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THE 1ST INTERNATIONAL CONFERENCE ON KOLA PLANTS ORGANIZED BY NANOTECHNOLOGY RESEARCH GROUP (*NANO*+), LADOKE AKINTOLA UNIVERSITY OF TECHNOLOGY OGBOMOSO, NIGERIA

IN COLLABORATION WITH

PAN AFRICANA STRATEGIC AND POLICY RESEARCH GROUP (PANAFSTRAG), LAGOS, NIGERIA

LAUTECH Nanotechnology Research Group
...Enabling Qualitative Research at the Smallest Scale

BOOK OF ABSTRACTS OF THE HYBRID CONFERENCE LAUTECH-PANAFSTRAG KOLA 2024

THE TREASURE BEYOND CONSUMPTION: EXPLORING KOLA FOR SUSTAINABLE DEVELOPMENT

MONDAY 6 - THURSDAY 9 MAY, 2024
VENUE: THE HALL, LAUTECH, OGBOMOSO & ZOOM

Chairman
Prof. Razaq Olatunde Rom Kalilu
Ag. Vice-Chancellor, LAUTECH, Ogbomoso, Nigeria

Co-Chairman/Host
Major-General Ishola Williams (Rtd)
Executive Secretary, Pan Africana Strategic and Policy Research Group (PANAFSTRAG) Lagos, Nigeria

Host/Convener
Prof. Agbaje Lateef
Head, Nanotechnology Research Group (*NANO*+), LAUTECH, Ogbomoso, Nigeria

LOC Chairperson
Prof. Musibau A. Azeez
Department of Pure and Applied Biology, LAUTECH, Ogbomoso, Nigeria

KEYNOTE SPEAKER
Prof. Omotoye Olorode
Professor of Botany
Odoje Biodiversity Centre, Odoje-Orile, Ogbomoso, Nigeria

Speakers at the Conference

Prof. Joseph A. Morakinyo (USA)

Prof. Ebenezer O. Farombi, Department of Biochemistry, University of Ibadan, Ibadan, Nigeria

Dr. Patrick O. Adebola, Director-General, Cocoa Research Institute of Nigeria, Ibadan, Nigeria

Dr. Onyebuchi P. Agwu, Universite´ Felix Houphouet Boigny, Abidjan, Côte d'Ivoire

Mr. Wale Fatade, Commissioning Editor, Nigeria, The Conversation Africa

Dr. Daniel Nyadanu, Cocoa Research Institute of Ghana, Accra, Ghana

Prof. Eriola Betiku, Department of Biological Sciences Florida A&M University Tallahassee, USA

SCHEDULE OF ACTIVITIES (TIME ZONE GMT +1)

DAY ONE (MONDAY, MAY 6, 2024)

ARRIVAL

DAY TWO (TUESDAY, MAY 7, 2024): OPENING CEREMONY

Time	Activities	Anchor/Presenter
9:00 am	Arrival and registration of participants	**Dr. M.K. Awodele/Mrs. V.A. Ajayi**
9:45	Arrival of dignitaries and special guests	**Protocol**
10:00	National, State and LAUTECH anthems	Public Relations & Alumni Unit
10:05	Introduction of guests	**DR, Public Relations & Alumni Unit**
10:10	Convener/Host's speech	**Prof. Agbaje Lateef** Head, Nanotechnology Research Group (*NANO*$^{+}$), LAUTECH, Ogbomoso
10:20	Speech by Co-Chairman	**Major-General Ishola Williams (Rtd)** Executive Secretary, PANAFSTRAG, Lagos
10:30	Goodwill message	**Prof. Adepoju . T. J. Ogunkunle** Dean, Faculty of Pure and Applied Sciences, LAUTECH, Ogbomoso
10:40	Goodwill message	**Dr. Ruth Holly** Wellcome Collections/Wellcome Trust, UK
10:50	Chairman's speech	**Prof. Razaq O. Rom Kalilu** Acting Vice-Chancellor, LAUTECH, Ogbomoso
11:10	Citation of keynote Speaker	**Prof. T.B. Asafa**
11:20-12:30 pm	Keynote Speech ***Cola* in full Perspective**	**Prof. Omotoye Olorode** Odoje Biodiversity Centre, Ogbomoso, Nigeria
12:30	Vote of thanks	**Prof. Musibau A. Azeez** Chairperson, LOC
12:40	Photograph session	**Public and Alumni Relations Unit**
12:40	**Short break**	
1:00	Citation of lead speaker	**Prof. M.A. Azeez**
1:00-1:45	**Lead paper:** Kola, legendary plants of outstanding properties	**Prof. Joseph A. Morakinyo** Formerly of Department of Plant Biology, University of Ilorin, Nigeria
1:50	**Lunch break**	
2:30-3:20	**Lecture 3**: Green heterogeneous biocatalyst synthesis from kola nut pod husk: a case of waste-to-wealth	**Prof. Eriola Betiku** Department of Biology, Florida Agricultural and Mechanical University, Tallahassee, USA
3:30	**Lecture 4:** Kola for circular bioeconomy and sustainable development: our research efforts	**Prof. Agbaje Lateef** Department of Pure and Applied Biology, LAUTECH, Ogbomoso
4:10	**KOLA 2024/028:** Effects of bitter kola (*Garcinia kola*) as growth promoter in broiler chicks from day old to four weeks old	Adedeji, O.S., Farinu, G.O., Ameen, S.A., Olayeni, T.B., Oyetoro B.A., and Rom-Kalilu, F.A
4:20	**KOLA 2024/029**: The use of chemicals and botanicals for kolanut preservation in Nigeria – a systematic review and meta-analysis approach	Agulanna, F.T
4:30	**KOLA 2024/030:** Performance and egg quality parameters of laying hens fed different dietary inclusion levels of bitter kola (*Garcinia kola*)	Adedeji, O.S., Farinu, G.O., Ameen, S.A., Olayeni, T.B., Oyetoro B.A., and Rom-Kalilu, F.A
DISCUSSION/INTERACTION		

DAY THREE (WEDNESDAY, MAY 8, 2024)	
9:00 am	**Lecture 5: Workshop on communication of research findings to the public** **Wale Fatade** Contributing Editor, The Conversation-Africa
9:45	**Lecture 6**: A**dvances in *Cola* research: achievements, challenges and perspectives** **Dr. Patrick Adebola** The Executive Director, Cocoa Research Institute of Nigeria (CRIN), Ibadan, Nigeria
10:30	**Lecture 7: Application of genetics, physiological and biochemical approaches to overcome sexual incompatibility and pre-establishment stress of kola [Cola nitida (Vent.) Schott and Endl.]** **Daniel Nyadanu*, S.T. Lowor, Prince Pobee, Jerome Dogbatsey and Abraham Akpertey** Cocoa Research Institute of Ghana, Ghana
11:15	**Tea Break**

TECHNICAL SESSION

	Moderators	
	ABSTRACT NUMBER/TITLE	**AUTHORS/PRESENTERS**
11:30	**KOLA 2024/001**: Proximate and antimicrobial properties of *Garcinia kola*: a significant evidence of a functional food snack	Adeoye, A.O., Ajani, R.A., and Alabi, W.
11:40	**KOLA 2024/002:** Agro-morphological and molecular diversity of kola (*Cola nitida*) clones from Côte d'Ivoire and Nigeria	Yaya, O., Guillaume, K.K., Jean Marc, S.D., Désiré, P.N., Martial, S.D., Sélastique, A.D., and Sylvére, S.R
12:00 pm	**KOLA 2024/003:** Seed of underexploited *Cola millenii* K. Schum: A rich source of industrial product as bio-insecticides	Adegoke, A.E., and Bello, M.O
12:10	**KOLA 2024/004:** A review of the bioactive components and pharmacological properties of *Garcinia kola*	Akomolafe, A.P., Ibrahim, K., Onyemuwa, C., Olorunfemi, E.S., and Momoh, I.S
12:20	**KOLA 2024/005:** Search for rootstocks suitable for grafting of *Cola nitida* [(Vent.) Schott & Endl.]: case of *Cola cordifolia*	Jean-Marc, S.D., Ouattara, Y., Jean Brice, O.E., Menzan, G.K., Francis, Y., and Mahaman, K.O
12:30	**KOLA 2024/006:** Structure and market conduct of *Garcinia kola* Heckel (bitter kola) in Abia state, Nigeria	Olowoyo, F.B., Samson, E.O., Okpara, I.G.,Umunna, M.O., Aigbokie, S.O., and Okelola, O.E
12:40	**KOLA 2024/007:** *Garcinia kola*: A Comprehensive phytochemical and pharmacological review	Olorunfemi, E.S., Akomolafe, A.P., Adesokan, M.O., and Olayiwola, R.F
12:50	**KOLA 2024/008:** Potential drug interactions of bitter kola in the body system	Sulyman, R.A., Bello, H.B., Akinyele, A.A., Akomolafe, A.P., and Olorunfemi, E.S
1:00	**KOLA 2024/009:** An overview of the role and efficacy of *Garcina kola* in ophthalmology	Adegbehingbe, B.O
1:10	**KOLA 2024/026:** Botany and economic importance of monkey kola: an underutilized plant species in Nigeria	Azeez, M.A., Lateef, A., Nurudeen, O.N., Durodola, F.A., Adubi, A.O., Yekeen, T.A., Badmus, J.A., Adebayo, E.A., and Oladipo, I.C
1:20	**KOLA 2024/027:** Capacity building for kola farmers on good agricultural practices (GAPs) in Osun State	Abdul-karim, I. F., Adebiyi, S., Williams, O.A., and Adenuga, O.O
1:30	**KOLA 2024/032:** Possible variations in nutritional and phytochemical properties of different colour shades of cured and uncured *Cola nitida* seeds	Jayeola, C.O., Olorundare, B.O., Abdulkareem, F.I., Ugioro, O., Odeyemi, E.F., and Williams, O.A
1:30	**Lunch Break**	

	AFTERNOON SESSION: Moderators	**Prof. J.A. Badmus/Prof. M.O. Durowoju/Prof. M.A. Olamoyegun/Dr. O. Adedokun/Dr. M.K. Awodele**
2:10	**KOLA 2024/010:** *Garcinia kola* in knee osteoarthritis: effects on pain, obesity and hypertension	Adegbehingbe, O.O., Idowu, T.O., Oladiran, R.O., Ikem, R.T., and Oyelami, O.A
2:20	**KOLA 2024/011:** Efficacy of *Garcinia kola* in glaucoma management	Adefule-Ositelu, A.O., Adegbehingbe, B.O., Adefule, A.K., Adegbehingbe, O.O., Samaila, E., and Oladigbolu, K
2:30	**KOLA 2024/012:** Kinetic and thermodynamic studies of paracetamol adsorption onto extract modified groundnut shell activated carbon	Olowonyo, I.A., Aremu, M.O., Salam, K.K., and Lateef, A
2:40	**KOLA 2024/013:** Reflections on the history of kola nut and national integration in Nigeria	Oladiti, A.A., and Azeez, M.T
2:50	**KOLA 2024/014:** *Cola acuminata*: past, present and future in nanobiotechnology	Oladipo, I.C., and Ogunsona, S.B
3:00	**KOLA 2024/015**: Phytochemical characterization and GC-MS analysis of *Azanza garckeana* seed crude extract: identification of bioactive compounds	Yusuf-Omoloye, N.A., Ajigbewu, O.H., Adeyemi, F.M., Sule, W.F., Oyedara, O.O., Wahab, A.A., and Lateef, A
3:10	**KOLA 2024/016:** Pricking and hydro-priming duration improve germination of bitter kola (*Garcinia kola* Heckel) seeds	Hammed, L.A., Ojo, D.J., Olosunde, M.O., Olaiya, A.O., Olaniyan, A.B., and Olubode, O.O
3:20	**KOLA 2024/017:** Breaking dormancy in *Cola nitida*, Vent. Schott & Endl. through seed-coloured biotype with method and intensity of scarification	Hammed, L.A., Boladale, S.B., Olubode, O.O., and Atayese, M.A
3:30	**KOLA 2024/018:** Germination, seedling growth and dry matter accumulation of kola (*Cola nitida* Vent, Schott & Endlicher) in the nursery as affected by seed-biotype colour and curing period in dodecahedron pyramidal device (DPD)	Boladale, S.B., and Hammed, L.A
4:00	**KOLA 2024/019:** The health benefits of *Cola nitida*	Oladipo, I.C., and Ogunleke, O.B
4:10	**KOLA 2024/020:** Feed additive potentials of kola nut, bitter kola and wonderful kola: a review	Ojediran, T.K., and Ojediran, J.T
4:20	**KOLA 2024/021:** Innovations in technological advancement for kola nut processing	Itabiyi, O. E., Sangotayo, E.O., Olojede, M.A., and Akinrinade, N.A
4:30	**KOLA 2024/022:** Economics of the use of botanicals and readily available materials for storage and preservation of kolanut among stakeholders in Ekiti and Ogun States, Nigeria	Lawal, J.O., Oyedokun, A.V., and Ugwu, C.A
4:40	**KOLA 2024/023:** Potentials of alkaloids from kola plants in cancer treatment: a review	Badmus, J.A., Yekeen, T.A., Adedosu, O.T., Adebayo, E.A., Azeez, M.A., and Lateef, A
4:50	**KOLA 2024/024:** Biological activities of *Garcinia kola* and possible roles as an emerging therapeutic agent	Bello, K.A
5:00	**KOLA 2024/025:** Effects of storage materials on some chemical and biochemical parameters of three kola varieties preserved with three different storage materials	Olalekan-Adeniran, M.A., Akinoso, R., Yahaya, L.E., and Ogunjobi, M.A.K
5:10	**KOLA 2024/031:** The effects of dietary bitter kola (*Garcinia kola*) inclusion on body weight, haematology and survival rate of pullet chicks	Adedeji, O.S., Farinu, G.O., Ameen, S.A., Olayeni, T.B., Oyetoro B.A., and Rom-Kalilu, F.A
5:20	**Participants are to move to the general room for Polling and Closing of the conference**	
	DAY FOUR (THURSDAY, MAY 9, 2024): DEPARTURE	

WELCOME ADDRESSES

Prof. A. Lateef
Convener, Host and Head, Nanotechnology Research Group (NANO⁺), LAUTECH, Ogbomoso, Nigeria

It is with great joy that I welcome you to the 1st International Conference on Kola Plants (LAUTECH-PANAFSTRAG KOLA 2024). I am excited that this conference is organized by our research group in partnership with the Pan Africana Strategic and Policy Research Group (PANAFSTRAG), Lagos under the auspices of our referred statesman of inestimable value, Major-General Ishola O. Williams (Rtd), being the first of its kind with a non-governmental organization. In our engagements on nanotechnology, we have partnered with agencies of government in organizing conferences.

