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BOOK OF ABSTRACTS

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BIOINFORMATICS AND MOLECULAR BIOTECHNOLOGY AND STRUCTURAL BIOLOGY

Molecular Investigation of Ameliorative Potentials of *Cymbopgon citratus* Leaves Extract in Carbon tetrachloride-induced Oxidative Stress and Hepatotoxicity

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ABSTRACT

Cymbopogon citratus (*C. citratus*) is a green leafy vegetable used in traditional practices for the treatment of various diseases, such as hepatotoxicity, inflammation, rheumatism. The aim of this study is to evaluate the hepatoprotective potential of aqueous extract of *C. citratus* on carbon tetrachloride (CCl_4)-induced hepatotoxicity in rats thus establishing the numerous medicinal relevance of the plant. Thirty Male Wister rats were randomly separated into six groups (n=5). Hepatotoxicity was induced by administration of CCl_4 (at 40 mg/kg). Group 1 served as control (distilled water). Group 2 served as the negative control (40 mg/kg of CCl_4 and distilled water). Group 3, 4 and 5 were administered 40 mg/kg of CCl_4 and treated with 100, 200 and 300 mg/kg *C. citratus* respectively twice daily. Group 6 was administered 40 mg/kg of CCl_4 treated with 100 mg/kg silymarin (the standard drug) twice daily for seven days. Animals were sacrificed by cervical dislocation and liver tissues were harvested for molecular studies. The mRNA expression of Heme oxygenase (HO-1), Cytochrome P_{450} (CYP2D3, CYP3AF), Janus Kinase 2 (JAK2), Caspase 3 and Heat Shock Protein 70 (HSP70) were determined in the liver tissues by RT-PCR. Significant down regulation ($p<0.05$) of the CYP2D3, CYP3AF, JAK2, Caspase 3, HSP 70 gene were observed in group treated with *C. citratus* when compared with the negative control, however HO-1 gene was also upregulated significantly ($p <0.05$) upon treatment with *C. citratus*. This study depicts that the aqueous extract of *C. citratus* has hepatoprotective effect on CCl_4-induced liver injury.

Keywords: Hepatotoxicity, *Cymbopogon citratus, gene expression, hepatotoxicity, rheumatism*

Structural elucidation, mechanism of action and time-kill kinetics of crude extracts of *Hibiscus sabdariffa* L. calyx on uropathogens

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ABSTRACT:

The structural elucidation of crude extracts of *Hibiscus sabdariffa* calyx, mechanisms of action and time-kill kinetics of *H. sabdariffa* calyx aqueous extract on uropathogens, Southwest Nigeria were evaluated. Extraction of *H. sabdariffa* calyx and sterilization of extracts were conducted as column chromatography was utilized for the purification of *H. sabdariffa* calyx extracts. Structural elucidation of crude extracts of *H. sabdariffa* calyx was conducted by Gas chromatography-mass spectrometry (GC-MS) and Fourier transform infrared (FT-IR) spectroscopy. The mechanism of action and time-kill kinetics antimicrobial assay of *H. sabdariffa* calyx aqueous extract on uropathogens were evaluated. GC-MS analysis of the cold water extract of *Hibiscus sabdariffa* showed eleven peaks which indicate the presence of eleven biochemical elements. Aqueous extract of *H. sabdariffa* calyx had the highest peak of 3379.29 cm^{-1} among other crude extracts. Leakage of sodium, potassium and protein revealed the highest leakage values (730 Cmol/kg, 638.5 Cmol/kg and 87.2 mg/ml) on *E. coli, S. saprophyticus* and *E. coli* while, the least leakage values (308.7 Cmol/kg, 33.33 Cmol/kg and 73.24 mg/ml) were observed on *C. albicans, E. coli* and *P. vulgaris* respectively. Time-kill kinetics revealed reduction in microbial population with respect to time of exposure. Findings demonstrated that *Hibiscus sabdariffa* calyx crude extracts could be used as natural alternative in treating urinary tract infections due to its numerous biochemicals, efficacious mechanism of action and increased periodic time-killing effects. Testing the efficacy and toxicity of structurally-elucidated bioactive chemical compounds in *H. sabdariffa* crude extracts in treating urinary tract infections *in-vivo* is recommended.

Keywords: *Hibiscus sabdariffa; structural elucidation; mechanism of action; time-kill kinetics; biochemicals; uropathogens*

Morin Hydrate Mitigates Diesel Exhaust Particles-Induced Oxidative Stress and Inflammation in Pancreas of Type-2-Diabetic Rats

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ABSTRACT

Diesel exhaust particles have been reported to cause detrimental effects on the pancreas of diabetic rats. The pharmacological study of morin hydrate has shown it anti-diabetic effect. However, the ameliorating effect of morin hydrate in the pancreas of type-2diabetic rats exposed to diesel exhaust particles is yet to be reported. Type-2-diabetics, the most common type of diabetics are more prone to the adverse effects of exposure to diesel exhaust particles than healthy individuals. The aim of this study is to examine the effect of morin hydrate on the effects of diesel exhaust particles in the pancreas of type-2-diabetic rats. Streptozotocin induced type-2-diabetic experimental rats were divided into twelve groups of negative control, DEP, T2D-DEP, diabetic control, and morin hydrate. The animals were treated for 9 weeks and the rats blood glucose levels were monitored every 72 hours. The mRNA expression of interleukin-1 beta (IL-1β), interleukin 10 (IL-10) and hemeoxygenase 1 (HO-1) were investigated in the excised pancreas using RT-PCR. Histological endpoints were measured in the excised pancreatic tissue. In diabetic rats exposed to DEP, significant ($p<0.0001$) down regulation of HO-1 and IL-10 genes, significant ($p<0.001$) up regulation of IL-1β, complete loss of pancreatic tissue to fibrosis and necrotic changes were observed. These effects were significantly mitigated by morin hydrate at 30 mg/kg. We conclude that DEP cause toxic effects on the pancreas of type-2-diabetic rats and that morin hydrate ameliorate these effects through it antioxidant and anti-inflammatory response.

Keywords: *Morin hydarte; Type-2-diabetes; oxidative stress; inflammation; pancreas*

Chrysophyllum Albidum Fruit Pulp Powder Upregulates the Expression of Insulin and Antioxidant Genes in Type 2 Diabetic Rats

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ABSTRACT

Diabetes mellitus (DM) is a metabolic disorder characterized by chronic hyperglycemia which results in the induction of glucose auto-oxidation, generation of free radicals and consequentially oxidative stress if endogenous antioxidant status is not improved. Oxidative stress occurs when free radicals' production overwhelms endogenous antioxidants and has been implicated in the pathogenesis of DM. *Chrysophyllum albidum* (African star apple) is a seasonal fruit found to be rich in natural antioxidants. This study investigated the effects of *C. albidum* fruit pulp powder (CAFPP) inclusion in rats' diet on genes regulating endogenous antioxidant enzymes and insulin in type 2-diabetic rats. DM was induced by dietary supplementation of experimental rats' diet with high fat for 14 days followed by intraperitoneal injection of streptozotocin (35 mg/kg). The experimental rats were then grouped into seven viz: non-diabetic control; diabetic control; metformin; diabetic and non-diabetic fed with 5 and 10% CAFPP-supplemented diet. The expression of Nrf2, SOD, CAT, GST and insulin were investigated using reverse transcriptase-polymerase chain reaction (RT-PCR). Schrödinger suites was used for docking of compounds isolated from *C. albidum* with insulin. The results showed that CAFPP significantly ($p< 0.05$) up-regulated the expression of insulin, Nrf2, CAT, GST and SOD genes in both diabetic state and non-diabetic state relative to non-diabetic control. Molecular docking of compounds previously characterized from CAFPP revealed that they are potent ligands of insulin receptor. The study suggests that CAFPP is effective in the management of diabetes mellitus- induced oxidative stress through the up-regulation of Nrf2 antioxidant pathway. It could also ensure glucose homeostasis by up-regulating the expression of Insulin.

