters y 500 mg/kg/pc de extracto acuoso de cáliz de Hibiscus sabdariffa, el grupo 5, Orijin bitters y 200 mg/kg/pc de extracto acuoso del rizoma de Zingiber officinale, el grupo 6, Orijin bitters y 500 mg/kg/pc de extracto acuoso del rizoma de Zingiber officinale durante un período de 21 días. Después de la administración, las ratas fueron sacrificadas y se extrajeron los riñones para análisis bioquímico e histológico. Resultados: Orijin bitters alteró la función renal, lo que se indica por un aumento en el nivel de malondialdehído y una disminución en el nivel de superóxido dismutasa, catalasa y glutatión, junto con cambios histopatológicos como atrofia glomerular y degeneración tubular en comparación con el grupo de control. El resultado no fue estadísticamente significativo ($P < 0.05$). Por el contrario, los extractos acuosos de cáliz de Hibiscus sabdariffa y rizoma de Zingiber officinale exhibieron propiedades antioxidantes, reduciendo el estrés oxidativo y mitigando el daño renal en comparación con el grupo que solo recibió Orijin bitters. Aunque el resultado no fue estadísticamente significativo ($P < 0.05$). Conclusión: Orijin bitters puede tener efectos nefrotóxicos, mientras que Hibiscus sabdariffa y Zingiber officinale pueden ofrecer beneficios protectores debido a sus propiedades antioxidantes.

Palabras clave: Orijin bitters, Hibiscus sabdariffa, Zingiber officinale Roscoe, Antioxidante e Histología.