This conference focuses on the exploitation of kola plants beyond consumption by deploying latest technologies to extract more benefits from kola and its relatives. It was borne out of personal research efforts on kola nut over a decade. The story of this conference is a great lesson to me and underpins ceaseless pursuit of excellent research.

Our previous research activities on kola nut centred on conversion of waste-to-wealth by using its various parts to produce enzyme, food-grade supplement and several metal, metal oxide and alloy nanoparticles for the first time from 2012 till date. These new trends in the valorization of kola nut via biotechnology cum nanotechnology spurred me to write a review '*Cola nitida*: milestones in catalysis, biotechnology and nanotechnology for circular economy and sustainable development' which was published in Biocatalysis and Agricultural Biotechnology (Elsevier) in 2023. It was a summary of 16 articles that we had published on kola with the addition of other innovative reports by other scholars on kola nut.

In sharing the article on social media, Mr. Wale Fatade, the Contributing Editor (Nigeria) for The-Conversation-Africa took interest in the article and urged me to write a non-technical commentary for his outfit. I did under his editorial guidance and within a few days of the publication of the article titled ''Kola nut: from nanofertiliser to protecting metals from corrosion – our research finds new uses for the valuable plant'', two events unfolded. Firstly, it was translated to French by another journalist without prompting and the French version ''Noix de cola - du nanofertilisant à la protection des métaux contre la corrosion: notre recherche trouve de nouvelles utilisations pour cette plante précieuse'' was also published in The-Conversation-Africa. Secondly, I received a mail from Major-General Ishola Williams stating his interest to discuss with me the recently published article on kola nut in The-Conversation-Africa. The engagement

with General Williams led to the organization of this conference. He is such a strong motivator, who believes in the potentials and prospects of Nigeria.

Kola nut tree is a perennial cash crop that is grown because of its seed – kola nut. It is widely cultivated in West Africa but now found in Asia, South America and the Caribbean. Kola is rich in chemicals that give it stimulating effects when eaten. The world production of kola nut was about 311,331 tonnes in 2021 with Nigeria accounting for about 55.06%. Nigeria along with Côte d'Ivoire, Cameroon, Ghana, and Sierra Leone accounted for 99.80% of global production. The nut is traded across countries beyond West Africa. It is exported to USA, Europe, Mexico, India and China. In 2022, kola nut was priced at $2,500-4,800 per ton. However, there is the need to extract more economic gains from kola for sustainable development, which is the thrust of this conference.

We have assembled generations of scholars on kola in Nigeria and beyond to discuss research efforts on kola. Prof. Omotoye Olorode ranked among the earliest Nigerian scholars who worked on the genetics of kola nut, and Professor Joseph A. Morakinyo was his student at the University of Ife, Ile-Ife, Nigeria in this endeavour. Dr. Patrick Adebola, the Executive Director of Cocoa Research Institute of Nigeria (CRIN), Ibadan which has kola nut as one of its mandate crops was trained by Prof. Joseph A. Morakinyo at the University of Ilorin, Ilorin, Nigeria. Prof. Eriola Betiku is a renowned Chemical Engineer who has worked on an innovative generation of heterocatalysts from kola pod for biodiesel production. We shall listen to about 40 presentations that traverse crop and animal production, phytochemistry, food safety, phytomedicine, clinical trials, nanobiotechnology, commerce, history and culture with regard to kola plants.

The conference will push forward an agenda for the exploitation of kola plants within the paradigm of circular bioeconomy towards diversification of Nigeria's economy and for sustainable development agenda. Several innovative products can be generated from kola plants for applications in industries, agriculture, healthcare, environment, renewable and green energy among others.

On behalf of *NANO*$^{+}$, I thank the University under the leadership of Prof. R.O.R. Kalilu, the Executive-Secretary of PANAFSTRAG, Major-General Ishola Williams and Mr. Wale Fatade of The Conversation-Africa for various supports for this conference. Our invited speakers, participants and the entire University community and other guests are equally appreciated.

On this note, I welcome you to the 1st International Conference on Kola Plants and wish you a fruitful experience.

Thank you and God bless.

SPEECH PRESENTED BY THE EXECUTIVE SECREATARY OF PAN-AFRICANA STRATEGIC AND POLICY RESEARCH GROUP (PANAFSTRAG), MAJOR-GENERAL ISHOLA WILLIAMS (RTD) AT THE OPENING CEREMONY OF THE 1ST INTERNATIONAL CONFERENCE ON KOLA PLANTS

Protocols:

PANAFSTRAG expresses gratitude to the acting Vice-Chancellor, Prof. R.O. Rom Kalilu and the Management of LAUTECH for supporting Prof. Agbaje Lateef and his visionary team in holding this conference.

We appreciate the determination of Prof. Lateef with his team for opening the door to ideas and proposals to non-academic civil society organizations.

You cannot and must not especially continue with the Colonial Ivory Tower Principles and Practices. You have great models to adapt not adopt or copy blindly from the Japanese, the Koreans and obviously the Chinese. If we are to fast track Nigeria and lead African development, we must concentrate on APPLIED R & D with INNOVATION.

Let us look at the Chinese KEY R & D PROGRAMMES which are in areas of Social Welfare Education, Health and PEOPLES' LIVELIHOODS such as Agriculture, Energy and Resources, and Environment, which the Ministry of Innovation, Science, and Technology should note.

In addition, Chinese and many Universities worldwide are questioning '*publish or perish*' ideology and experimenting with new principle that will replace inappropriately '*publish or perish*' ideology which inhibits African Development in line with adapting those key priorities above. We must transform the Academic Colonial Ivory Towers to the African Peoples Towers in this regard.

We must establish special titles for Professors whose outputs have benefits for the people on medium or long term which the Ministry of Education and other relevant bodies should consider for implementation. Many scholars like Prof. Lateef and his team have products but is the Zonal Incubation Centre working with its linkages to SMEDAN, MAN, NACCIMA towards realization of commercialization of such products?

As a country, we have money to do what the Asians are doing if we stop talking to the gallery but be people-centred and stop stealing from the Common Wealth, but prudent with the public purse.

The future is AI for repurposing of products or creating new products. Are we ready to leapfrog? The Ministry of Innovation, Science and Technology, with the Ministry of Communications and Digital Economy must answer about the readiness of the country towards advances in AI. We need to produce materials for food to nuclear power including smart chips to begin with. We need to encourage more of these activities.

I do want to plead with Prof. Lateef and his team to continue to open their doors to ideas and to collaboration and be a model to other Tertiary Institutions. Zoom and other communication technologies are in place for meetings and intellectual discourse. Therefore there is no excuse for lack of progress.

PANAFSTRAG will continue to challenge LAUTECH and willing Universities with ideas and propositions because without producing our materials and products we cannot eat, build or manufacture anything. The Raw Materials Research and Development Council is yet to give account of its stewardship in our development. We request the acting VC and the Management, to please continue with your support.

To the Activist cum Scientist Keynote Speaker, Prof. Omotoye Olorode never-say-tire and other Speakers, give us actionable ideas and follow up too. Our request is to do same for palm products for its wine, kernels, nuts, and rafts with institutions which can get support from several agencies of government.

No institution has enough money, therefore our institutions are not poor, as they claim, to do what they needed to make Nigeria develop for our well-being with Ivory Towers becoming Peoples' Towers and replace '*publish or perish*' with '*PUBLISH FOR PUBLIC GOOD*'.

It will be well with all of us and our country. We shall overcome.

Thank you.

WELCOME ADDRESS BY THE ACTING VICE-CHANCELLOR, PROFESSOR RAZAQ OLATUNDE ROM KALILU AT THE 1ST INTERNATIONAL CONFERENCE ON KOLA PLANTS HELD ON MAY 7-8, 2024 AT LAUTECH, OGBOMOSO, NIGERIA

The Principal Officers of Ladoke Akintola University of Technology, Ogbomoso,
The Executive Secretary, Pan Africana Strategic and Policy Research Group (PANAFSTRAG),
Keynote Address Speaker,
Professors and otaher academics,
Conference attendees,
Distinguished ladies and gentlemen

On behalf of the University, it is my pleasure to welcome you to the 1st International Conference on Kola plants with the theme "**The treasure beyond consumption: exploring kola for sustainable development**". I am particularly delighted to note that this conference is organized by the LAUTECH Nanotechnology Research Group (*NANO*+) in collaboration with a Non-governmental International Organization, '*Pan Africana Strategic and Policy Research Group (PANAFSTRAG)*' under the leadership of a distinghuised elder stateman, Major-General Ishola Williams (Rtd) towards diversification of the Nigeria's economy by leveraging on kola plants; majority of which Nigeria is the world largest producer.

The *NANO*+ is a much-cherished research group in this University with track records of quality research via multidisciplinary concept. Earlier, the group has organized seven international conferences on nanotechnology at LAUTECH and Abuja. Most recently, the group canvassed for the establishment of the Center for Nanoscience and Nanotechnology Research (CEENANO) which is now a reality. In extending the frontiers of knowledge, members of the group have looked at kola nut beyond its mere consumption; but extended its utilities to biocatalysis, biotechnology and nanotechnology. I was briefed by the Head of the group, Prof. A. Lateef, that it was a commentary in regards of these new exploitations of kola nut which was published by *The Conversation-Africa* that motivated Major-General Ishola Williams to partner with the group in organizing this conference.

We are delighted that LAUTECH-PANAFSTRAG KOLA 2024 is a reality and the University is poised to partner with NGOs and CSOs in areas of mutual interests for the good of our nation and mankind. I am also happy that a doyen of kola research in Nigeria, another distinghuised elder stateman, Prof. Omotoye Olorode has been invited as the keynote speaker. At the moment, our country faces dire economic situation that requires critical thinking on diversification and creation of knowledge-based economy. The exploitation of kola and its relatives via research-based initiatives would contribute to efforts at smart exploitation of plant resources for sustainable development.

Our University is ready to champion this new thinking and this conference is one of such efforts at stimulating discussion on knowledge-based economy. We have the track records as the best State University in Nigeria, and the 11th in Nigeria according to the Times Higher Education (THE) of the UK. These accomplishments are due to the outstanding research efforts and dedication of staff, which would continue to receive supports of the University.

On this note, once again, I welcome you to the LAUTECH-PANAFSTRAG KOLA Conference 2024, the first of its kind, as I wish you fruitful discussion.

PLENARY LECTURES

Cola in full Perspective: Keynote address

Prof. Omotoye Olorode, B. Sc. (Ife), M.A., Ph. D. (Kansas)
Odoje Biodiversity Center, Odoje-Orile, Ogbomoso

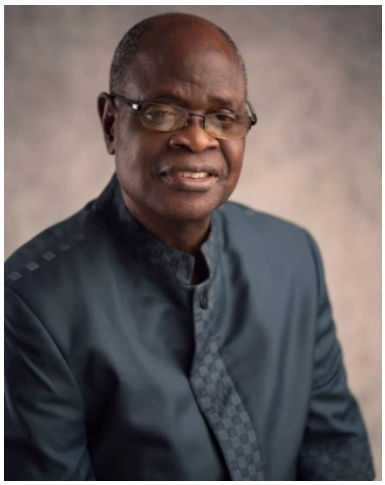
The theme of this conference, '*The Treasure beyond Consumption: Exploring Kola for Sustainable Development*', is quite loaded and intriguing. Therefore, we need to start with an interrogation of the theme! Suffice it to insist that all consequences of human activity—physical or intellectual—that have use value lead to some form of consumption or use which may diminish the quantum of the consequence of such activity.

Arising from the foregoing, *Cola* Schott & Endlicher (Sterculiaceae), the subject matter of this conference, implicates a whole lot of issues, a large number of specialisations, and with a plethora of possibilities of insights that will be ultimately related. The various relevant areas outlined in the Conference announcement of April 18, 2024 already presaged these preliminary observations.