Keywords: *Chrysophyllum albidum*; type 2 diabetes; gene expression; molecular docking; antioxidants, insulin

Citrus Flavonoid Hesperetin Upregulate the Expression of Heme Oxygenase-1 and Biliverdin Reductase Genes in STZ Induced Rats

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ABSTRACT

The effect of orally administered hesperetin on oxidative damage induced by streptozotocin (STZ)-in rats was investigated. Forty-eight Wistar rats were randomly assigned and given an injection of STZ (60 mg/kg) to induce diabetes or to remain un-induced (control). The experimental rats were divided into four groups and two groups (control and diabetic control) were separately administered normal saline, while the other two groups were treated with hesperetin (50 mg/kg) and metformin (100 mg/kg) daily for three weeks. Renal functions of each group were evaluated using biochemical assay. The expression of heme oxygenase 1 (HO-1), biliverdin reductase (BLVRD) genes and those linked with oxidative stress and inflammation was assessed in renal tissue by reverse transcriptase polymerase chain reaction (RT-PCR). Computational approach was used to determine the molecular interaction of hesperetin with heme oxygenase 1, biliverdin reductase enzymes. Renal functions were preserved by hesperetin with up-regulation of heme oxygenase 1, biliverdin reductase with down-regulation of transcription factor nuclear factor-kappaB (NF-κB), I-CAM and V-CAM when compared to diabetic control rats $p<0.05$. Hesperetin interacted well with BLVRD and HO-1 with binding affinity of -8.0 kcal/mol for HO-1 and -8.2 kcal/mol for BLVRD. Hesperetin exhibits renal-protective effects and reduce oxidative stress and inflammation in STZ diabetic rat model, which may be mediated by up-regulation of HO-1 and BLVRD and down-regulation of NF-κB expression.

Keywords: *Oxidative Stress, Diabetes, Inflammation, Genes, Molecular interaction*

Silibinin Ameliorates Oxidative, Inflammatory and Glucose Metabolic Effects in Liver of Type-2-Diabetic Rats Exposed to Air Particulate Matter

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ABSTRACT

Silibinin has anti-diabetic potential but it has not been reported to guide against elevated toxicity and inflammation in DEP exposed diabetic rats. Diabetes is a pathology that continues to be a universal plague threat with millions of individuals involved. The aim of this study is to examine the effect of silibinin on the regulation of genes associated with glucose metabolism, oxidative stress and inflammation in diabetic Wistar rats. Experimental rats induced with streptozotocin (45mg/kg) were divided into twelve (12) groups: negative control, DEP, T2D-DEP, diabetic control, silibinin treated groups (40mg/kg) for 7days. The rats' blood glucose was monitored at an interval of 3 days. The mRNA expression of phosphatidylinositol-3-kinase (PI3K), protein kinase B (AKT), adenosine monophosphate kinase (AMPK) and glucose transporter 4 (GLUT 4) interleukin-1 beta (IL-1β) and interleukin 6 (IL-6) heme oxygenase 1 (HO-1) were investigated in the liver excised using RT-PCR. Silibinin lowered the blood glucose through all diabetic treated groups. It significantly upregulated ($p<0.05$, $p<0.001$) the expression of PI3K, AKT, AMPK and GLUT 4 and significantly down regulate ($p<0.05$) the expression of genes associated with inflammation such as IL-1β and oxidant gene HO-1 at 40 mg/kg silibinin. The therapeutic potency of silibinin could be linked to its ability to down regulate pro-inflammatory genes and modulate genes associated with glucose metabolism leading to enhanced hepatic, function and improved insulin sensitivity.

Keywords: *Silibinin; Type-2-diabetes; gene expression; inflammation; liver; pancreas*

Co-administration of Metformin and Gallic Acid modulates JAK/STAT signaling pathway and Glutathione Metabolism in Fructose-fed Streptozotocin Diabetic Rats

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ABSTRACT

Incidence of diabetes Mellitus (DM) is on the rise with each passing year in spite of available therapies in the management of DM. Metformin, a standard antidiabetic drug, and gallic acid (GA) are some of the compounds with established antidiabetic properties. However, there is dearth of information on their combination in DM treatment. This study investigated the combined effect of metformin and GA on Diabetic Rats. Thirty-five male wistar rats were divided into 5 groups viz: diabetic control, normal control, Metformin (100 mg/kg), GA (100 mg/kg) and GA (100 mg/kg) + Metformin (100mg/kg). Diabetes was induced by administration of 10% fructose for 14 days followed by injection of streptozotocin (40 mg/kg). The pancreatic mRNA expression of antioxidant genes (glutamate cysteine ligase catalytic subunits (GCLC), glutamate cysteine ligase modifier subunits (GCLM) and GSS), inflammatory genes (tumour necrosis factor alpha (TNF-α), interleukin 1 beta (IL-1β), interleukin 6 (IL-6) and proteins of the Janus Kinase/ Signal Transducer and Activator of Transcription pathway (Janus Kinase (JAK), Signal Transducer and Activator of Transcription 5 (STAT5), were quantified using reverse-transcriptase polymerase chain reaction (RT-PCR). Metformin and GA were also docked with Insulin, Glutathione Synthetase (GSS), and Janus Kinase 2 (JAK 2) to determine their binding affinity. Rats treated with co-administration of GA and metformin significantly ($p< 0.05$) decreased fasting blood glucose level in comparison with groups treated with gallic acid and metformin alone. Gene expression study also showed the protective effect of co-administering metformin and gallic acid in pancreas of STZ-induced rats through improvement of glutathione synthesis (GCLC, GCLM, GGT), amelioration of inflammation (IL-1β, IL-6, IFN-ϒ) and modulation of JAK/STAT signaling pathway. This study showed that the combination therapy of metformin and GA modulated JAK/STAT pathway mediated by the cytokines, and replenished glutathione in the pancreas of diabetic rats.

Keywords: *Gallic acid, Metformin, inflammatory genes, diabetes mellitus, Janus Kinase, Signal Transducer and Activator of Transcription.*

Rutin Modulates the Expression of Pro-Inflammatory and Insulin Sensitive Genes In Streptozotocin-Induced Diabetic Rats

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ABSTRACT

Rutin is a citrus flavonoid (phytochemical) that has been reportedly used in the treatment of Diabetes Mellitus (DM) but little is known about its mechanism of action. DM is a metabolic disorder characterized by persistent hyperglycemia as result of insulin dysfunction. It is a killer disease and continues to be a global pandemic threat with millions of victims. The aim of this study is to investigate the effect of rutin on the expression of genes associated with glucose metabolism and inflammation in diabetic Wistar rats. Experimental rats induced with streptozotocin (60 mg/kg) were divided into six groups: normal control, diabetic control, metformin (standard drug) and rutin treated groups (25, 50 and 100 mg/kg) for 28 days. The rats' blood glucose and body weight were monitored at interval of 3 days. The mRNA expression of Takeda-G-protein-receptor-5 (TGR-5), glucacon likepeptide-1 receptor (GLP-1), Tumour necrotic factor α (TNF- α), Interleukin-1 beta (IL-1β) and Interleukin 6 (IL-6) were investigated in the liver and pancreas excised using RT-PCR. Rutin lowered the blood glucose across all treated groups. It significantly upregulated ($p<0.05$) the expression of TGR-5 (25 and 100 mg/kg), GLP-1 (25 and 100 mg/kg) and significantly downregulate ($p<0.05$) the expression of genes associated with inflammation such as TNF- α and IL-1β at 25 mg/kg. The antidiabetic effect of rutin could be linked to its potential to downregulate proinflammatory genes and modulate genes associated with glucose metabolism leading to enhanced pancreatic function and insulin release.

Keywords: *Rutin; Diabetes Mellitus; gene expression; inflammation; liver; pancreas*

Phyllantus niruri Protects Against Fe^{2+} And SNP Induced Oxidative Damage In Mitochondrial Enriched Fractions of Rats Brain

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ABSTRACT

The continuous generation of reactive oxygen species (ROS) and reduced endogenous antioxidants leads to oxidative stress and damage. This has been implicated in the pathogenesis of neurodegenerative disorders such as Alzheimer's disease and Parkinson's disease. The mitochondrion has been identified as a major source of ROS, and its dysfunction with time appears to contribute to neural decay and ageing. Excessive iron accumulation in cells has also been linked to over production of ROS. The therapeutic abilities of *Phyllantus niruri* have been reported but there is dearth of information concerning its hepato-protective ability. Cellular viability was assessed by MTT reduction, reactive oxygen species (ROS) generation was measured using the probe 2,7-dichlorofluoresce indiacetate (DCFH-DA). Glutathione content was measured using dithionitrobenzoic acid (DTNB). The potential neuroprotective effect of *P. nuriri* against Fe2+ and sodium nitroprusside (SNP) induced oxidative-stress in mitochondria of rats brain was evaluated. Fe^{2+} (10µM) and SNP (5µM) significantly decreased mitochondrial activity, assessed by MTT reduction assay, in a dose-dependent manner, this occurred in parallel with increased glutathione oxidation, ROS production and lipid peroxidation end-products (thiobarbituric acid reactive substances, TBARS). The co-incubation with methanolic extract of *P. nuriri* (10-200 µg/ml) reduced the disruption of mitochondrial activity, gluthathione oxidation, ROS production as well as the increase in TBARS levels caused by both Fe^{2+} and SNP in a dose dependent manner. HPLC analysis of the *P. nuriri* extract revealed the presence of gallic acid (20.54±0.01), caffeic acid (7.93±0.02), rutin (25.31±0.05), quercetin (31.28±0.03) and kaemferol (14.36±0.01). This result suggests that these phytochemicals account for the protective actions of *P. niruri* against Fe^{2+} and SNP-induced oxidative stress. It also showed that *P. nuriri* consist of important bioactive molecules that negates the deleterious effects of Fe^{2+}, an intrinsic producer of ROS, that leads to neuronal oxidative stress and neurodegeneration.