Given the rather ambitious sweep of the intent of the theme of this conference, a keynote presentation can only attempt an outline of the issues that will, or may, be pertinent in our disquisition. Consequently, I have divided this presentation into three parts and a conclusion that are, of course, related as we shall see. These parts or segments are:
Variation (being the province for analogous or homologous properties), and wild relatives, of the genus *Cola*; including genomic and chemical (organic constituents, secondary products, and chemo-taxonomic properties) relationships. Where does, bitter "kola" and other "kolas" come in?

Phyto-geography and distribution of *Cola* and its relatives in Nigeria.

Use of *Cola* as masticatory, food, medicine, and social activities. *Cola* in Nigerian economy—colonial and post-colonial; *Cola* trade in regional (West African) and national (Nigerian) integration.
The paper concludes with reflections, in regard to *Cola*, on human environment as determinant of culture, history, science, religion and overall social relations.



Kola, legendary plants of outstanding properties

Professor Joseph Akintade Morakinyo
Formerly of Department of Plant Biology, University of Ilorin, Ilorin, Nigeria

There are two groups (i.e., two genera) of plants that share "kola" as their common name, they are *Cola* and *Garcinia*, called "kola" and "bitter kola" respectively, but this review is essentially on *Cola*, focusing on *Cola nitida*. The origin, history, production, and utilization of the nut of *Cola nitida*, and research into its utilization, production and improvement are reviewed. Kola is indigenous to Africa and its use by Africans as a stimulant to suppress thirst, hunger, fatigue and drowsiness dates back to prehistoric times. This is in addition to its cultural and mystic values for hospitality, payments, and consultation with the gods.

In the past two centuries, the use of kolanut extracts in the pharmaceutical industry, beverage industry, in medication and for culinary purposes have become well established based on the chemical composition of the nuts that includes caffeine, theobromine, kolatin, phenolics, etc. The use of kolanut extract in coca cola was one of the popular industrial uses of kolanut more than a century ago. Several other industrial products, worldwide, have kolanut extract in them, and this utilization potential has led to the need for increased kolanut production and research for improvement.

Research into kolanut production improvement dated back to 1911, but detailed experimental field planting started in 1964 with the planting of a diallel cross experiment in Agege, Nigeria, for detailed evaluation of eight selected clones and their twenty-eight hybrids. All the 36 genotypes had significant variances with the higher kolanut yielding kola clones AA231 and AC71 also having high combining abilities, the general combining ability (gca) being higher in AA231and the specific combining ability (sca) higher in AC71 for kolanut yield. This experiment led to the discovery of better yielding clones AA231, AC71 and AD44 that were recommended for kolanut production or for use in developing synthetic varieties based on their gca or to be used in specific hybrid combinations, based on their sca.

The diallel crosses also led to the discovery of sexual incompatibilities (self-and cross-incompatibilities) which are known to drastically reduce kolanut production on farms by up to 50%. Associated with the sexual incompatibilities is the variable breeding

system with emerging dioecy that also reduces kolanut production by limiting fruit bearing to only plants with female flowers. In addition to these constraints of incompatibilities and emerging dioecy is the grossly inefficient natural pollination by relatively unknown insect which has led to the recommendation of hand pollination. Hand pollination is known to give phenomenal increase to Kolanut production (10 – 20-fold increase), it is however labour intensive and may not be economical. Improved insect pollination may, therefore, be a viable option, but will require identifying kola plant pollenizers and factoring honeybee pollination into the production. In the meantime, there is the need for focused research attention on all identified constraints of kolanut production. The usefulness of stem cuttings in reducing kola tree height, maturity time, and ensuring genotype stability and high kolanut yield, is highlighted.

Green heterogeneous biocatalyst synthesis from kola nut pod husk: a case of waste-to-wealth

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Due to their caffeine stimulation, kola nuts, *Cola nitida* (obi gbanja or goro) and *Cola acuminata* (abata) are of huge social and economic value in Nigeria and other West African countries. Nigeria is the world's largest producer of kola nuts. In 2022, the production of kola nuts in Nigeria was 174,107.87 t, which accounts for 55.27% of the world's production (315,024.46 t).

Once the fruits are extracted from the pods, the husks are discarded. Disposal of the kola nut pod husks is a major challenge that must be addressed because it adds to environmental pollution. Although there are reports on the conversion of husks to absorbents, as a source of potash in soap manufacturing, and as a bio-oil source for biofuel production at the laboratory scale, there is no known industrial usage of the waste.

Our research group has investigated the potential of kola nut husks as a catalyst for transesterifying oils into biodiesel. The husk is rich in potassium (K) and calcium (Ca) upon calcination at high temperatures (300–1100 ^{o}C). The husk has been prepared without pretreatment and used directly for catalyst production with great success. In another study, it was fermented and pretreated with methanol before calcination. However, the additional steps did not improve the catalytic activity.

The catalyst has been used to catalyze the transesterification of yellow oleander (*Thevetia peruviana*) oil, Kariya (Hildegardia barteri) seed oil, and rubber (*Hevea brasiliensis*) seed oil. In another study, the husk was combined with cocoa pod husk and plantain peel to prepare an active heterogeneous alkali catalyst (with high K, Ca, and Mg contents) that was used to catalyze the transesterification of honne, rubber, and neem oil blend.

Three different husks from kola nut, cocoa, and fluted pumpkin were blended and used to manufacture another heterogeneous alkali catalyst. The catalyst was found to be rich in K, Ca, and Fe and was used to catalyze the transesterification of the yellow oleander and rubber oil mixture. All the studies involving kola nut husk for catalyst manufacturing demonstrated that it could serve as a value-added product and help reduce biodiesel production costs while combating environmental pollution.

Kola for circular bioeconomy and sustainable development: our research efforts

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Nigeria

The theme of this conference, '*The Treasure beyond Consumption: Exploring Kola for Sustainable Development*', was borne out of personal experiences in exploring *Cola nitida* for the production of microbial enzyme, food-grade supplements and nanoparticles by deploying skills in biotechnology and nanotechnology in research endeavours dating back to 2010.

These efforts have proven that kola nut can be of tremendous values beyond its consumption and phytomedicinal exploitation. In this presentation, we shall share our experiences in using different parts of kola nut in creating new range of products that contributes to sustainable development through circular bioeconomy.

Application of genetics, physiological and biochemical approaches to overcome sexual incompatibility and pre-establishment stress of kola [*Cola nitida* (Vent.) Schott and Endl.]

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Cocoa Research Institute of Ghana, Akim Tafo, Ghana

Kola [*Cola nitida* (Vent.) Schott and Endl.] is a tree crop of great economic and socio-cultural importance. Sexual incompatibility and pre-establishment stress due to drought and heat stress are some of the bottlenecks of kola production. Studies to select kola varieties that are sexually compatible and tolerant to drought stress are limited. The objective of this study was to assess self-compatibility and cross-compatibility of kola genotypes using genetics, physiological and biochemical approaches. Also, the study aimed to evaluate the offsprings of the crosses for tolerance to stress under field conditions and under well watered and drought stressed conditions in a screenhouse.

Assessment of self-compatibility and cross-compatibility of genotypes of kola field gene banks at the Cocoa Research Institute of Ghana was carried out. Data was collected on pod set, number of pods, pod weight, number of nuts per pod, outturn of nuts and brix. Pollen grain production, pollen grain germination ability, pollen tube length of the various kola genotypes were also evaluated. The genotypes were also assessed for elemental minerals, sugars and phenolic compounds known to play a role in fertility and sexual compatibility of crops. Under the well watered and drought stressed conditions in the screen house, data was collected on growth of shoot, root and physiological traits. Under field conditions in two production environments, the kola hybrids were assessed for survival, leaf chlorophyll, leaf senescence, plant height and stem diameter. Differences among the accessions of kola for pod set or sexual compatibility, yield traits, pollen functional traits, pollen and stigma biochemical traits was assessed through generalized linear models, kruskal-wallis tests and multivariate analysis.

Significant and large variations for sexual compatibility, nut yield and nut quality attributes were observed for crosses of genotypes of field genebanks of kola in Ghana. The cross pollinations in general resulted to more than two-fold pod set than the self-pollinations confirming the need for pollinizers to increase fruit set in kola. Differences among the genotypes for pollen viability, pollen germination and pollen tube length was significant ($P<0.05$). Significant and positive correlation was observed between pollen germination and pod set. The correlation between pollen tube length and pod set was also significant ($P < 0.05$). Individual genotypes with high pollen quality identified

in this study could be used as parents to develop kola hybrids with enhanced pollen germination and pollen tube vigor and thus enhance fruit set and seed set in kola plantations to increase profitability of farmers.

Our findings revealed remarkable genetic variations among the accessions of kola for sugars, phenols and elemental minerals in the pollen and stigma tissues. The top three traits that had high CoS2 values and drive genetic diversity among the accessions of kola were phenols, flavonoids and magnesium suggesting their importance for breeding pollen and stigma biochemical traits to improve compatibility of kola genotypes. In general, the regression between sexual compatibility and elemental minerals and soluble sugars composition was positive and significant. This suggests that an increase in elemental minerals and sugars composition could result in expression of sexual compatibility in the stigma of kola genotypes. The regression between sexual compatibility and phenols and flavonoids was significant and negative. This indicates that an increase in phenolic compounds composition of pollen and stigma could result in expression of self-incompatibility in kola.

These findings provide new insights into the mechanisms of sexual incompatibility in kola. There were significant differences among the kola hybrids grown under field conditions in two environments for survival, leaf chlorophyll, leaf fluorescence, plant height and stem diameter. Similarly, genotypic variations were observed among the kola hybrids assessed under screen house conditions for drought tolerance, shoot and root traits. Kola hybrids with potential for self-compatibility and tolerance to pre-establishment stress were identified and would be important in developing high yielding varieties of kola.

Advances in *Cola* research: achievements, challenges and perspectives

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The Kola crop is grown in the forest area and the sheltered valleys in the forest outliers of the savannah areas and is of tremendous importance to the people of Nigeria. The two major species are *C. nitida* and C. *acuminata*, which are cultivated for their edible seeds. Less is, however, known about the wild relatives of Kola that are rarely cultivated.

Cocoa Research Institute of Nigeria (CRIN) was established 1964 and mandated to engage in research and development activities on Kola and other four major economic crops. The institute engages in the improvement of the genetic potentials, agronomic and husbandry practices, processing and storage of the crops. Other activities include the integration of the cultivation of the crop into cropping systems engaged by farmers, identification of the ecology and control methods of pest and diseases affecting crops; investigation of the effective utilization of the crop and its by-products, and the feasibility of small-scale production of such end-use products.

Genetic improvement, best agronomic practices and the development of several end-use products are among the advances of Kola research highlighted in this paper. On the other hand, most kola plantations in Nigeria are very old, moribund and fruitless, with those that produce fruits having declining in yield. New kola plantings are almost non-existent. Other challenges militating against the improvement of the crop among which are poor yields, long gestation period, pest and disease problems, and problems associated with storage are also discussed.

Information on Kola is still very scanty despite its economic importance in West and Central Africa. Greater research effort is needed in this crop especially on improving productivity, diseases and pest control, and reduction of post-harvest loses in the two commercial species. Speeding up the breeding cycle and circumventing the interspecific crossability barriers through the use of appropriate molecular tools should also be of priority.

ABSTRACTS OF ORAL PRESENTATIONS

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Proximate and antimicrobial properties of *Garcinia kola*: a significant evidence of a functional food snack

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Keywords
Garcinia kola
Aqueous extract
Acetone extract
Antimicrobial properties

Abstract

Garcinia kola, an economic plant is widely valued in West and Central Africa for its edible nuts as well as for ethno-therapeutic applications. Macronutrients and antimicrobial potential of the seed were investigated. Proximate composition was done and the active constituent extracted by water and acetone extractions at different concentrations. Bacterial isolates; *Staphylococcus aureus, Escherichia coli, Streptococcus pneumoniae, Haemophilus influenza, Klebsiella pneumoniae,* and *Bacillus subtilis* were tested to determine the potency of the extract as an antimicrobial agent. The extract was concentrated and varying dosage was used to confirm the susceptibility profile of six bacterial isolates. The result showed that the aqueous extracts exhibited higher antimicrobial activities at 200 mg/ml, with zones of inhibition between 18-24 mm for hot water and 5.0-19.4 mm for cold water extract. Graded acetone extract was found to exhibit more significant inhibition against the isolates. The highest zone of inhibition was observed at 200 mg/ml with highest inhibition of 28.00 mm obtained against *Staphylococcus aureus*. The lowest zone 10.00 mm was seen at 6.25 mg/ml. This work showed that *G. kola* has food value and antimicrobial properties with aqueous and acetone extracts having varying degree of antimicrobial properties.

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Agro-morphological and molecular diversity of kola (*Cola nitida*) clones from Côte d'Ivoire and Nigeria

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Keywords
Cola nitida
Côte d'Ivoire
Nigeria
Morphological traits
Molecular diversity
SNP

Abstract

Kola nut is important to Ivorian economy. However, its cultivation faces major difficulties, including the lack of quality planting material. To overcome this constraint, the kola research program has focused on exploiting the intraspecific diversity of *Cola nitida*. Thus, 30 clones from Côte d'Ivoire and Nigeria were characterized morphologically and molecularly (with 145 SNP markers). The results showed contrasting morphological traits between the two origins. Nigerian clones have a thick cortex, large nuts and large leaves, unlike those from Côte d'Ivoire. Three groups independent of origin were revealed. The GI group seems more interesting, with clones with large nuts. On a molecular level, the 145 markers used were moderately informative (PIC = 0.38). Differentiation among populations was moderate (F_{ST} = 0.11), allowing partial separation of the two origins. The genetic distance was 0.46. In addition, the groups formed by PCoA and phylogenetic analysis were superimposed on the geographical origins of the clones. Analysis of the genetic structure of the clones revealed six groups. The NIG-366, NIG-379 and NIG-350 clones from Nigeria are very close to the Côte d'Ivoire origin. Comparison of genetic groups revealed a strong divergence between CIV2 and NIG3 for nut size and mass, and could therefore be used as genitors for search for QTLs linked to the traits concerned.

Diversité morphologique et moléculaire des clones de colatier (*Cola nitida*) originaires de la Côte d'Ivoire et du Nigeria

La noix de cola est importante pour l'économie ivoirienne. Cependant, sa culture se heurte à d'importantes difficultés,

notamment le manque de matériel végétal de qualité. Pour surmonter cette contrainte, le programme de recherche sur la cola s'est concentré sur l'exploitation de la diversité intraspécifique de l'espèce Cola nitida. Ainsi, 30 clones originaires de Côte d'Ivoire et du Nigeria ont été caractérisés morphologiquement et au plan moléculaire (avec 145 marqueurs SNP). Les résultats ont montré des caractères morphologiques contrastés entre les deux origines. Les clones du Nigeria ont un cortex épais, de grosses noix et de grandes feuilles, contrairement à ceux de Côte d'Ivoire. Trois groupes génétiques indépendants de l'origine ont été mis en évidence. Le groupe GI semble plus intéressant, avec des clones à grosses noix. Au niveau moléculaire, les 145 marqueurs utilisés sont moyennement informatifs (PIC = 0,38). La différenciation entre les populations a été modérée (FST = 0,11), ce qui permet de séparer partiellement les deux origines. La distance génétique est de 0,46. De plus, les groupes formés par la PCoA et l'analyse phylogénétique ont été superposés aux origines géographiques des clones. L'analyse de la structure génétique des clones a mis en évidence six groupes. Les clones NIG-366, NIG-379 et NIG-350 du Nigeria sont très proches de l'origine ivoirienne. La comparaison des groupes génétiques a révélé une forte divergence entre CIV2 et NIG3 pour la taille et la masse des noix, et pourraient donc être utilisés comme géniteurs pour la recherche de QTLs liés aux caractères concernés.

Mots clés : *Cola nitida*, Côte d'Ivoire, diversité moleculaire, caractères morphologiques, SNP

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Seed of underexploited *Cola millenii* K. Schum: A rich source of industrial product as bio-insecticides

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Keywords
Cola millenii
Bio-insecticide
Industrial product
Callobruchus maculatus
Bioactive compounds

Abstract

The search for industrial products from natural resources is an on-going process. Thus, in screening of plant constituents of economic significance, seed extract of one of the under–exploited *Cola* species-*Cola millenii* K. Schum was investigated for bioactive compounds and insecticidal activities against *Callobruchus maculatus* known for destruction of beans on the field and in storage. *C. millenii* seed extract was obtained by cold maceration with methanol and the bioactive compounds were quantified using Gas Chromatography-Mass Spectrometer. *C. maculatus* obtained from infested cowpea sample was reared for the emergence of another generation on Ife brown beans in plastic jars covered with plastic mesh. The LC_{50} was deduced from the plot of mortality against concentration. The likely mode of insecticidal activity of the samples; Glutathione-s-transferase and acetylcholinesterase activities were determined spectrophotometrically. A yield of 7g/100g methanolic seed extract was obtained and twelve compounds amounting to 97% were identified. The extract showed potent bio-insecticidal activity with LC_{50} of 1.67 mg/ml. It significantly ($p<0.05$) decreased the activities of glutathione-s-transferase by 80% and acetylcholine esterase by 66.67%. *Cola millenii* seed methanolic extract have insecticidal properties that involve the inhibition of neurological and cellular defence mechanisms of *C. maculatus*. It is therefore recommended that a bio insecticide should be developed from *Cola millenii* extract and commercialization of the product encouraged.

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A review of the bioactive components and pharmacological properties of *Garcinia kola*

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Keywords
Garcinia kola
Antidiabetic
Antihypertensive
Antianalgesic
Drug development

Abstract

The use of traditional plant-based medicines as alternative treatments for a wide variety of diseases has grown in significance, and researchers continue to investigate the application of plant materials to medicinal practices. *Garcinia kola*, a folk medicine, commonly called bitter kola (English), orogbo (Yoruba), adi (Igbo) and Gooro (Hausa) has been used to cure a variety of conditions, including appendicitis, liver damage, diarrhea, infections, nausea, and vomiting. The aim of this review is to extensively update important and current information about its potential pharmaceutical applications. We used electronic resources like ScienceDirect, PubMed, Wiley, Google Scholar, Hindawi, and Springer to find relevant information about the pharmacological properties and phytochemical components of *Garcinia kola*. The pharmacological properties of *G. kola* have been associated with the presence of a broad range of chemicals in extracts from different plant sections, including benzophenones, flavonoids, xanthenes, and 9,12-Octadecadienoic acid (Z, Z), stearic acid methyl ester, hexadecanoic acid methyl ester, and 9-Octadecenoic acid methyl ester. Here, we highlighted current information on its pharmacology, history, distribution, traditional uses, phytochemical components, and range of biological activity. Various parts are highly effective as antiviral, antifungal, antipneumonia, cytotoxic, antitrypanosomal, antibacterial, antihypertensive, antianalgesic, and anti-inflammatory agents. Investigations of the mechanisms underlying the chemical components' bioactivity are required. Furthermore, characterization of different bioactive compounds would enable advancements in drug development, suggesting that the development and application of these active components could benefit humanity as a whole.

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Search for rootstocks suitable for grafting of *Cola nitida* [(Vent.) Schott & Endl.]: case of *Cola cordifolia*

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Keywords
Cola nitida
Terminal cleft grafting
Cola cordifolia
Survival rate

Abstract

Improving the yield of Ivorian kola orchards requires the creation of high-performance planting material. The use of vegetative propagation of high-performance clones by cuttings is hampered by low success rates and poor rooting of the plants obtained. The production of grafted plants from high-yielding clones is therefore being considered. The aim of this study is to determine the effect of genotype on the success rate of plants grafted with *Cola cordifolia* and thus to determine the effectiveness of the *Cola cordifolia* rootstock. Five genotypes are involved: AMA, BOGO, DIDI, MOUSS and SELI. The experimental design was a total randomisation with one factor under study (the genotype) and three replications. End-split grafting was carried out in a tunnel nursery. The experimental unit consisted of 10 plants. The survival rate of the plants was measured after one month of experimentation. The results showed an average success rate of 54.7±13%. The genotype had no significant effect on success rates. Thus, end-split grafting applied to *Cola cordifolia* used as a rootstock is advantageous for the propagation of *C. nitida*. *Cola cordifolia* could therefore be offered to *Cola* growers in the future as a substitute for *Cola nitida* rootstock for seedling production.

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Structure and market conduct of *Garcinia kola* Heckel (bitter kola) in Abia State, Nigeria

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Keywords
Market structure
Bitter kola
Marketing
Respondents

Abstract

This study examined the structure and market conduct of *Garcinia kola* in Abia state. The producers, marketers and consumers as respondent were purposively and randomly selected in the study area. Data were collected with the aid of a well-structured questionnaire administered interpersonally to 180 respondents. Descriptive statistics tools were used to analyze the usefulness of *Garcinia kola* to the respondents while Gini coefficient was used to analyze the market structure. The results show that the major usefulness of bitter kola was medical reasons (60%), cultural reasons (17.1%), while 12.5% of the respondents have both medical and cultural reasons. The results show a Gini coefficient of 0.06 for the bitter kola marketers, which indicate higher competition for sales of the bitter kola in the study area. Deforestation, seasonal fluctuation in production, lack of modern processing technology and price fluctuation were the most severe constraints to bitter kola marketing. Based on these findings, it was recommended that bitter kola marketers should endeavour to form a co-operative to assist one another with loans. The government should create awareness and campaign against deforestation among youths and adults. Also banking industry in Abia State should consider giving out loans to traders to enable them go on mass trading of the product since price fluctuation was one of the most severe constraint to bitter kola marketing in the study area.

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Garcinia kola: A Comprehensive phytochemical and pharmacological review

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Keywords
Garcinia kola
Gastroprotective
Hepatoprotective
Bioactive compounds
Phytochemicals

Abstract

Plant derived medicines have made substantial contribution to human health and has been a source of inspiration for novel drug. Due to the significant uses of traditional plant-based medicine in the treatment of diverse diseases, researchers continue to investigate their applications in various ways ranging from their pharmacological, pharmaceutical to clinical activities. This review aims to give the detail important and novel information on the clinical and toxicological uses of wonder plant using various data basis. Some of the resources used in this study include materials sourced from Scopus, Springer, ScienceDirect, PubMed, Wiley, Google Scholar, Hindawi and other databases. *Garcinia kola* has been used as a remedy against various diseases such as diabetes, rheumatism, menstrual cramp, throat infection, liver disorder, cardiac diseases and malaria. This study revealed that *Garcinia kola* has antidiabetic, antimicrobial, pharmacological, anti-trypanosomal, anti-asthmatic, anti-malaria, anti-hypertensive, anti-inflammatory, analgesic, cardioprotective, gastroprotective, hepatoprotective and nephroprotective activities. The presence of bioactive compounds such as saponins, tannins, flavonoids, sterols, triterpenoids, alkaloid, and phenol significantly present in the plant extracts, support its numerous properties and uses in traditional medicine.

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Potential drug interactions of bitter kola in the body system

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Keywords
Garcinia kola
Aphrodisiac
Kolaviron
Anticoagulant,
Antihypertensive
Drug interaction

Abstract

Understanding of the interactions of drug with certain foods, drinks or other consumables is an important process. The functions of some drugs are inhibited due to their interactions with another specific substance consumed, which can lead to complications of the side effects of the particular drug and even worsen the medical condition. Bitter kola; a highly valuable traditional seed is known for its efficacy in the treatment of throat infections, malaria, cold, and to induce aphrodisiac effect. The seed has been reported to be rich in bioactive compounds including kolaviron, flavonoids, benphenones, benzopyran, xanthones, kolanone and garcinianin which are responsible for its medicinal properties. The seed is commonly taken as snacks by both young and old people without the consideration of the effects of its interaction with the drug they are placed on. Hence, this review paper aimed to provide comprehensive information on the interactions of bitter kola with some specified drugs. Numerous bibliographic databases such as Google Scholar, Researchgate, PubMed, Springer and ScienceDirect were used to access recent updates on the subject matter. It was observed that the use of bitter kola may interfere with the metabolism of drugs such as anticoagulant, antidiabetic and antihypertensive medications in the body thereby altering their effectiveness or initiate a side effect. Hence, it is recommended that the consumption of bitter kola especially immediately after taking certain medications should be discouraged.

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An overview of the role and efficacy of *Garcina kola* in ophthalmology

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KOLA 2024/009

Keywords
Garcinia kola
Antimicrobial
Ophthalmology
Pharmacodynamics
Clinical trials

Abstract

Garcinia kolanuts, Heckel Guttiferrae species are trees common and grown in the savanna forests of most West African countries. They are grown in the southern parts of Nigeria. They are edible but bitter, and are widely used both for medicinal purposes and traditional ceremonies. The medicinal properties of its tree and the fruit are currently and vastly being studied. Based on the findings from many experimental animal and human clinical trials, the role of *Garcinia Kola* (GK) has been demonstrated in its antibiotic, antifungal and antiviral properties in additions to several other pharmacological properties that have been documented in Ophthalmology. GK aqeous solution had strong inhibitory activities on *Escherichia coli, Enterococcus faecalis, Proteus mirabilis* and *Staphylococcus albus*. When the effects of the 5% of GK aqueous solution was compared with that of 0.05% ciprofloxacin there was no statistical difference P<0.5%. These results give evidence of some antibacterial activities in Garcinia kola extracts. Following other studies done on laboratory animals and *in-vitro* bacterial flora from hospital clinic patients eyes, it was detected that these same extracts could also have antifungal activities. These studies established that GK extracts exhibited significant sensitivity and inhibitory activities against the fungal micro-organisms isolated from patients' eyes. GK aqueous solution had being studied *in-vivo* for possible antiviral activities following the proven antibacterial and antifungal effects *in-vitro* on human conjunctival isolates in earlier studies. This present study is a preliminary research on the antiviral effects of the same extract on patients' eyes clinically diagnosed with viral infections. The effectiveness of GK extract to quickly bring resolutions to the ocular symptoms and signs of the patients suffering from either EHKC and or EKC was highly noticeable and encouraging. Since no specific anti-adenoviral agent is presently in existence globally, this may serve as a breakthrough in the management of these viral infections.