Solanum Anguivi Lam. Fruit with Bioactive Polyphenolic Compounds Exerts *in Vitro* Antioxidant Properties and Inhibits Ca^{2+} Induced Mitochondrial Swelling

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ABSTRACT

To evaluate the antioxidant and radical scavenging activities of *Solanum anguivi* fruit (SAG) and its possible effect on mitochondrial permeability transition pore as well as mitochondrial membrane potential (ΔΨm) isolated from rat liver. Antioxidant activity of SAG was assayed by using 2,2-diphenyl-1-picrylhydrazyl (DPPH), reducing power, iron chelating and ability to inhibit lipid peroxidation in both liver and mitochondrial swelling were determined. Identification and quantification of bioactive HPLC-DAD. SAG exhibited potent and concentration dependent free radical-scavenging activity (IC_{50}/DPPH=275.03±7.8 µg/mL). Reductive and iron chelation abilities also increase with increase in SAG concentration. SAG also inhibited peroxidation of cerebral and hepatic lipids subjected to iron oxidative assault. SAG protected against Ca^{2+} (110 µmol/L)-induced mitochondrial swelling and maintained the ΔΨm. HPLC analysis revealed the presence of gallic acid chlorogenic acid m. HPLC analysis revealed the presence of gallic acid [(17.54±0.04) mg/quercetin [(21.90±0.02 mg/g), caffeic acid (16.64±0.01 mg/g), rutin [(14.71±0.03) mg/g] and (7.39±0.05) mg/g]. These effects could be attributed to the bioactive polyphenolic compounds present in the extract. These results suggest that SAG extract is a potential source of natural antioxidants that may be used not only in pharmaceutical and food industries but also in the treatment of diseases associated with oxidative stress.

KEYWORDS *Solanum anguivi fruit, Antioxidant activity, Oxidative stress, Mitochondrial swelling, HPLC, Polyphenolic compounds, MPTP*

Scaffolds of 1, 2, 4, triazolo [1, 5-a] pyrimidin-7-amine as potential inhibitors of *Plasmodium falciparum* dihydroorotate dehydrogenase: Fragment-Based Drug Design, 2D-QSAR and DFT Calculation

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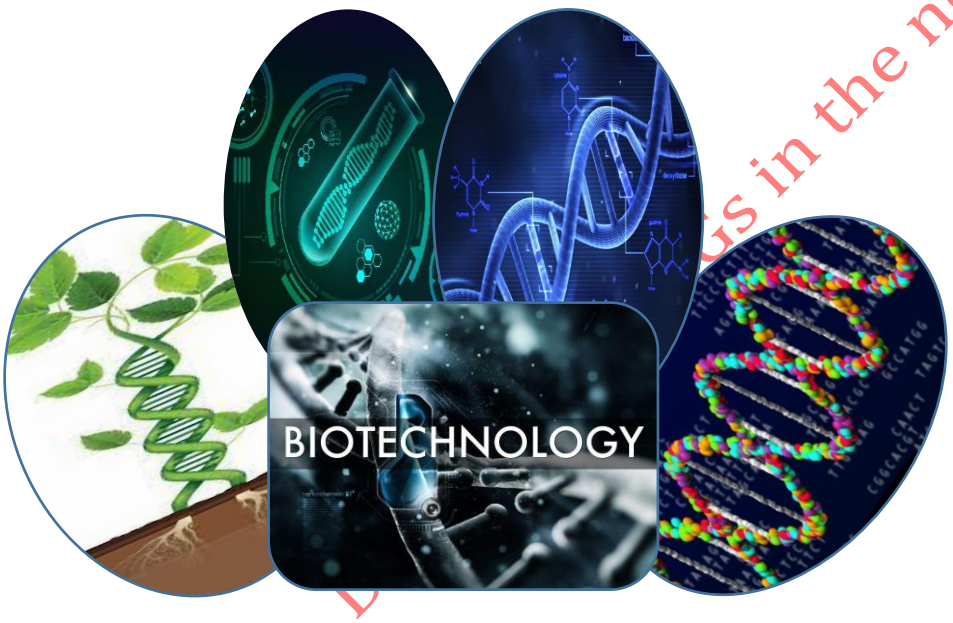
ABSTRACT

Plasmodium falciparum dihydroorotate dehydrogenase (*Pf*DODH) is one of the enzymes currently explored in the treatment of malaria due to increased drug resistance to the available antimalarial drugs. Although there is currently no approved drug targeting *Pf*DODH, many of the compounds in clinical trials had 1, 2, 4, triazolo [1, 5-a] pyrimidin-7-amine moieties as their backbone structure. This study sought to design new compounds from the fragments of known experimental inhibitors of *Pf*DODH. Nine experimental compounds retrieved from Drug Bank online were downloaded and broken into fragments using Schrodinger power shell; the fragments were recombined to generate new ligand structures using BREED algorithm. The new compounds were docked with *Pf*DODH crystal structure, after which the compounds were filtered with extensive drug-like parameters. The compounds were compared with the standard inhibitor to pick the 'leads' before predicting their toxicities. A 2D-QSAR model was built using the multiple linear regression method and externally validated. The compounds electronic behaviours were studied using DFT calculations. Structural investigation of the six designed compounds, which had lower binding energies than the standard inhibitors, showed that five of them had 1, 2, 4, triazolo [1, 5-a] pyrimidin-7-amine moieties and interacted with essential residues at *Pf*DODH binding site. In addition to their drug-like and pharmacokinetic properties, they also showed minimal toxicities. The externally validated 2D-QSAR model with R^2 and Q^2 values of 0.6852 and 0.6691, confirmed the inhibitory prowess of these compounds against *Pf*DODH. Based on frontier molecular orbitals and global reactivity descriptors, the DFT calculations showed regions of the molecules prone to electrophilic and nucleophilic attack. The current study may provide insight into the development of a new set of potent *Pf*DODH inhibitors.

Keywords: *Plasmodium falciparum dihydroorotate dehydrogenase, fragment-based drug design, 2D-QSAR, DFT calculation, 1, 2, 4, triazolo [1, 5-a] pyrimidin-7-amine, molecular docking*



INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY

Isolation and Molecular Identification of a Novel Organic Solvent-Tolerant *Bacillus pumilus*-FAO.SPT15 Producing Hydrolytic Enzymes.

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ABSTRACT

Organic-solvent tolerant (OST) bacteria are of great industrial importance today because they are cheap alternative sources for OST-hydrolytic enzymes such as amylases, proteases, and lipases which find application in many biotechnological processes including production of fine chemicals, plastics and in environmental management. In this study, novel OST-bacteria were isolated, identified based on phenotypes, biochemical characteristics and 16S rRNA molecular gene sequence analysis. The microorganisms were screened for the production of hydrolytic enzymes and the effect of pH, temperature, organic solvents and protein concentration were determined. A gram-positive strain identified as *Bacillus pumilus* FAO.SPT15 grew well on a modified Luria Bertani medium containing 10% (v/v) organic solvent with log P values ≥3.66 (n-Hexane) with an optimum pH and temperature of 6.0 and 30 °C, respectively. The activities of the crude amylase, protease and lipase produced extracellularly by *B. pumilus* FAO.SPT15 were optimum at pH 6.5, 5.0 and 8.0 respectively at temperature 50-60 °C. In the presence of 10, 20 and 40% (v/v) organic solvents such as benzene, chloroform, toluene, n-hexane, acetone, isopropanol, n-butanol, isoamyl-alcohol and methanol, Amylase had a residual activity of 70%, lipase had a residual activity of 68%, protease had a residual activity of 60% at 30 and 60 min respectively. But in the presence of organic solvents such as ethanol, acetonitrile, methanol and dimethylsulfoxide (DMSO) with log P values ≤-0.24, the crude enzymes showed varying levels of increased enzyme activities. This strain offers a possible potential use in biotechnological industries especially for bioremediation of contaminated sites and also in the production of industrial enzymes that are stable to organic solvents.