	A multi-centre, non-randomised within-patient controlled study was performed on 106 adult volunteers to investigate the effects of *Garcinia kola* extracts on the pupillary sizes; a 4% aqueous drop has a transient miotic effect on human pupils not sustainable for more than 45 minutes. We conducted another study to evaluate the intraocular pressure(IOP) lowering efficacy of *Garcinia kola* 0.5% aqueous solution eye drops in patients with newly diagnosed primary open angle glaucoma or ocular hypertension compared with Timolol Maleate 5%. This was a randomized; double masked, multicenter, active controlled prospective study. The IOP lowering effect of both treatments was equivalent. Another study compared the pharmacodynamic activities of *Garicinia kola* (GK) extract with known antiglaucoma medication using the movements and sites of separation on thin layer chromatography. Thin layer chromatography (TLC) showed comparative corresponding spots of the extracts with those of the antiglaucoma drugs, and the same extent of movements'. The laboratory analysis of the GK extracts showed receptors inhibition of B-adrenergic sites, adenosine, melatonin, opiate, purine, calcium channel L-type and 5HT5A. More research is currently ongoing.

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Garcinia kola in knee osteoarthritis: effects on pain, obesity and hypertension

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Keywords
Garcinia kola
Flavonoids
Arthritis
Obesity
Hypertensive Heart Disease
Non-pharmacological care

Abstract

An abundance of pain and risk factors in knee osteoarthritis (KOA) indicates the imperfect nature of pharmacological therapy. This study evaluated the effect of *Garcinia kola* on blood pressure and body weight in hypertensive-obese KOA (HOKOA) patients.
We performed a prospective phase IV, randomized, intention to treat, controlled, double blind, clinical trial. Patients who met the inclusion criteria were randomized into three groups (A, amlodipine; B, *G. kola*, and C, control [ascorbic acid]). Each dose of research drug consisted of 5 mg amlodipine, 250 mg *G. kola*, and 100 mg ascorbic acid. The primary outcome measures were change in mean weight (kg) and blood pressure (systolic pressure [SBP], diastolic pressure [DBP]). A phase I study established an effective pain control effect of *G. kola* in KOA subjects. Seventy-three HOKOA patients of a phase IV study were recruited and 49 met inclusion criteria. *G. kola* appeared to significantly reduce blood pressure with a decrease in SBP (-14.37±6.73 mmHg, and decrease in DBP (-9.48±3.43 mmHg). *G. kola* resulted in a mean weight loss of 6.6% + 4.6% (95%CI: 4.2-9.1, $p<0.0001$). After cessation of *G. kola*, the mean duration of blood pressure control was 9.1±7.4 days and the mean weight reduction period was 13.6±8.3 days. *Garcinia kola* in short term appears to be clinically effective at lowering mean blood pressure and promoting weight reduction in KOA. Ultimately, this reduction in pain, obesity and blood pressure by *G. kola* could prolong a person's life.

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Efficacy of *Garcinia kola* in glaucoma management

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Keywords
Garcinia kola
Flavonoids
Arthritis
Obesity
Hypertensive Heart Disease
Non-pharmacological care

Abstract

Garcinia kolanut, a natural fruit native to west Africa has been found to be useful in treating many medical conditions worldwide. We evaluated the intraocular pressure (IOP) lowering efficacy of *Garcinia kola* 0.5% aqueous solution eye drops in patients with primary open angle glaucoma or ocular hypertension (POAG/OH). A randomized, double masked, multicenter, active controlled prospective study was adopted. Patients who met the inclusion criteria were randomly assigned in equal numbers to receive Timolol 0.5% eye drops as a control medication (A = Group 1 eyes) or *Garcinia kola* 0.5% eye drops as the study medication (B = Group 2 eyes). All drops were instilled at 6 am and 6 pm daily. Goldman applanation tonometry was performed at 9 am, 12 pm and 3 pm at baseline, week 6, week 12 and week 24 visits. A total of 178 patients were randomly assigned to *G. kola* and Timolol groups. At baseline, there were no differences in mean IOP between groups. At the end of the study period (24th week, the mean (± SD) reductions in IOP as 12.93 ± 2.3 mmHg (47.8% ± 0.8% reduction) in *G. kola* group and 13.09 ± 2.8 mmHg (48.2% ± 1.03% reduction) in the Timolol group ($P > 0.05$) were achieved. It can be concluded that the IOP lowering effect of both *G. kola* and Timolol was equivalent.

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Kinetic and thermodynamic studies of paracetamol adsorption onto kola extract-modified groundnut shell activated carbon

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Keywords
Cola nitida
Paracetamol
Batch adsorption
Impregnation
Isotherm
Carbonization

Abstract

The feasibility of preparing a novel adsorbent was investigated by modifying groundnut shell with nitric acid and further impregnating the resulting adsorbent (GSAC) with *Cola nitida* pod extract (CNPE). To obtain the CNPE, varied mass (0.5 – 2.5g) of milled *Cola nitida pod* was used in the extraction process. The produced adsorbent was characterized. Batch adsorption experiments were carried out at temperature, adsorbent dosage and agitation of 25 ℃ , 0.1g and 200 rpm, respectively, using varied extract modified GSAC. Adsorption isotherm, kinetics and thermodynamic parameters were evaluated. The proximate analysis showed that GSAC and extract modified GSAC have 63.21 and 69.83% of carbon, respectively. Batch adsorption experiments showed that the GSAC impregnated with *Cola nitida* pod extract obtained using 0.5 g of milled pod was able to remove the highest amount (91%) of paracetamol from pharmaceutical wastewater. Freundlich isotherm with correlation coefficient (R^2) of 0.9208 best described the adsorption process. Based on kinetic studies, the performance of pseudo-second-order kinetic model was better than pseudo-first-order model for the description of time-dependent behavior of the process with correlation coefficient of 0.9913. The thermodynamic tests indicated that the adsorption process was favorable and spontaneous and confirmed the endothermic nature of the process. Comparison of the result obtained from this study with literatures showed that kola nut pod extract modified GSAC is a good adsorbent for the removal of paracetamol from pharmaceutical wastewater.

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Reflections on the history of kola nut and national integration in Nigeria

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Keywords
History
Kola nut
National unity
Nigeria

Abstract

This paper historicizes the social and cultural reality of the kola nut as a factor of National integration and unity among different ethnic groups in Nigeria. The kola nut is a treasure base agricultural cash crop products economically viable and consumed during festive and ceremonial occasions such as naming, marriage feasts, and passage of rights from one age to another. Data for the study shall be from primary and secondary sources related to analyzing the history on the role of the kola nut as a rallying point of unity in Nigeria's history from the pre-colonial to the post- colonial period of Nigeria' history. Kola nut is widely acknowledged among the major ethnic group of Nigeria as the most widely consumed agricultural produce in Nigeria. It has great stimulant properties and has been found to be useful to cater for the human health among Nigeria's population. Kola nut is grown among the Yoruba people in the West, eaten more by the Hausa groups in the North and ritually and spiritually symbolic in Igbo traditions in the Eastern part of Nigeria. It is therefore against this background that this paper will identify the roles of kola nut as a symbolic agricultural produce exemplifying the foundation and the basis for national integration in Nigeria's political landscape.

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Cola acuminata: past, present and future in nanobiotechnology

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Keywords
Cola acuminata
Historical perspectives
Nanobiotechnology
Phytochemicals

Abstract

Cola acuminata, commonly known as the kola nut, has been revered for centuries in traditional medicine and cultural practices across Africa. With its rich phytochemical composition, including alkaloids, tannins, flavonoids, and phenolics, it has garnered increasing attention in modern scientific research, particularly in the field of nanobiotechnology. Historically, *C. acuminata* has been utilized for its stimulant properties and medicinal benefits in various indigenous practices. The exploration of its bioactive compounds and their potential applications in nanotechnology has emerged as a promising avenue in recent years. A comprehensive examination of the historical significance, current research trends, and future prospects of *C. acuminata* in nanobiotechnology applications are thoroughly researched. Presently, numerous studies have demonstrated the biocompatibility, antimicrobial and antioxidant properties of *C. acuminata* extracts and derived compounds for nano-biotechnological interventions. In nanomedicine, *C. acuminata*-derived nanoparticles have shown remarkable potential as anticoagulating and thrombolytic therapeutic agents, also known for combating pathogenic organisms. Endeavors are warranted to elucidate *C. acuminata* mediated nanoparticles mechanisms of action, optimization of the plant extraction methods, and exploration of novel applications in areas such as targeted drug delivery, biosensing, tissue engineering, and environmental remediation. In conclusion, the integration of *Cola acuminata* into nanobiotechnology presents a multifaceted opportunity to harness its traditional knowledge and natural resources for addressing contemporary healthcare and environmental challenges. By leveraging its diverse phytochemical profile and biocompatibility, C. acuminata holds great promise for shaping the future landscape of nanomedicine, nanomaterials, and beyond.

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Phytochemical characterization and GC-MS analysis of *Azanza garckeana* seed crude extract: identification of bioactive compounds

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Keywords
Azanza garckeana
Malvaceae
GC-MS analysis
Phytochemicals

Abstract

Azanza garckeana (AG) (Kola of Tula) also known as African Snot Apple belongs to the family Malvaceae, which is one of the least-exploited indigenous wild fruit trees of interest in Africa, particularly Southwest, Nigeria. The present study aimed to characterize the phytochemicals through Gas chromatography-mass spectrometry (GC-MS) analysis of *A. garckeana* seeds crude extract. The AG seeds were air-dried, coarsely powdered, and soaked with distilled water; the recovered crude liquid extract was filtered using Whatman No. 1 filter paper and then centrifuged at 4000 rpm for 15 minutes. The phytochemical analysis was performed conventionally using the universal laboratory techniques for qualitative and quantitative methods and GC-MS. The phytochemical analysis screened for included phenols, saponin, flavonoids, tannin, alkaloids, cyanogenic glycosides, terpenoids, cardiac glycosides, sterols, and phytate. *A. garckeana* seed extract revealed the presence of nine phytochemicals qualitatively and at different concentrations quantitatively. Gas chromatography-mass spectrometry (GCMS) identified sixteen (16) different important phytochemical constituents including ethylbenzene at a retention time of 12 min and octadecanoic acid which appeared at the highest retention time of 38 min. To the best of our knowledge, this is the first description of the phytochemical constituents of the seed of *A. garckeana*, as there is no literature available yet on phytochemicals and GC-MS studies of the seed. The results of this study will provide more applications in the field of alternative medicine from natural sources in the development of novel drugs.

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Pricking and hydro-priming duration improve germination of bitter kola (*Garcinia kola* Heckel) seeds

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Keywords
Garcinia kola
Dormancy
Germination
Pricking
Hydro-priming

Abstract

Garcinia kola is a tree-crop valued for its tremendous applications. Seeds exhibit embryo dormancy which lasts 28 months. Hence, the needs for pre-sowing treatments for timely and even germination. The experiment conducted in Department of Horticulture, was factorial in Completely Randomized Design replicated thrice. Factor-1: pricking at two levels (pricked and un-pricked), factor-2: hydro-priming duration at 5 levels (un-primed, priming for 30, 60, 90 and 120 minutes) giving 10 treatment combinations. A number of 48 seeds sown per treatment and data collected on germination and growth were subjected to analysis of variance and treatment means separated using Duncan Multiple Range Test (P≤0.05). It was observed that germination commenced at 8 Weeks After Sowing (WAS) in pricked & hydro-primed seeds and 24 WAS in un-pricked & hydro-primed seeds. Seed pricked and hydro-primed for 30, 60, 90, 120 minutes and pricked & unprimed seeds attained germination percentage of between 90% and 100% at 12 WAS. The morphological growth values of the seedlings of the early germinants were not different (P≤0.05) almost throughout the period of study. For timely and even germination in *Garcinia kola*, pricking of seeds before sowing is inevitable while hydro-priming for 30 to 120 minutes drastically improves seed germination but not seedling growth. This study provides an intervention breakthrough towards plantation establishment of *G. kola* in the nearest future.

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Breaking dormancy in *Cola nitida*, Vent. Schott & Endl. through seed-coloured biotype with method and intensity of scarification

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Keywords
Cola nitida
Dormancy
Germination
Scarification
Seed coloured-biotype

Abstract

Cultivation of kola nut has fallen overtime due to its discouraging seed dormancy (4-32 weeks), uneven germination and prolonged nursery period (96 weeks), among others. This study determined the effects of seed-coloured biotype, method and intensity of scarification on germination and growth of kola seedlings. The experiment, conducted in screen-house, was 3x2x3 factorial in completely randomized design with three replicates. Seed-coloured biotype: white, pink and red, scarification method: epicarp-scraping and epicarp-cutting, scarification intensity: single-, double- and triple epicarp-scraping/epicarp-cutting, giving 18 treatments and controls (untreated white-, pink- and red-coloured seeds). Data collected on percentage germination and morphological growth performance, were subjected to analysis of variance. Germination values of 3.33-6.67% were observed as early as 2 Weeks After Sowing (WAS) in white seeds treated to single epicarp-scraping and single & double epicarp-cutting, pink seeds treated to single & double epicarp-cutting and red seeds treated to single & double epicarp-cutting. At 20 WAS, white-, pink- and red-coloured biotype seeds treated to single-epicarp scraping gave germination of 96.6-100% while other treated seeds gave germination of 73.3-93.3%. Untreated seeds of white-, pink- and red-coloured biotype recorded low germination of 40-60%. Seedlings raised from white-coloured seeds treated to triple-epicarp scraping had highest plant height value (transplantable height) of 35.9 cm followed by 35.1 cm, at 20WAS. Timely and even germination would be obtained in *C. nitida*, if the seeds, of all biotype colours, are treated to single epicarp-scraping, while tripling the epicarp-scraping further improves early seedling growth to transplantable height at 20 WAS.