Keywords: *Bioremediation, Amylases, Proteases, and Lipases, Organic-solvent tolerant, Bacillus pumilus*

Production of Biobutanol from Wood of Mahogany and Iroko Using *Clostridium spp* and *Saccharomyces cerevisiae*

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ABSTRACT

The global interest in biobutanol production as a sustainable alternative to fossil fuel has increased significantly in the last two decades; due to the rising concerns about diminishing oil reserves and increased emission of greenhouse gases. Biobutanol amongst other biofuels attracted more attention because of its close similarity to automobile gasoline, low hygrosopicity and vapour pressure which prevents increase in moisture content of biobutanol. Biobutanol can be produced from sugars, starch and lignocellulosic biomass by solvent producing Clostridia via acetone-butanol ethanol fermentation. The major limitations in biobutanol production are availability of compatible feed stocks, low litre volume per biomas and product inhibition. These limitations are resolved with advances in genetic engineering and continuous fermentation processes with efficient product recovery techniques. This study was aimed at isolation of Clostridia species from the soil and screening for their ability to produce biobutanol from sawdust supplemented fermentation media. Soil samples were randomly collected from three different locations. Clostridium species were isolated using reinforce Clostridia media and identified using standard microbiological methods. Two wood sawdust samples (Mahogany and Iroko) were subjected to physical and alkaline pretreatment for size reduction and delignification of the samples. These pretreated samples were hydrolyzed into simple monomeric sugars by *Saccharomyces cerevisiae.* The hydrolyzed samples were subjected to batch fermentation using Clostridium species under anaerobic condition for biobutanol production. The value in 100ml/g of biobutanol produced by the two sawdust supplemented media; mahogany and Iroko are 2.52 and 2.18 respectively, under the same condition. This variation in quantity of biobutanol produced suggests that the quantity of available simple sugars in mahogany sawdust supplemented medium exceeds that of iroko as confirmed by the proximate analysis of the two samples. The volume of biobutanol produced is extremely low when compared with global energy demand.

Keyword: Biobutanol, Iroko, Mahogany, Production, Sawdust, wood

Acid and Alkaline Pretreatments of Cassava (*Manihot Esculenta* Crantz) TMS-0505 Peels for The Production of Bioethanol Using *Zymomonas mobilis*

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ABSTRACT

Due to health concerns as a result of the accumulation of high toxic emissions produced by fossil fuel, the quest for other substitutes for energy that are environmentally friendly such as bioethanol has been in increased demand. Increased in agricultural activities through (domestic and industrial activities) growth over the years in the world at large and especially in Nigeria which has a poor waste management technology is generating serious concern as this poses a serious health risk to humans and causes a nuisance to the environment. Recently, agricultural wastes are now being used as an alternative substrate for bioethanol production. The use of cassava peels (*Manihot esculenta)* serves as the main carbon source for the production of bioethanol. In this study, Bioethanol production from the peels of *Manihot esculenta* was successfully achieved by co-culture of *Aspergillus niger* and *Zymomonas mobilis* through simultaneous saccharification and fermentation processes. Pretreatments using 0.1 M sulphuric acid and sodium hydroxide was carried out on the substrate. *Aspergillus niger* and *Zymomonas mobilis* were added to ferment the peels at 28^{o}C for 5 days during which the total bacterial and fungal counts, mineral composition, cellulose content, reducing sugar, pH, temperature and the quantity of bioethanol produced were determined. The bacterial count (3.58 x 10^3), fungal count (2.81 x 10^3), mineral composition (15.64 mg/100g), cellulose content (66.08 % and 69.29 %), reducing sugar (6.98±0.01 and 8.98±0.00 g/l), pH 7.67, the temperature was at 36^{o}C at the initial stage of fermentation and later remain static at 28^{o}C till 5th day of fermentation, the total quantity of bioethanol yield obtained was (17.08 g/ml) after the 5th day of fermentation. The fermented hydrolysate was distilled at 78^{o}C. Therefore, *Aspergillus niger* and *Zymomonas mobilis* are proven effective for saccharification and fermentation of *Manihot esculenta* peels for bioethanol production as a substitute for fuel and energy sources.

Keywords: *Bioethanol, Manihot esculenta peels, pretreatment, fermentation*

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Inhibition of purified glutathione transferase from Hide Beetle (*Dermetes maculatus*) larva by ethanolic extract of cayenne pepper (*Capsium annum*)

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ABSTRACT

Glutathione transferase (GST) is an enzyme that catalyzes the conjugation of glutathione with a large variety of xenobiotics. The hide beetle (*Dermetes maculatus*) is one of the most damaging insect pests of dried and stored agricultural products in the world. The control of this insect is necessary to enhance both quality and quantity of stored products. Therefore, this study was carried out to determine the inhibitory potential of ethanolic extract of cayenne pepper (*Capsium annum*) on purified GST from hide beetle (*Dermetes maculatus*) larvae. *D. maculatus* larvae were collected from decaying dried catfish (*Clarias sp*), demobilized by freezing at 4°C and were homogenized in ice cold 20 mM potassium phosphate buffer, pH 7.0 containing 1 mM EDTA and 1 mM ß- mercaptoethanol. After centrifugation of the homogenate at 10,000 g for 20 min at 4°C, the supernatant (crude enzyme) obtained was purified by DEAE-sephacel and GSH-sepharose 4B. The inhibitory potential of ethanolic extract of *C. annum* and known plant-based inhibitors were evaluated. The inhibition concentration causing fifty percent (IC_{50}) inhibition of GST activity by *C. annum* extract was similar to that of anisaldehyde but less potent when compared with α-terpeneol. The extract of *C. annum* exerts its inhibitory power on the glutathione transferase via mixed inhibition. These findings showed that GST is present in the larvae of *D. maculatus* and the inhibitory properties of *C. annum* extract can be employed in designing inhibitors with enzymic target for pest control thereby improving quality and quantity of stored products.

BIOREMEDIATION OF WASTE-WATER: Immobilization as an Eco-Friendly and Effective Biological Treatment

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ABSTRACT

Wastewater is effluents of either natural (rainwater runoff, stormwater), domestic waste, or commercial (industrial) waste. These have been the leading causes of pollution of our water bodies. This has been a global challenge because of its adverse effects on human and aquatic lives. Over the years, several methods, such as sludge treatment, chemical treatment, physical water treatment, and biological water treatments, have been utilized to ensure proper wastewater treatment before discharge into the water bodies. Bioremediation is a tool for biological treatment that is now on the rise because it is eco-friendly, has higher efficiency, and is cost-effective. The use of free cells in bioremediation is fast becoming a less effective form of remediation, unlike the use of support in the form of immobilization. In this review, we report the current improvements and strategies involved in the use of solid supports either through entrapment, adsorption, encapsulation and covalent bonding/cross-linking for increasing the efficiency of wastewater management using biological treatments

KEYWORDS: *wastewater, bioremediation, biodegradation, immobilization, biological treatment*

Microalgal Based Adsorption for Efficient Removal of Heavy Metals from Contaminated River

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ABSTRACT

Heavy contamination of the aquatic systems as a result of direct or indirect release of both domestic and majorly industrial effluent into them has become an issue of great concern. Some of these contaminants are biodegradable while there are others that are not because of the complexity in their structure. Heavy metals belong to the class of aquatic pollutants. The presence of heavy metal has become a serious environmental concern especially in Asa Dam River which is a major river in Ilorin Kwara state, Nigeria. In this study, three microalgae biomass (*Coelatrella sp, Neodesmus pupukensis and Nannochloropsis sp*) were used as adsorbent to remove five heavy metals (Iron, Zinc, Lead, Manganese and Cadmium) from water sample collected from Asa Dam River. The biodegradation experiment was carried out at different contact time (24 and 48hours), constant concentration (1 mg/ml) and pH (8); the optical density of the mixture was also monitored for 72 hrs to determine biomass production. At 24h, the highest reduction in concentration of Mn, Fe, Zn, was 84.67 % (*Neodesmus pupukensis*), 98.54% (*Neodesmus pupukensis*) and 97.15% (*Coelastrella* sp) respectively while Cd and Pb was 96.57% and 82.8% (*Nannochloropsis* sp). Similarly, at 48 hours, there was continuous reduction in concentration of the metals with cadmium having a complete removal efficiency of 100 % by both *Coelastrella* sp. and *Nannochloropsis* sp. Additionally, there was increase in the optical density of *Coelastrella* sp. (0.478 to 0.899), *N.pupukensis* (0.228 to 0.712) and *Nannochloropsis* sp. (0.139 to 0.420). The performance of these three microalgae in reducing the concentration of these heavy metals as presented them as prospective bio-adsorbent that can be used in the bioremediation of contaminated water bodies.

Keywords: *Bioadsorption, Asa Dam, Coelastrella sp, Neodesmus pupukensis, Nannochloropsis sp, Heavy metals*

Genome Wide Analysis of Cytochrome P450 Genes of Bacteria Isolate from Pesticide Polluted Environment and Their Role in The Maintenance of A Cleaner Environment

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ABSTRACT

In light of the rapidly growing human population, pesticides overtime has been utilized to either maximize crop production by preventing, destroying, repelling, or mitigating any pest. This in turn has become a major cause of environmental pollution as most of these pesticides are harmful to untargeted microorganism, plants and even human. However, after constant application of these pesticides to a particular area it has been observed that some pests and microorganisms became genetically resistant to pesticides. Moreover, it has been established that pests have evolved the mechanisms to degrade metabolically (enzymatically) or otherwise circumvent the toxic effect of many types of chemicals that we have synthesized as modern pesticides. Generally, three main enzymes, general esterases (GEs), glutathione S-transferases (GSTs) and cytochrome P450-mediated monooxygenases (CYPs), are involved in the process of metabolic detoxification of pesticides. To mitigate this form of pollution cytochrome P450 genes of bacteria isolated from a pesticide polluted environment could play a crucial role in the rejuvenation of heavily polluted environment.

Key words: *Cytochrome P450 genes, Bacteria, Pesticides, Pollution, General esterases (GEs) and Glutathione S-Transferases*

Biological Remediation of Heavy Metals: A Sustainable Tool for Eco-Recovery

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ABSTRACT

The quest for modernization which has led to the setting up of new industries and the expansion of existing industrial establishments has resulted in the disposal of Heavy metals (HM) from industrial effluents, causing air, water and soil pollution. These disposed materials have high persistence capacities and also can change into toxic recalcitrant up on combining with other eco-materials or manmade products. The pollution of the environment by these metals has resulted in severe negative environmental impact. Remediation is the only way to tackle these heavy metals which are also called toxic metals. Several methods and practices have been implemented for degrading these recalcitrant materials, of which bioremediation has been proven to have significant remediation impact on heavy metals than other methods. Giving a brief note on the types of heavy metals and their impact on the environment, this review attempts to highlight the positive outcomes of bacterial bioremediation, phycoremediation and phytoremediation as tools for eco-recovery.

Keywords: *Heavy Metals, phytoremediation, bacterial remediation, phycoremediation*

Physicochemical Parameters and Benthic Macroinvertebrates of Temidire Stream Associated with The NNPC Oil Depot, Apata, Ibadan, Southwest Nigeria

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ABSTRACT

Some physicochemical parameters and macroinvertebrate assemblages of Temidire stream, a first order stream which flows through Nigeria National Petroleum Corporation (NNPC) depot and Temidire community in Apata, Ibadan metropolis were investigated in order to determine the pollution status of the water and its impact on the biological community. Water and sediment samples were collected from four sites on the Temidire stream, and from an adjacent stream (station 1; putative control site). These samples were analyzed for some physicochemical parameters using standard methods, and the levels of heavy metals were determined by atomic absorption spectrophotometry. Macrobenthos were collected from the five stations using a kick sampling method. The result revealed the mean conductivity (586.3 ± 158.72 µS/cm) and phosphate (0.12±0.11mg/L) levels were above and below the allowable limits of United States Environmental Protection Agency (USEPA) for fresh water bodies, respectively. Total dissolved solids, conductivity and phosphate of station 1 differed significantly from the other stations ($p < 0.05$). The level of heavy metals concentration recorded in both surface water (mg/L) and sediment (mg/g) samples of studied stations ranged from 0.139±0.017 - 0.585±0.163 Pb; 0.132±0.038 - 0.22±0.051 Ni; 0.221±0.019 - 0.425±0.388 Cd; 0.102±0.086 - 0.292±0.176 Cu; and 0.372±0.161 - 1.678±0.580 Mn for surface water while sediment contained 14.68±3.535 - 24.98±7.739 Pb; 3.44±1.572 - 14.32±5.824 Ni; 1.16±1.44 - 1.52±0.674 Cd; 3.17±1.09 - 15.82±15.94 Cu and 226.06±45.947 - 427.12±158.11 Mn. A total of 96 individuals from seven invertebrate taxa in seven families from six orders were collected from the five stations during this study. Aquatic insects represented 71.4% of the taxa and 75% of all individuals collected. The rest of the taxa was composed of Gastropoda and Annelida. Two macroinvertebrate taxa *Gyrinus* and *Dystiscus* were found in all the sampled stations. Stations 4 and 5 that are closer to the NNPC depot recorded lower taxa number compared to the putative control site. The PCA analysis of the physicochemical parameters which revealed toxic heavy metals (Pb and Cd) in water and sediment correlated most with the first component as well as the concentrations of the heavy metals that exceeded the recommended permissible limit of the USEPA suggested anthropogenic pollution of the study area. The low abundance of macroinvertebrate taxa coupled with few pollution-sensitive species encountered only in the control station indicated stressed environmental condition along the stations. This study revealed that the macroinvertebrate community of the Temidire stream has been impacted by the perturbed water quality of the stations.

Keywords: Macroinvertebrates, Surface water, Sediment, Petroleum products depot, Heavy metals

MEDICAL BIOTECHNOLOGY

In Vitro Antioxidant Activities of Selected Medicinal Herbs and their Polyherbal Formulation

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ABSTRACT

The present study aimed to investigate the antioxidant activity of a polyherbal formulation (PHF) containing five medicinal plants fruits of *Garcinia kola, Citrus Limon, Allium sativum,* rhizome of *Zingiber officinale, and* leaves of *Moringa oleifera,* using *In vitro* methods. Ethanolic extract of each herbal plant was prepared by the Soxhlation process, Phytochemical constituents, Total Phenolic Content (TPC) and Total flavonoid content (TFC) of the extracts were estimated using standard methods. Extracts were analysed for its antioxidant potential using DPPH (1, 1-diphenyl-2-picrylhydrazil), FRAP (Ferric Reducing Antioxidant Power), Hydroxyl (OH) radical scavenging activity, Nitric oxide (NO) scavenging activity, ABTS {2, 2'-azino-bis (3- ethylbenzothiazoline-6-sulfonic acid)}, SRS (Superoxide Radical Scavenging activity) and TBA (Thiobarbituric acid) methods to assay their free scavenging activity. Results shows that PHF contains Flavonoids (QE) 15.61±1.95, Total phenol (GAE) 25.24±3.56, tannins, alkaloids, glycosides, Anthraquinone, Terpenoid, Steroid, Phlobatannins and Coumarins. DPPH, FRAP, OH, NO, ABTS, SRS and TBA of ethanol extracts of PHF were 86.09±1.58, 66.95±0.03, 80.89±0.10, 68.13±0.16, 65.54±0.55, 69.69±1.12, and 76.32±0.79 at 250 µg/mL respectively. When compared with known standards PHF possess high antioxidant activity in a concentration dependant manner. IC50 values of drug combination exhibited higher antioxidant potential in DPPH (86.09±1.58µg/mL) and OH (80.89±0.10µg/mL), which may be due to the combined activity of the individual plant extracts with its high phenolic and flavonoid content. these findings may provide efficient, supportive, or alternative treatment procedures for numerous health ailments associated with the accumulation of harmful free radicals and reactive oxygen species.