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Germination, seedling growth and dry matter accumulation of kola (*Cola nitida* Vent, Schott & Endlicher) in the nursery as affected by seed-biotype colour and curing period in dodecahedron pyramidal device (DPD)

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Keywords
Cola nitida
Dormancy
Seed-biotype colour
Dodecahedron pyramidal device
Curing period

Abstract

Prolonged dormancy period and non-uniformity growth patterns of *Cola nitida* pose challenges for farmers, discouraging them from establishing kola plantations. Experiment was conducted at Abeokuta, South-Western Nigeria, at the nursery site of the Department of Horticulture, Federal University of Agriculture, Abeokuta, to study the effects of kola seed biotype colour and curing period on germination, seedling growth and dry matter accumulation of *Cola nitida* in the nursery. The nursery experiment was laid out in a Completely Randomized Design. Treatments consist of seed biotype colour (white, red and pink) and curing period (0, 4, 8, and 12 weeks). The resulting 12 treatments were replicated three times. Data collected on percentage germination, plant height (cm), number of leaves/plant, stem girth (mm), leaf area (m^2) and dry matter accumulation (g/plant) were subjected to analysis of variance and means were separated using Duncan's Multiple Range Test ($P< 0.05$). Germination commenced early at 4WAS on white kola seeds cured for 8-week (10.0%) and red kola seeds cured for 4-week (6.66%). At 6WAS, white kola seeds cured for 8-week had above 50% germination and attained 100% at 18WAS. White, Pink and Red kola nut seeds cured for 8, 12 and 4-week in DPD had an improved seedling growth and increased dry matter accumulation, thereby; attained transplantable size within short period, while control (un-cured seeds) had a tendency of nursery establishment failure. Regardless of curing period, white, pink and red kolanut seeds cured in DPD resulted into rapid germination with improved seedling growth and increased dry matter yield.

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The health benefits of *Cola nitida*

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Keywords
Cola nitida
Bioactive compounds
Health benefits
Pharmaceuticals

Abstract

Cola nitida, commonly known as kola nut, has been utilized for centuries across West Africa for its cultural, social, and medicinal significance. Recent scientific research has shed light on its diverse array of health benefits, extending beyond its traditional use as a stimulant. First and foremost, *Cola nitida* is rich in bioactive compounds, including caffeine, theobromine, and polyphenols, which exhibit antioxidant properties. These compounds scavenge free radicals, reducing oxidative stress and inflammation, thereby potentially mitigating the risk of chronic diseases such as cardiovascular disorders, cancer, and neurodegenerative conditions. Moreover, *Cola nitida* has demonstrated promising effects on cognitive function and mental health. Its caffeine content acts as a central nervous system stimulant, enhancing alertness, concentration, and cognitive performance. Additionally, certain constituents of *Cola nitida* may modulate neurotransmitter activity, contributing to mood regulation and stress reduction. Furthermore, its extracts have shown antimicrobial properties against various pathogens, suggesting potential applications in combating infectious diseases. Additionally, its anti-inflammatory properties may alleviate symptoms associated with inflammatory conditions like arthritis and asthma. Despite these promising findings, further research is warranted to elucidate the mechanisms underlying its health benefits and to assess its safety profile, particularly regarding long-term consumption and potential interactions with medications. In conclusion, *Cola nitida* represents a valuable botanical resource with multifaceted health-promoting properties. Continued investigation into its therapeutic potential may unveil novel avenues for preventive healthcare and pharmaceutical development.

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Feed additive potentials of kola nut, bitter kola and wonderful kola: a review

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Keywords
Kola nut
Bitter kola
Wonderful kola
Feed additives
Animal husbandry

Abstract

The chemical composition of kola nut, bitter kola and wonderful kola showed that they contained carbohydrate, ash, crude fibre, ether extract, crude protein, tannin, saponin, phytic acid, phenol, trypsin inhibitor, sterol, steroids, flavonoid, alkaloid, oxalate, caffeine, hydrogen cyanide and vitamins in different proportions. These bioactive compounds gave the kolas phytogenic potentials as feed additives. The use of 4-8% kola nut pod meal in broiler diets recorded improved feed conversion ratio (FCR), reduced total serum protein, creatinine, alanine aminotransferase (ALT), aspartate aminotransferase, and cholesterol levels, and increased antioxidant enzyme concentration while 500-2000 ppm caused reduced haemoglobn (Hb), packed cell volume (PCV), albumin, and depressed weight. The use at 10-30% in broilers resulted in depressed weight gain (WG), FCR, and carcass weight (with increasing inclusion levels). Up to 20% resulted in better FCR, WG and digestibility, higher globulin and lower cholesterol in diet of rabbits. The use of bitter kola meal at 5-20% improved FW, WG, improved Hb, PCV, WBC and spermatogenesis and reduced cholesterol in broilers. It depressed hen day production in layers but enhanced egg weight at 2.5-7.5% inclusion. The use of wonderful kola meal at 5-20g/kg resulted in improved live weight, WG, FCR, and increased carcass proportions, with reduced cholesterol and increased ALT in pigs. However, there is dearth of information on the use of kola nut seed or pod in layers and pigs; bitter kola seed on pigs and wonderful kola seed in poultry and rabbits. More effort is still needed to determine the appropriate inclusion levels and fully elucidate their mode of actions.

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Innovations in technological advancement for kola nut processing

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Keywords
Kola nut processing
Technological innovation
Freeze drying
Microwave drying
Supercritical CO_2
Extraction
Industry challenges
Technology adoption

Abstract

The kola nut industry plays a crucial role in diverse socio-economic contexts and is currently investigating technological innovations aimed at enhancing processing methodologies. This research delved into the acceptance and attitudes towards emerging processing techniques like freeze drying, microwave drying, and supercritical carbon dioxide extraction. Information was collected electronically from key players within the industry to assess the present and prospective utilization of these technologies using a bespoke Google form. The study revealed a traditional reliance on sun drying (38%), oven drying (22%), and a nascent adoption of microwave drying (10%). Stakeholders identified product quality (24%), cost (22%), and environmental impact (20%) as the primary challenges with current processing methods. A significant portion of respondents (33.3%) have a moderate understanding of innovative technologies, while 25% exhibit a high level of understanding. Factors influencing the adoption of new technologies include cost-effectiveness (25%), environmental benefits (19%), and improvements in product quality (18%). Respondents perceive increased processing efficiency (30%) and enhanced product quality (28%) as the primary benefits of these technologies. However, high initial costs (31%) and a lack of technical expertise (27%) are seen as the main barriers to adopting these innovations. Overall, 75% of respondents recommend investing in innovative technologies to other industry stakeholders. This study highlighted the need for strategies to reduce costs and enhance technical training to facilitate the broader adoption of advanced processing methods in the kola nut industry.

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Economics of the use of botanicals and readily available materials for storage and preservation of kolanut among stakeholders in Ekiti and Ogun States, Nigeria

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Keywords
Kolanut
Storage
Botanicals
Economics
Nigeria

Abstract

Kolanut has economic and cultural significance in Nigeria. Postharvest handling of kolanut is vital in determining its quality and economic value. A combination of botanicals and other readily available materials for storage and preservation of kolanut is prevalent amongst stakeholders. Hence, this study identified and documented the botanicals and/or other readily available materials used in kolanut preservation and storage and analyzed the factors driving their use in Ekiti and Osun States. Multistage sampling procedures with structured questionnaires were used to elicit information from the kolanut stakeholders using a Stratified Random Sampling technique. Three villages each from the local governments were selected and the stakeholders were stratified into two: adopters of botanical method and non-adopters. Each stratum was proportionately sampled based on size to give a population of 60 respondents. Data collected were subjected to descriptive, budget and inferential analysis. Most kolanut handlers in Osun and Ekiti States are female (51.6%), with average turnover of N504,666.00 and 71.6% of all kolanut traders have no credit facilities. The mean age was 47±14.67yrs and 81.7% had formal education. Readily available materials and botanicals identified include: Alum (6.6%), Bitter leaf (25%), ground pepper (11.6%), *Jatropha* leaf (15%), sandpaper leaf (3.3%) and camphor (28.3%). Identified synthetic insecticides being used in kolanut preservation include: Lambda cyhalothrin (23.3%), chlorpyrifos (23.3%), aluminium phosphide (20%), Profenofos (40%), +Cypermethrin (4%) and EC- (28.3%). Use of botanicals for kolanut storage and preservation at lower cost should be improved upon as revealed by this study for safety and quality.

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Potentials of alkaloids from kola plants in cancer treatment: a review

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KOLA 2024/023

Keywords
Kola
Cancer
Alkaloids
Apoptosis
Cell cycle

Abstract

The family of Kola plants is an essential and significant sacred symbol of unity in the West African sub-region. In addition to its traditional sacrificial usage, it is also an important folklore medicinal agent for preventing and treating several diseases. However, like any other plant, scientific findings have related their medicinal values to the phytochemical constituents like alkaloids, flavonoids, saponins, tannins among others. Alkaloids are highly diverse nitrogen-containing, low-molecular-weight compounds found naturally in plants, animals, and some microbes. Alkaloids of plant origin are important drug candidates with proven efficacy currently in use, while some are still undergoing clinical trials, primarily against cancer. Purine alkaloids such as theobromine, caffeine, and theophylline are the major alkaloid compounds of methylxanthine origin prominently reported in kola plants. These alkaloids have been tested against several types of cancer cell lines and have efficient activities against the hallmarks of cancer. They are reported to inhibit unbridled proliferation through apoptosis induction to prevent cell growth with damaged DNA and the arrest of the cell cycle to allow for DNA repair. In addition, reactive oxygen species (ROS) elevation, senescence, colony formation reduction, and p53 expression are mechanisms of the anticancer properties of the alkaloids. These compounds have also been tested as adjuvants, mitigating the toxic effects of chemotherapy drugs without affecting their efficiency. This review provides insight into the essential therapeutic potential of alkaloids in the Kola plant family, affirming the importance of further research to develop a lead drug against cancer incidence from the plants.

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Biological activities of *Garcinia kola* and possible roles as an emerging therapeutic agent

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KOLA 2024/024

Keywords
Garcinia kola
Therapeutic agent
Health
Medicinal plant

Abstract

Garcinia kola (bitter kola), a name some times also used for *Garcinia afzelli* is a species of flowering plant belonging to the mangosteen plants. It is a multipurpose tree indigenous to West and Central Africa. Its natural habitat is subtropical or tropical moist lowland forest. The highly preferred species is called "Wonder Plant" because all of its part can be used as medicine. Bitter kola as one of the many non-timber forest products (NIFTPs) such as wonder kola (*Bucholzia coriacea*), sponge (*Accanthus montanus*) and kola nuts (*Cola nitida*/*Cola acuminata*) are more profitable and of socio-economic importance in the J4 area of the forest of South-West Nigeria. Yorubas call it 'orogbo'. Its commercialization in various markets has raised the standard of living of merchant involved both in rural and urban centres. The ongoing increase in commercial value of bitter kola has made cultivation of its trees more important and of greater interest vis-à-vis; bitter kola in biotechnology, valorization of bitter kola waste and bitter kola in nanotechnology among others. Also, search for new therapeutic agents against several diseases such as inflammation, diabetes, hypertension, and cancer has made scientists to embrace the importance and great value of medical plants. Basic medical research has shown kolaviron (KV) isolated from bitter kola to act as anti-inflammatory agent by inhibiting the product of nitric oxide, prostaglandin E2 and tumor necrosis factor-alpha. In several models of hepatotoxicity, KV has been shown to elicit ant-tumor property via elevation of phase II drug metabolizing enzymes. Prevention of DNA oxidation process and pro apoptotic effect by increasing baxlbcl2 ratio. The anti-hyper cholestromic effect KV in animal fed on high cholesterol diets has been established. This review shows the diverse biological activities of *Garcinia kola* and possible roles as an emerging therapeutic agent.

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Effects of storage materials on some chemical and biochemical parameters of three kola varieties preserved with three different storage materials

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KOLA 2024/025

Keywords
Kola nuts
Storage materials
Phytochemicals
Storage duration

Abstract

Kola nut is an important ingredient in pharmaceutical preparations due to its rich biochemical compounds. It is also consumed majorly as a stimulant which is associated with its phytochemical compounds. Three kola nut varieties, *Cola nitida*, *Cola acuminata* and *Cola verticillata* were stored in three storage materials for a period of 20 weeks and their proximate, minerals, caffeine and theobromine were evaluated. White coloured opaque polyvinyl chloride (PVC) bowls, jute sack and brown paper were used as storage materials. Raffia woven basket and polypropylene sheets were used to house the storage materials that are in direct contact with the samples. The experiment was carried out at Cocoa Research Institute of Nigeria, Ibadan. For each of the three kola varieties, both the proximate parameters the phytochemicals and the minerals varied significantly for the storage material and storage duration. The highest moisture content of 56.42% was recorded for *Cola nitida* stored in PVC, while the lowest was for *Cola verticillata* with the value of 31.75% in jute storage. The reverse was experienced for carbohydrate, while caffeine and theobromine were significantly different at 95% level of significance for the storage duration. For each of the kola varieties, duration of storage and the storage materials have significant effect on the chemical parameters evaluated. Brown paper had the lowest values for majority of the different parameters evaluated.