Keywords: *Total Phenolic Content (TPC), Ferric Reducing Antioxidant Power (FRAP), 1, 1-diphenyl-2-picrylhydrazil, Hydroxyl (OH) radical scavenging activity.*

Antimicrobial Efficacy of Synthesized Silver Nanoparticles from The Stem Extract of *Carnegiea Gigantea* On Some Urinary Tract Pathogens

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ABSTRACT

The development of antimicrobial compounds from synthesized nanoparticles provides a promising approach to the management of antimicrobial resistance. Medicinal plants are potent sources of natural antimicrobial compounds and provide effective approaches for the management of antimicrobial resistance. This study investigated the antimicrobial efficacy of stem extract and plant-mediated synthesis of AgNPs (AgNPs) of *Carnegiea gigantea* against Urinary tract pathogens obtained from the Dalhatu Araf Specialist Hospital, Lafia. Phytochemical analysis of the *Carnegiea gigantea* stem extract was done which showed terpenoids as the most prominent and acts as a reducing and capping agent. The formation of CG-AgNPs was displayed within 2 min with evidence of surface plasmon bands between 440 nm to 460 nm. Further characterization was done using FTIR, TGA, X-ray Diffraction, SEM, and TEM analysis. The average size of the CGAgNPs determined by the TEM analysis was 15. o5 nm. Microbiological analyses such as cultural and biochemical confirmation of microbial isolates, antimicrobial sensitivity tests, determination of minimum inhibitory concentration, and minimum bactericidal concentration were carried out on the plant extract and synthesized CG-AgNPs using Nitrofurantoin and Capsofungin as a positive control for bacterial and fungal isolates. Urinary tract pathogens are *Escherichia coli*, *Pseudomonas*, *Klebsiella*, *Staphylococcus*, and *Candida* species. The plant extract and corresponding synthesized CG-AgNPs were effective against all test isolates at a range of 50 mg/L to 400 mg/L. The MIC of plant extracts and synthesized CG-AgNPs were at 100 mg/L and 25 mg/L, respectively while the MBC was at 200 mg/L and 50 mg/L for plant extract and synthesized CG-AgNPs, respectively. Data obtained shows that the synthesized CG-AgNPs a higher potency against urinary tract pathogens compared to the stem extracts commonly used by the locals.

Keywords: *Urinary tract pathogens, Carnegiea gigantea, plant extract, silver nanoparticles, antimicrobial activity*

Involvement of The ER-Stress Signaling Pathway in The Ameliorative Effect of *Cymbopogon Citratus* on Streptozotocin-Induced Diabetic Rats

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ABSTRACT

Accumulating evidence suggests that endoplasmic reticulum (ER) stress plays a part in the pathogenesis of diabetes mellitus, contributing to pancreatic dysfunction and insulin resistance. Ameliorating ER stress may be a viable therapeutic approach in the proper management of diabetes mellitus. In traditional/ folk medicine, *Cymbopogon citratus* is considered as a natural remedy for many diseases including diabetes mellitus. Although well known for its antidiabetic effect, the mechanism underlying this effect is yet to be established. This study investigated the mode of action of *C. citratus* in alleviating diabetes induced by streptozotocin in wistar rats. Streptozotocin (60mg/kg) was used to induce diabetes mellitus in rats. After 72 hours of STZ administration, rats with fasting blood glucose ≥200mg/dl were selected for this experiment. The rats were administered *C. citratus* methanolic leaves extract via gastric gavage needle at doses 100, 200 and 400 mg/kg for two weeks while metformin (100 mg/kg) was used as positive control. Fasting blood glucose (FBG) and expression of ER-stress related genes were determined. Possible compounds responsible for this effect were also predicted through molecular docking. FBG level decreased ($p<0.05$) upon commencement of oral administration of *C. citratus* methanolic extract and the decrease was maintained throughout the treatment period. At the molecular level, a significant down-regulation in the expression of ER stress genes was observed upon treatment with *C. citratus* methanolic extract. Molecular docking suggests that apigenin targets GRP78 with binding affinity of – 9.3 kcal/mol and may be responsible for this ameliorative effect on ER stress. These findings suggest that *C. citratus* lowered blood glucose levels by ameliorating ER stress. The ameliorative effect of this plant on ER stress can be attributed to its down-regulative effect on GRP78 signaling.

Keywords: *C. citratus, diabetes mellitus, ER-stress, medicinal plants, molecular docking*

Alteration of Critical Enzymes Associated with Carbohydrate Hydrolyzing Enzymes and Histological Architecture in Pancreas of Diabetic Rats by *Massularia acuminata* Stem Extract

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ABSTRACT

This study was designed to investigate the effect of *Massularia acuminata* on hyperglycemia, thiobarbituric acid reactive species (TBARS) levels, carbohydrate hydrolyzing enzymes (α-amylase, α – glucosidase and lipase) activity and histopathological changes on the β-cells of the pancreas in STZ-induced diabetic rats. Adult male rats (35) were randomly divided into seven groups. Group 1, 2 and were normal rat administered normal saline (0.9% NaCl) and extracts of *M. acuminata* (50 mg/kg and 100 mg/kg), once daily for 14 days respectively. Diabetes was induced in rats via a single-dose intraperitoneal injection of streptozotocin (50 mg/kg) dissolved in 0.1 M citrate buffer (group 3). Diabetic rats were subsequently treated daily with *M. acuminata* (50 mg/kg and 100 mg/kg) extracts and acarbose (a standard antidiabetic drug) orally for 14 days respectively (groups 5, 6 and 7). Blood glucose level was monitored every 4 days. After sacrifices, the TBARS level, carbohydrate hydrolyzing enzymes activity and morphological changes on the β-cells of the pancreas in STZ-induced diabetic rats were assessed. The result revealed that treatment of diabetic rats with *M. acuminata* and acarbose significantly ($p<0.05$) reduced the blood glucose and TBARS levels, as well as activities of α-amylase, α – glucosidase and lipase were observed in diabetic rats. Histological examination of the β-cells of the pancreas of diabetic rats treated with *M. acuminata* showed that the cells had varying degrees of recovery when compared with the diabetic group. Thus, it can be concluded that *M. acuminata* could serve as natural, effective and complementary therapy for diabetes management.

Keywords: *Diabetics, β-cells, caspase, hyperglycemia, streptozotocin TBARS level, α-amylase, α – glucosidase and lipase*

Insilico Prediction of Antibiotics resistance in *Staphylococcus aureus* from whole genome sequence of selected African Countries

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ABSTRACT

S. aureus has a unique characteristic to acquire resistance to any antibiotics (Chamber and Delos, 2009), it does this through horizontal gene transfer from its sources even chromosomal mutation are taken into consideration. Thirty-three whole genome sequence of *Staphylococcus aureus* from Nigeria, South African and Ghana were downloaded from NCBI GenBank. The antimicrobial resistance genes were identified using the Comprehensive Antibiotic Resistance Database (https://card.mcmaster.ca) version (RGI 5.1.1; CARD 3.1.0). Prediction of the prevalence and distribution of resistance genes in whole genome sequence *of Staphylococcus aureus* among selected Africa Countries. mepR had the highest occurrence of 12.6% among the various existing genes in the whole genome sequence and lowest occurrence of 0.4% were observed for FuD, parE, dfrG and gyrB. ArlR, mepR, GlpT (83.3%); mgrA, mepR (91%), ArlR (83%) and mgrA (100%), LmrS (77.8) were the most occurrence genes among Sequences from Nigeria, Ghana and South Africa respectively. Nigeria had the highest percentage strict gene (71%) and lowest was observed in South Africa (43%). Antimicrobial resistance genes in *Staphylococcus aureus* whole genome sequence from Nigeria, Ghana and South Africa were identified. mepR and mgr were found to be most occurrence among the sequences. Avoidance of infectious organisms is a very good way in preventing the use of antibiotics because if there is no infection, then no need for the use of antibiotics.

Keywords: *Staphylococcus aureus, Resistance genes, CARD, Highest occurrence and African Countries.*

Effect of Protein Isolate from Fermented Locust Beans (*Parkia biglobosa* Jacq.) Seed on Acute Ethanol-induced Fatty Liver in Wistar Rats

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ABSTRACT

Consumption of alcohol has continued to gain attention across the globe due to its devastating influence on human health. The liver sustains different injuries because it is the primary site of alcohol metabolism. Currently, there is no FDA-approved drug for treating alcohol liver disease (ALD). This study investigates the protective effect of protein isolate from fermented *Parkia biglobosa* (PBPI) seed on acute ethanol-induced fatty liver. Rats were treated with 48% ethanol to induced acute fatty liver, and assigned to Group 1 **(**Control), Group 2 **(**Negative control), Group 3 **(**48% ethanol + PBPI (200 mg/kg)), Group 4 (48% ethanol + PBPI (400 mg/kg) and Group 5 (48% ethanol + cellgevity (28.6 mg/kg)). Treatment with PBPI lasted for 21 days. The liver index, hepatic malondialdehyde (MDA) and triglyceride (TG) activities, and serum TG were determined. The mRNA expression of antioxidant genes (catalase and superoxide dismutase), glutathione metabolising genes (glutamate cysteine ligase catalytic subunits (GCLC), glutamate cysteine ligase modifier subunits (GCLM) and gamma glutamyl transferase (GGT)), inflammatory genes (tumour necrosis factor alpha (TNF-α), interleukin 1 beta (IL-1β), interleukin 6 (IL-6) and interferon gamma (IFN-ϒ)) and fatty acids accumulation genes (acetyl-coA carboxylase (ACC), low-density lipoprotein receptor (LDL-R), 3-hydroxyl-3-methyl-glutaaryl-CoA reductase (HMG-CoA reductase) and peroxisome proliferator-activated receptor gamma (PPARϒ)) were quantified using reverse-transcriptase polymerase chain reaction (RT-PCR) . Acute-ethanol induction triggers increased liver index, serum and hepatic TG, and MDA production which were dramatically ameliorated by PBPI. Gene expression study also showed the protective effect of PBPI through up-regulation of antioxidant genes (SOD and CAT), improvement of glutathione synthesis (GCLC, GCLM, GGT), amelioration of inflammation (IL-1β, IL-6, IFN-ϒ) and fatty acid synthesis (ACC, LDL-R, HMG-CoA reductase) in the liver of acute-ethanol induced rats. This study demonstrated that PBPI offered hepato-protective potential against ethanol-induced fatty liver in wistar rats.

Keywords: *Parkia biglobosa, protein isolate, acute-ethanol induced fatty liver, inflammatory genes, antioxidant, glutathione, lipid peroxidation*

Antitrypanosomal Activity of Stigmasterol Against *Trypanosoma congolense* Infection in Rats Coupled with Inhibition of *Trypanosomal sialidase In Vitro* and *In Silico*

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ABSTRACT

Stigmasterol has been reported to possess antitrypanosomal activity using *in vitro* model but no reports on the *in vivo* antitrypanosomal and *in vitro* anti sialidase activity which is necessary in drug development process has not been evaluated. Hence, the present study investigates the *in vivo* effects of stigmasterol against *T. congolense* in addition to its *in vitro* and *in silico* inhibitory on trypanosomal sialidase. Stigmasterol, at 100 mg/kg BW, did not significantly ($p > 0.05$) reduce the progression of *T. congolense* infection in animals but a 200 mg/kg BW stigmasterol treatment significantly ($p < 0.05$) reduced the parasitemia, although, it did not completely eliminate the parasite from the bloodstream of infected animals. Interestingly, treatments with stigmasterol significantly ($p < 0.05$) ameliorated the *T. congolense* induced anemia. Furthermore, the *T. congolense*-associated increase in free serum sialic acid with a corresponding decrease in membrane bound sialic acid were prevented, though insignificantly ($p > 0.05$), by the 200 mg/kg BW treatment. Additionally, *in vitro* enzyme kinetic studies revealed that stigmasterol uncompetitively inhibits the partially purified bloodstream *T. congolense* sialidase with an inhibition binding constant of 356.59 mM. Meanwhile molecular docking studies, revealed a predicted binding free energy of -24.012 kcal/mol between stigmasterol and *T.rangeli* sialidase. We concluded that stigmasterol could retard the proliferation and the major pathological features of *T. congolense* infection whilst the anemia amelioration was mediated via inhibition of sialidase.

Keywords: *Anemia, Parasiteamia, Sialic acid, Sialidase, Stigmasterol, Trypanosoma congolense*

Corchorus olitorius Alleviates Sodium Fluoride Induced Stress On Male Wistar Rats

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ABSTRACT

Corchorus olitorius is a leafy vegetable with broad therapeutic uses. However, the seed shows various physiological capabilities locally. This study investigates the potential of *Corchorus olitorius* seed (COS) in alleviating oxidative stress in rats. Twenty (20) male Wistar rats were grouped into four (I – IV) with Group I as the control and received 0.5ml normal saline, Group II received 0.5ml of 1.43 mg/kg body weight of Diclofenac, group III and IV received 0.5 ml of 200 and 400 mg/kg body weight of the extract respectively, one hour prior to induction of inflammation. The paw volume was measured at 30 minutes' intervals for three hours consecutively as an indicator of inflammation. Thereafter, serum levels of alkaline phosphatase, aminotransferase, protein, bilirubin, urea, creatinine, catalase, and superoxide dismutase were measured. The result revealed a significant decrease in rat paw volume (III and IV) after COS administration, it, therefore, shows anti-inflammatory potency of the extract. Furthermore, COS boosted the activities of superoxide dismutase and catalase but reduced significant serum enzymes, urea, and creatinine level. This could be attributed to its non-toxic effect. We, therefore, conclude that COS extract has anti-inflammatory and antioxidant potentials with no deleterious effect.

Keywords: *Anti-inflammatory, Corchorus olitorius, antioxidant, biochemical parameters, oxidative stress*

Eugenol Mitigates Delayed Wound Healing in Type 2 Diabetic Rats Through the Modulation of Crucial Enzymes and Inflammatory Cytokines

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ABSTRACT

Delayed and poor wound healing is a complex and multifactorial complications of diabetes, resulting in significant clinical morbidity, amputation and mortality. Managing wound healing in diabetes is very expensive using the conventional ways hence the search for cheap natural and alternative therapeutic agents. Eugenol is the main constituent of clove oil and widely distributed in many plants. This study investigated the effect of eugenol on key enzymes; α-amylase, α – glucosidase, acetylcholinesterase (AChE), adenosine deaminase (ADA) and arginase, relevant to wound healing in diabetic rats. Type 2 diabetes was induced experimentally by high fat diet with low dose of streptozotocin (STZ, 25 mg/kg, i.p.) in Wistar rats (180-220 g) and wounds were created on the dorsal surface of the hind paw of rats. Rats were treated orally with 2.5 - 5 mg/kg of eugenol and/or topical application of eugenol (10 mg/ml) on the wounds of diabetic and/or normal rats for 14 days. Various biochemical, molecular and histopathological parameters were evaluated in wound tissue. There was significant ($p < 0.05$) increase in percentage wound closure rate and anti-inflammatory cytokine (1L – 10) levels as well as reduction in α-amylase, α – glucosidase, AChE, ADA and arginase activities, blood glucose and pro- inflammatory cytokine (TNF-α and 1L – 6) levels of diabetic rats treated orally and topically with eugenol compared with diabetic control rats. The wound healing effect of eugenol observed in this study may be attributed to the modulation of critical enzymes linked to wound healing, inflammatory cytokines as well as antioxidant properties of eugenol. Hence, the combination therapy of oral administration and topical application of eugenol produced the highest wound closure rate compared with diabetic control. This study suggest that eugenol possess wound healing effect in diabetic rats

Keywords: *Antioxidant properties, acetylcholinesterase (AChE), adenosine deaminase (ADA), arginase, Inflammatory Cytokines, Eugenol*

Effects of Vitamin E in Perfluorononanoic Acid Induced Reproductive Toxicity And Nrf2–Keap1 Signaling Pathway In Male Wistar Rats

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ABSTRACT

Perfluoroalkyl acids (PFAAs) are a family of perfluorinated chemicals consisting of high-energy carbon-fluorine (C F) bonds. Perfluorononanoic acids (PFNA) are resistant to hydrolysis, photolysis, microbial degradation and metabolism by animals. Exposure to PFNA is via contaminated air, food and water. This study was designed to investigate the toxic effect of Perfluorononanoic acid on the male reproductive organ and also to evaluate the possible effects of vitamin E on PFNA induced reproductive toxicity and NRF2–KEAP1 signaling pathway in male wistar rats. 50 male rats were divided into 7 groups; (PFNA induced, vitamin E treated and co-administration of vitamin E and PFNA). PFNA and vitamin E were administered orally daily for 14 days. After last treatment, the reproductive tissues (testis and epididymis) were collected and used for histological examination, biochemical and hormonal assay. GSH levels and SOD, CAT, GPx, GST activities were reduced in the group treated with PFNA compared to the control group. Subsequently, Nrf2, HO1, and NQO1 showed a marked decrease, and elevated keap 1 expression in the PFNA induced groups when compared to the control group and the vitamin E treated group. PFNA treated rats showed a significant degenerative damaged in the testes and epididymis at 5mg/kg, while the treated group showed normal tissue architecture in comparison to the control group. The results suggested that PFNA interferes with Nrf2–Keap1 signaling pathway, spermatozoa production and motility; causes oxidative damage in testis and epididymis but vitamin E was able to ameliorate the effect of PFNA in experimental rats.