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Botany and economic importance of monkey kola: an underutilized plant species in Nigeria

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KOLA 2024/026

Keywords
Monkey kola
Botany
Domestication
Forest resources
Underutilized plants

Abstract

Tropical Africa is well endowed with many fruit plant resources whose botany is still very scanty and their potentials not fully realized. Of these numerous plant resources is the *Cola* species, which are made up of both cultivated and wild edible forms that produce sweet edible fruits. The edible wild forms are regarded as the minor relatives of cultivated forms and are generally referred to as Monkey kola. Members include species such as *Cola pachycarpa*, *Cola lepidota, Cola lateritia, Cola rostrata* and *Cola millenii* which are found in the humid west and central African forest regions. They are found as protected stands in gardens, farmland, and forest reserves, and used locally for their fruits, in herbal medicines and lumber. Presently, there is paucity of information on the botany and economic importance of these important native plants which now necessitated this review. This is with a view to unlock the potentials of these plants, promote their conservation and domestication, which will subsequently lead to their industrial applications for the benefit of humanity.

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Capacity building for kola farmers on good agricultural practices (GAPs) in Osun State

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KOLA 2024/027

Keywords
Good agricultural practices (GAPs)
Training
Capacity building
Kola nut
Productivity

Abstract

The study capacity building on kola farmers good agricultural practices (GAPs) in Osun State was carried out to train farmers on maintenance, yield and production in the study area. The training empowers the kola farmers on GAPs, accessed ways to improve, increase production, identified the livelihood of the farmers, and examined the constraints faced by the farmers in the study area. Eighty registered respondents who are kola nut farmers in Osun State were interviewed, and a structured interviewed schedule was used to collect the data. The data collected were analyzed using descriptive and inferential statistical tools. The study revealed that: the majorities 70% were male, the majorities 60% were married, 51.3% had primary education, and 10% of the respondents had tertiary education. Also, 31.3% of the farmers with the age range of 31-40 years had kola nut farming experience, a little below average 48.0% had between 1-5 hectares of land for kola farming. Furthermore, 30% of the farmers inherited their farm land for farming, while only, 11.3% purchased their farm lands for production. The attitude of farmers towards farming is 48%, while 35% agreed kola farming is mainly for old farmers. About 63.8% indicated inadequate training on GAPs is severe constraints, 75% agreed poor government attitude towards farming is severe constraints in the study areas. The study concluded that farmers in the areas were old; and they inherited the farm land from their forefathers, while some of the farm land is old for kola nut production, also the productivity is low as a result of poor fertility which led to low yield. For adequate sustainability of kola nut production in the study areas, youths need to be encouraged and motivated in order to improve kola production, and adequate training.

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Effects of bitter kola (*Garcinia kola*) as growth promoter in broiler chicks from day old to four weeks old

Adedeji, O.S[1]., Farinu, G.O[1]., Ameen, S.A[1]., Olayeni, T.B[2]., Oyetoro B.A[1]*., and Rom-Kalilu, F.A[2]

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KOLA 2024/028

Keywords
Bitter kola
Dietary supplement
Broiler chicks
Inclusion level
Growth promoter

Abstract

The impact of varying levels of bitter kola (*Garcinia kola*) dry seed powder inclusion on parameters such as feed intake, weekly body weight gain, weekly feed efficiency, and carcass characteristics of broiler chicks from day-old to 4 weeks of age was investigated. A total of 200 broiler chicks of the Anak strain were distributed into five groups, each comprising 40 birds. These groups were subjected to inclusion levels of 0% (control), 2.5%, 5%, 7.5%, and 10% (w/w) of *Garcinia kola* dry seed powder, respectively. Significant differences ($p < 0.05$) were observed in feed intake, body weight gain, and feed efficiency across the different inclusion levels. Feed efficiency was found to be highest in the control and 2.5% groups, while it was lowest in the 5% and 7.5% inclusion levels. Notably, no mortality was recorded during the study period, potentially attributed to the antimicrobial properties associated with the inclusion of *Garcinia kola* dry seed powder in the diets.

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The use of chemicals and botanicals for kolanut preservation in Nigeria – a systematic review and meta-analysis approach

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KOLA 2024/029

Keywords
Botanicals
Chemicals
Kolanut
Preservation
Nigeria
Systematic review
Meta-analysis

Abstract

Kolanut indigenous to West Africa is economically vital to the well-being and survival of many Nigerians. As the second most important indigenous cash crop in Nigeria, its importance as commodity crop for many rural farmers and households in the country cannot be over-emphasized. However, while only cultural methods are recommended for the control of kola weevils in storage, many kolanut processors in the country still use gamallin-20 and phostoxin tablets to preserve kolanuts. These pesticides pose health hazards and have negative long term health effects on consumers and processors. This review and meta-analysis aim to help understand the relationship between the use of chemicals and botanicals for kolanut preservation in Nigeria. A comprehensive search of relevant databases was conducted. Studies published between 2000 and 2024 were included. The studies were analyzed using a thematic approach, with meta-analysis conducted to estimate the overall impact of the use of these chemicals and botanicals on the health of consumers of kolanut. The results from the meta-analysis indicate that the negative effects caused by these chemicals is associated with a higher risk of liver damage, [odds ratio (OR) 1.17; 95% confidence interval (CI), 1.07–1.28], and digestive problems (OR 1.13; 95% CI, 1.03–1.25). No conclusive association was found between kolanut intake and cardiovascular diseases. The findings of this study highlight the significant negative impact of these chemicals on the health of kolanut consumers and processors. Policy interventions are needed to mitigate the negative consequences of the use of chemicals to preserve kolanut.

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Performance and egg quality parameters of laying hens fed different dietary inclusion levels of bitter kola (*Garcinia kola*)

Adedeji, O.S[1]., Farinu, G.O[1]., Ameen, S.A[1]., Olayeni, T.B[2]., Oyetoro B.A[1]*., and Rom-Kalilu, F.A[2]

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KOLA 2024/030

Keywords
Bitter kola
Dietary supplement
Laying hens
Inclusion level
Egg production

Abstract

The study aimed to assess the impact of various inclusion levels of *Garcinia kola* on the performance and egg quality parameters of laying hens over an 8-week period. Forty ISA Brown point-of-lay birds, aged 20 weeks, were randomly allocated to five treatments, each consisting of eight birds per treatment and four birds per replicate. Birds in each treatment group were provided with diets containing different amounts of *Garcinia kola* per 1000 grams of feed: 0 g (control), 5 g, 20 g, 40 g, and 80 g. The trial duration was 8 weeks. No significant differences ($p > 0.05$) were observed in egg weight, yolk weight, yolk index, yolk length, yolk colour, yolk albumen ratio, shell weight, shell thickness, and Haugh unit of the eggs across the different treatment groups. However, significant differences ($p < 0.05$) were noted in performance metrics, albumen weight, and yolk height. Notably, the inclusion of *Garcinia kola* up to 80 g/1000 g/kg in the diet did not result in any adverse effects on the birds. However, optimal performance and egg quality were achieved at the 5 g/1000 g/kg inclusion level of dietary *Garcinia kola*.

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The effects of dietary bitter kola (*Garcinia kola*) inclusion on body weight, haematology and survival rate of pullet chicks

Adedeji, O.S[1]., Farinu, G.O[1]., Ameen, S.A[1]., Olayeni, T.B[2]., Oyetoro B.A[1]*., and Rom-Kalilu, F.A[2]

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KOLA 2024/031

Keywords
Bitter kola
Dietary supplement
Pullet chicks
Inclusion level
Growth
Haematology

Abstract

The study investigated the effects of dietary inclusion of dry seed powder of *Garcinia kola* (bitter kola) at varying levels (0 g/kg, 20 g/kg, 30 g/kg, and 40 g/kg of feed) on haematological parameters, body weights, and survival rates of pullet chicks over an eight-week period. Two hundred and fifty-one-day-old pullet chicks were randomly assigned to five treatment groups, each with two replicates of 25 birds. The results indicated that inclusion of *Garcinia kola* dry seed powder in the diet led to improved weight gain in groups B, C, D, and E compared to the control group A. Notably, the lowest weight gain was observed in group E, which was fed 40 g/kg of bitter kola dry seed powder, while the highest weight gain was recorded in group D, fed 30 g/kg of the dry seed powder. Throughout the duration of the experiment, a higher level of inclusion of bitter kola dry seed powder in the diet corresponded to a lower mortality rate, supporting the documented antimicrobial activity of *Garcinia kola*. Hematological parameters including packed cell volume (PCV), hemoglobin concentration (Hb), red blood cells (RBC), mean corpuscular hemoglobin (MCH), and mean corpuscular volume (MCV) did not significantly differ between test groups B, C, D, and E and the control group A. However, there was a significant ($p < 0.05$) increase in white blood cells (WBC), particularly lymphocytes, suggesting the potential antimicrobial effect of *Garcinia kola* seeds, attributed to the crucial role lymphocytes play in the immune defense mechanism in both humans and animals.

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Possible variations in nutritional and phytochemical properties of different colour shades of cured and uncured *Cola nitida* seeds

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KOLA 2024/032

Keywords
Kolanut
Colour variants
Curing
Nutritional composition
Phytochemicals
Minerals

Abstract

Cola nitida is one of the common species of kolanut in Nigeria. Being an important economic cash crop, it has lots of health significances. The health benefits of kolanuts especially *C. nitida* are keenly attributed to the nutritional, biochemical, phytochemical, and physicochemical compositions which could vary with physical properties. Colour is an important physical property of kolanut, however its effect on the health compositions of kolanut is not well-studied. Thus, this study sought to investigate the effect of colour on the nutritional and phytochemical compositions of *C. nitida* seeds. The three known colours (red, pink, and white) of cured and uncured seeds were processed into powdery forms and used for proximate, mineral, and phytochemical analyses. There was no significant difference between all samples in terms of %crude fat (2.56–2.98), %ash (2.27–2.63), %moisture (9.66–9.97) and %dry matter (90.03–90.34). Interestingly, %crude protein markedly differs with the cured nuts RCK having the highest values (15.29%), while PCK and WCK had 14.38% and 13.88% respectively. However, the reverse was the case with carbohydrate content having its highest value with WCK (67.18%) followed by PCK and RCK, respectively. Potassium and iron were very high among the minerals analysed for all samples whereas the caffeine content of all the kolanut samples ranged from 0.102 to 0.167%, though not significantly different in all the colours of both cured and uncured kolanuts. From the trend of results obtained, it could be speculated that the varying physical colours of *C. nitida* seeds has no marked significance on their nutritional and phytochemical constituents.


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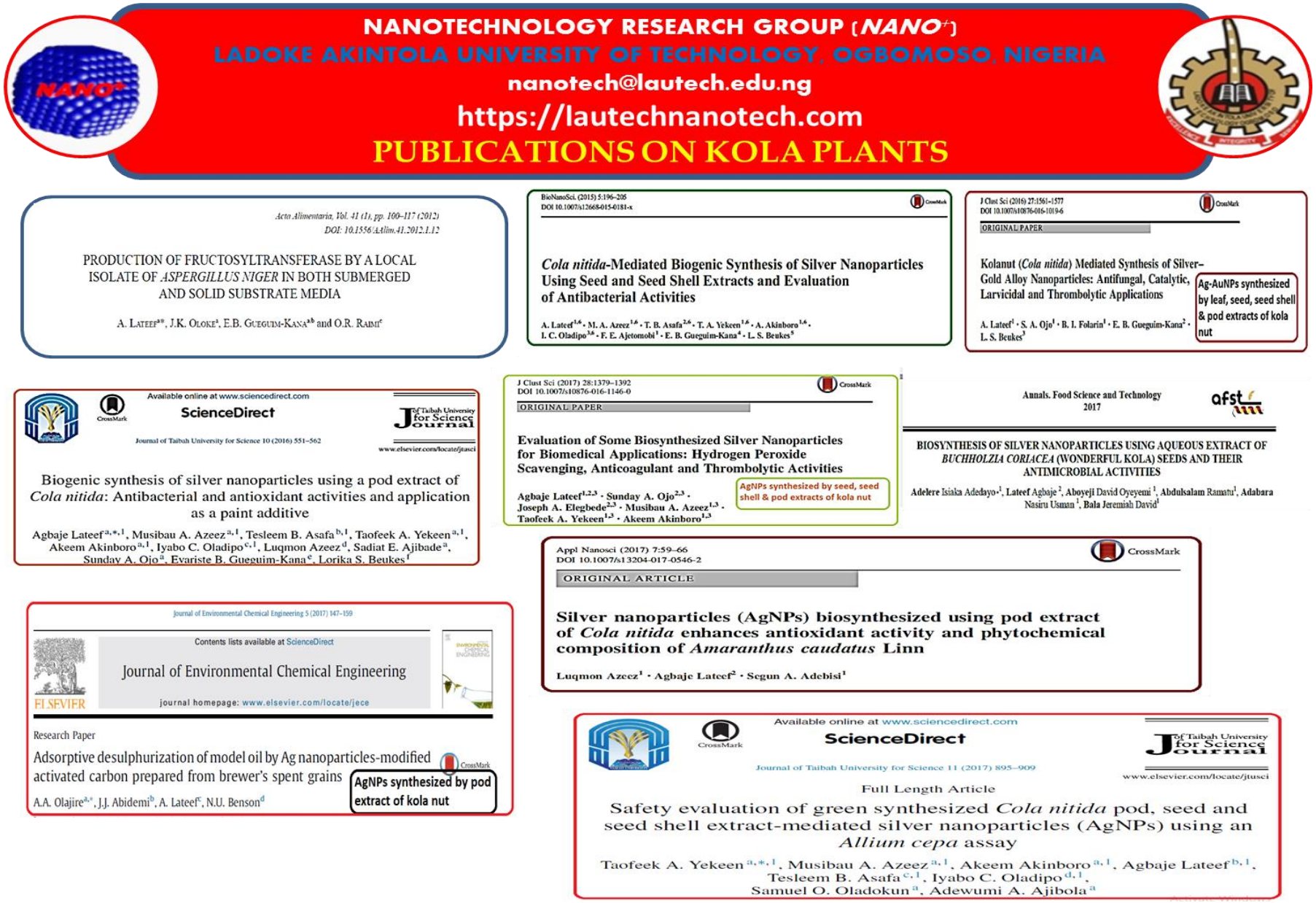
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Kolanut (Cola nitida) Mediated Synthesis of Silver–Gold Alloy Nanoparticles: Antifungal, Catalytic, Larvicidal and Thrombolytic Applications
Ag-AuNPs synthesized by leaf, seed, seed shell & pod extracts of kola nut
Biogenic synthesis of silver nanoparticles using a pod extract of Cola nitida: Antibacterial and antioxidant activities and application as a paint additive
Evaluation of Some Biosynthesized Silver Nanoparticles for Biomedical Applications: Hydrogen Peroxide Scavenging, Anticoagulant and Thrombolytic Activities
AgNPs synthesized by seed, seed shell & pod extracts of kola nut
BIOSYNTHESIS OF SILVER NANOPARTICLES USING AQUEOUS EXTRACT OF BUCHHOLZIA CORIACEA (WONDERFUL KOLA) SEEDS AND THEIR ANTIMICROBIAL ACTIVITIES
Silver nanoparticles (AgNPs) biosynthesized using pod extract of Cola nitida enhances antioxidant activity and phytochemical composition of Amaranthus caudatus Linn
Journal of Environmental Chemical Engineering
Adsorptive desulphurization of model oil by Ag nanoparticles-modified activated carbon prepared from brewer's spent grains
AgNPs synthesized by pod extract of kola nut
Safety evaluation of green synthesized Cola nitida pod, seed and seed shell extract-mediated silver nanoparticles (AgNPs) using an Allium cepa assay