Keywords: *Perfluorononanoic acid, nuclear erythyroid 2 factor 2, caspase, heme oxygenase, NAD(P)H dehydrogenase (quinone).*

AGRICULTURAL BIOTECHNOLOGY

Effects of Different Extracts from Editan (*Lasianthera Africana P Beauv)* leaves on Antioxidants and Anti-diabetes properties *In-vitro*

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ABSTRACT

Lasianthera africana P Beauv plant locally known as Editan is a leafy vegetable, native to the South-Eastern part of Nigeria, which is commonly used for soup and in fore lore medicine. The aim of the study was to use different extraction methods [aqueous, ethanol and nano synthesis)] on the leaves while *in-vitro* antioxidants and anti-diabetes assessment of the extracts was carried. Antioxidant assays such as [ferric reducing antioxidant power (FRAP), 1-Azinobis (3-Ethylbenzo-Thiazoline-6-Sulfonate (ABTS), 2,2-diphenyl-1-picryldrazyl (DPPH), hydroxyl radical scavenging ability (OH), nitric oxide radical scavenging ability (NO), Fe^{2+} chelation ability and lipid peroxidation (LPO) were determined. While the enzymes activities [α-amylase and α-glucosidase] were also carried out. The samples were extracted using standard methods and same concentration was used (10µg/mL) for the study. The results show that nano extract had the highest antioxidant property while the aqueous extract had the highest anti-diabetes significantly ($p<0.05$). The characterization of the bioactive compounds from the nano extract was determined using HPLC, It was observed that gallic acid, caffeic, naringenin, kaempferol and quercetin acid and rutin were abundantly presence with more of aromatic ring stretch functional groups as indicated with the use of FTIR while the SEM micrograph structure showed a compact and smooth particle size which could have increased the nano extract activities when compare to other samples. In conclusion, the extracts showed that it could offer possible medical intervention in the management of diseased conditions if adequately exploited based on its uniqueness.

Keywords: *Editan; Scavenging; Diabetes; Enzymes; Antioxidant; HPLC*

Effects of Direct Fed Microbes on Nutrient Digestibility, Intestinal Morphology and Serum Biochemistry of Layer hen

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ABSTRACT

The use of antibiotics as growth promoters had raised a lot of concerns in different part of the world, including Nigeria. This is due to the resurgence of antibiotic resistance and drug residues in animal products. Probiotics (Direct Fed Microbes) are good alternatives and promising results have been recorded upon their usage. This study was therefore conducted to investigate the effect of *Pichia kudriavzevii*-based Direct Fed Microbes (DFM) on nutrient digestibility, intestinal morphology and serum biochemistry of layer hens. One hundred and ninety-six (196) Issa brown point-of-lay hens aged 15 weeks were randomly grouped into 7 treatment groups of 9 replicates in a completely randomized design. The DFM was administered at a concentration of $15x10^8$cfu per kilogram of feed and data obtained was subjected to analysis of variance using ANOVA of SAS, 2003 version 9.3. Probability values less than 0.05 was considered significant. The results of this study showed that *P. kudriavzevii*-based Direct-Fed Microbes significantly ($p<0.05$) improved the digestibility of mineral nutrient of layer birds, except the digestibility of phosphorus. The digestibility of crude protein, fibre, ash, moisture content and gross energy were also improved significantly ($P<0.05$) except for the digestibility of crude fat. Compared with the control, the villus height was greatly increased together with the villus height to crypt depth ratio while the width of the intestinal wall was adversely affected. The crypt depth of the control group was significantly higher ($p<0.05$) than that of the treatment groups. Both strains of *P. kudriavzevii* improved the intestinal morphology as there was no observable lesion throughout the course of the experiment. Cholesterol level and LDL were significantly ($P<0.05$) lowered while HDL level was increased. These results suggest that *P. kudriavzevii* would be a very effective DFM and its inclusion in poultry diet could improve nutrient digestibility and intestinal morphology which will invariably improve the performance of layer hens.

Keyword: *Antibiotics, growth promoters, DFM, P. kudriavzevii, Nutrient digestibility*

MICROBIAL AND FOOD BIOTECHNOLOGY

Algae Biotechnology: The Role In Production of Biofuels For Sustainable Development

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ABSTRACT

Algae biofuels are third-generation biofuels with improve yield and easy biodegradation with minimal environmental hazards. High energy and cost of production have been the major limiting factors in generating these biofuels. Despite the shift to other renewable source of energy, energy production has not been able to meet up with consumption. Hence, there is need to improve algae biofuel production in order to complement solar and other energy sources that are currently in use. This review presents the current improvements in the use of technologies to increase biofuel production from microalgae and to minimize cost and energy requirements.

Keywords: *Algae, biofuels, energy, technologies, production*

Microbiological Studies on Selected Industrial Effluents from Oriade Local Goverment, Nigeria.

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ABSTRACT

Industrial effluent that enter water body may lead to heavy source of environmental pollution and affects the water quality. It can serve as habitat for pathogenic microbes and can constitute health hazard to the populace. The present study was designed to enumerate and identify microorganisms and to determine physicochemical properties of industrial effluents. Samples were collected from four different industries in Oriade local government (Ilesha, Ikeji-Arakeji and Ipetu Ijesha). The Industrial effluent samples were subjected to microbiological and physicochemical analyses. Bacteria isolated from industrial effluent samples during raining season were *Bacillus cereus*, *Bacillus subtilis*, *Enterobacter aerogenes*, *Enterococcus faecalis*, *Klebsiella oxytoca*, *Lactococcus lactis*, *Micrococcus luteus*, *Salmonella typhi*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Staphylococcus saprophyticus*, *Shigella flexneri*, *Streptococcus viridians* and *Pseudomonas aeruginosa*. The fungi isolated were *Aspergillus niger*, *Aspergillus flavus*, *Aspergillus fumigates*, *Fusarium culmorum*, *Rhizopus stolonifer* and *Saccharomyces cerevisiae*. Effluent from bakery had the highest bacterial load 2.45× 10^4cfu/ml and Cassava processing plant had lowest bacterial load 1.78× 10^4 cfu/ml. *Bacillus cereus* was the dominant bacterial specie while *Aspergillus flavus* was the dominant fungal specie. Palm oil mill effluent had the highest mean for pH value (10.48), colour (19.15Pt/co) temperature (27˚C), conductivity (240(µS/cm) total soluble solids (322 mg/l) total hardness (251mg/l). Effluent from the brewery had highest value for iron (3.67±0.02). Therefore, from the study the effluents from all industries had high microbial load and physicochemical parameters exceeded the tolerable levels set by WHO standards. The presence of these microorganisms and chemical substances pose a potential threat to the health of populace inhabiting these places.

Stability of pectinases from wild and mutant strains of *Rhizopus stolonifer* to medium pH and temperature

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ABSTRACT

Rhizopus stolonifer isolated from cocoa pod was exposed to sub-lethal dose of chemical mutagens (ethidium bromide) and random selection (quantitative method) was used to screen and select mutant with the highest pectinase activity. Pectinase was produced from wild and selected mutant strain via submerged fermentation containing 1% pectin. The crude enzymes obtained after centrifugation were subjected to ammonium sulphate precipitation using 0-60% saturation while further purification was carried out by ion exchange chromatography on DEAE-sephadex A-50 and gel filtration chromatography on sephadex G-200. The pH and thermal stabilities of the enzymes were determined. Two forms of pectinase (W_A&W_B), (M_A&M_B) were observed for both wild and mutant strains of *R. stolonifer* respectively. Activity recovery of 3.78% and 7.76% were obtained for W_A and W_B respectively while 9.9% and 2.65% were obtained for M_A and M_B respectively. The enzymes were found to be monomeric enzymes. Pectinases from both strains had optimum activity at pH 5.0. However, the optimal activity of W_B was at 40°C while M_A and M_B had optimum activity at 50°C. Pectinase from mutant strain was observed to be more stable at slightly acidic and alkaline pH as it retained 91% activity while pectinase from wild strain retained 80% activity. The higher yield in pectinase coupled with a shift in optimum temperature and the relative stability observed at above 50°C by pectinase from mutant strain compared to that from the wild shows that classical strain improvement can be used to achieve both quantitative enhancement and qualitative improvement of pectinase for industrial processes.