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The effects on oxidative aging, physical and flow properties of Agbabu natural bitumen modified with silver nanoparticles
AgNPs synthesized by kola pod extract
Beni-Suef University Journal of Basic and Applied Sciences
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Responses of Moringa oleifera to alteration in soil properties induced by calcium nanoparticles (CaNPs) on mineral absorption, physiological indices and photosynthetic indicators
CaNPs synthesized by pod extract of kola nut
Journal of Food Measurement and Characterization
ORIGINAL PAPER
Influence of calcium nanoparticles (CaNPs) on nutritional qualities, radical scavenging attributes of Moringa oleifera and risk assessments on human health
CaNPs synthesized by pod extract of kola nut
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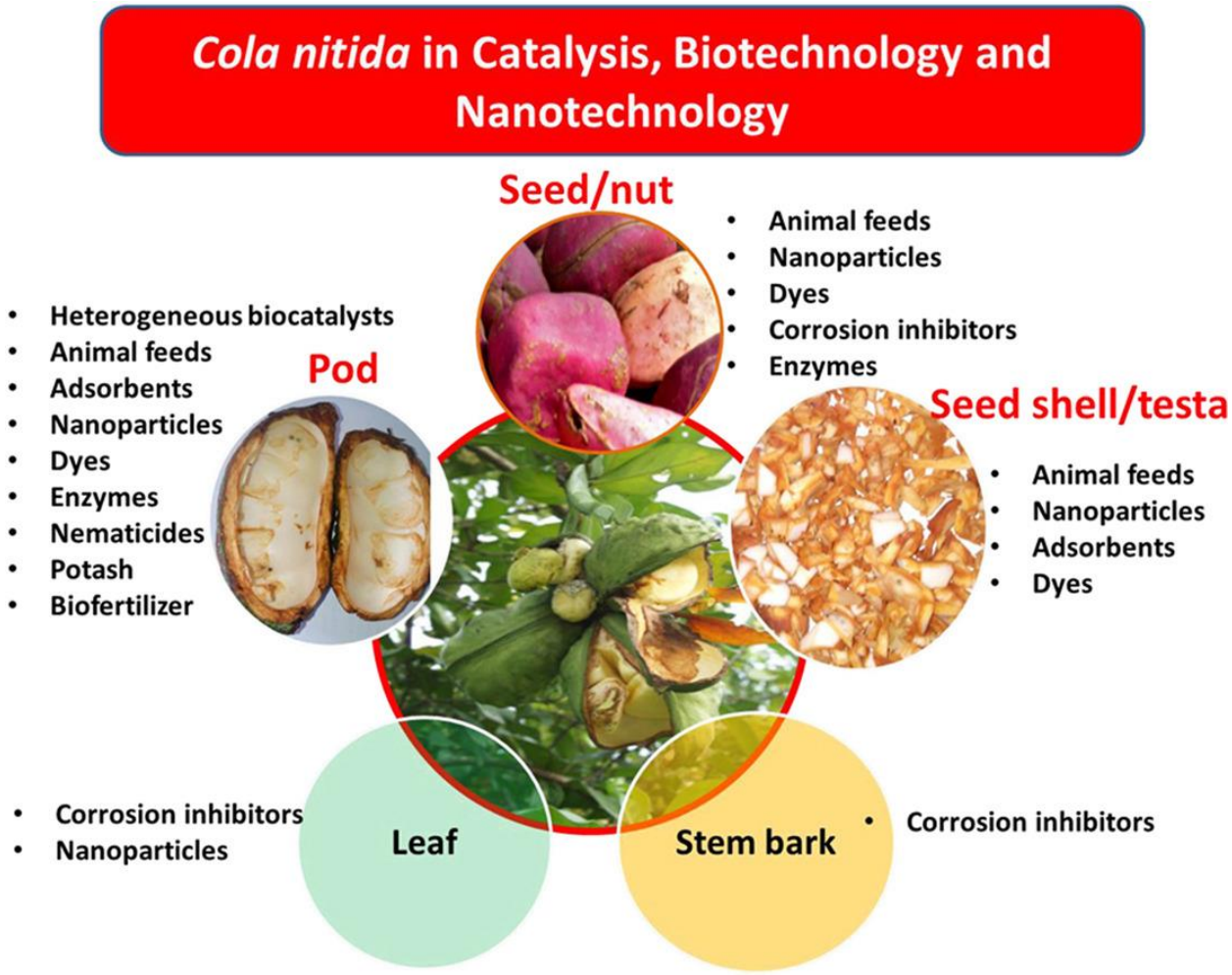
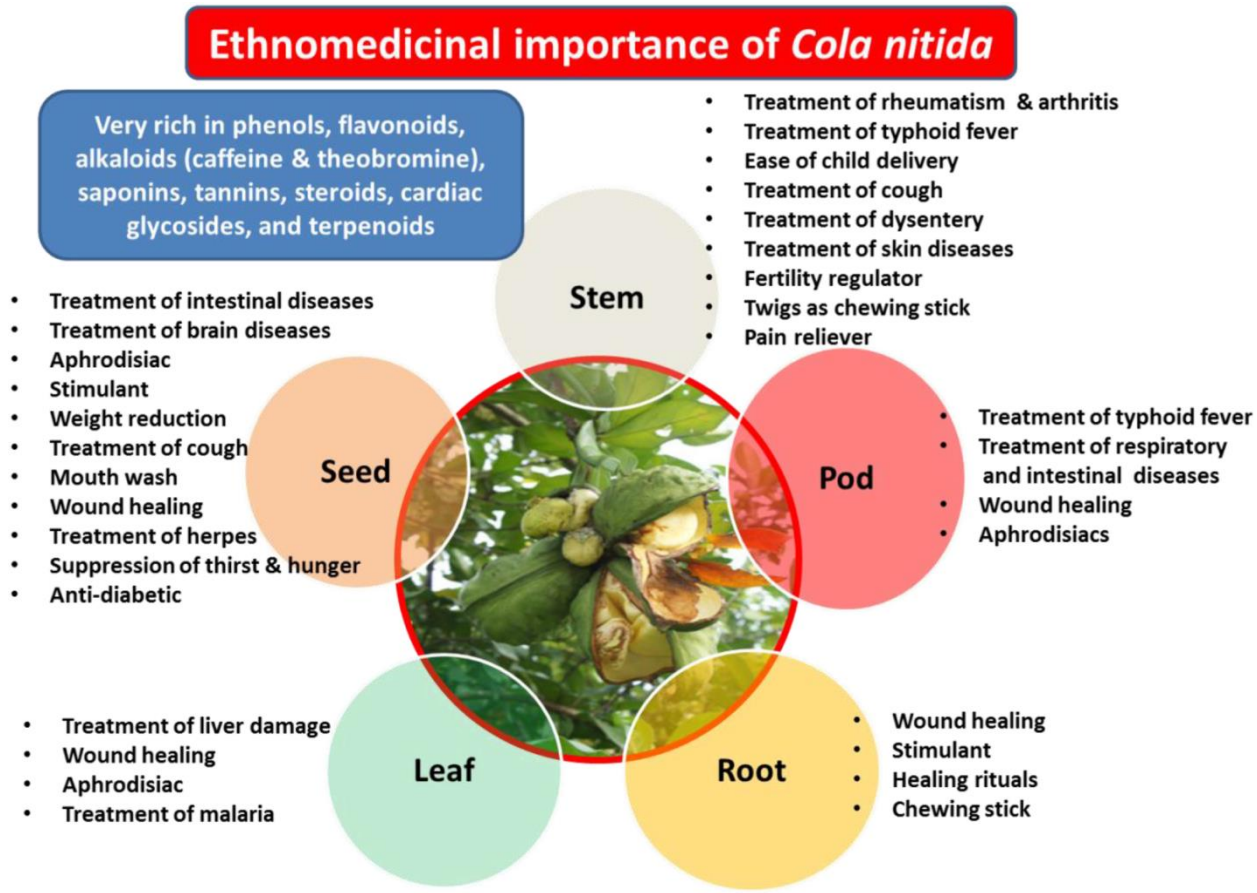
Corrosion inhibition performance of silver nanoparticles embedded-gloss paint on carbon steel and aluminium substrates in 2.0 M H2SO4 solution
AgNPs synthesized by pod extract of kola nut
South African Journal of Botany
Kolanut-mediated magnesium oxide nanostructures for biomedical applications: Antimicrobial, antioxidant, larvicidal, anticoagulant and thrombolytic activities
Inorganic Chemistry Communications
Short communication
Phytofabrication of titanium-silver alloy nanoparticles (Ti-AgNPs) by Cola nitida for biomedical and catalytic applications
Biocatalysis and Agricultural Biotechnology
Cola nitida: Milestones in catalysis, biotechnology and nanotechnology for circular economy and sustainable development
THE CONVERSATION
Noix de cola - du nanofertilisant à la protection des métaux contre la corrosion : notre recherche trouve de nouvelles utilisations pour cette plante précieuse
Heliyon
Research article
Multifunctional titanium dioxide nanoparticles biofabricated via phytosynthetic route using extracts of Cola nitida: antimicrobial, dye degradation, antioxidant and anticoagulant activities
THE CONVERSATION
Kola nut: from nanofertiliser to protecting metals from corrosion – our research finds new uses for the valuable plant
Waste Management Bulletin
Synthesis, characterization, and adsorptive performance of titanium dioxide nanoparticles modified groundnut shell activated carbon on ibuprofen removal from pharmaceutical wastewater
Titanium oxide NPs synthesized by pod extract of kola nut


Cola nitida in Catalysis, Biotechnology and Nanotechnology
Seed/nut
Animal feeds
Nanoparticles
Dyes
Corrosion inhibitors
Enzymes
Heterogeneous biocatalysts
Animal feeds
Adsorbents
Nanoparticles
Dyes
Enzymes
Nematicides
Potash
Biofertilizer
Pod
Seed shell/testa
Animal feeds
Nanoparticles
Adsorbents
Dyes
Corrosion inhibitors
Nanoparticles
Leaf
Stem bark
Corrosion inhibitors


Ethnomedicinal importance of Cola nitida
Very rich in phenols, flavonoids, alkaloids (caffeine & theobromine), saponins, tannins, steroids, cardiac glycosides, and terpenoids
Stem
Treatment of rheumatism & arthritis
Treatment of typhoid fever
Ease of child delivery
Treatment of cough
Treatment of dysentery
Treatment of skin diseases
Fertility regulator
Twigs as chewing stick
Pain reliever
Seed
Treatment of intestinal diseases
Treatment of brain diseases
Aphrodisiac
Stimulant
Weight reduction
Treatment of cough
Mouth wash
Wound healing
Treatment of herpes
Suppression of thirst & hunger
Anti-diabetic
Pod
Treatment of typhoid fever
Treatment of respiratory and intestinal diseases
Wound healing
Aphrodisiacs
Leaf
Treatment of liver damage
Wound healing
Aphrodisiac
Treatment of malaria
Root
Wound healing
Stimulant
Healing rituals
Chewing stick


Plant growth promotion by AgNPs and CaNPs
Improved nutritional quality of plants
Improved nutraceutical quality of plants
Remediation of contaminated soil for farming
Reduced burning of kola pod
Nanoadsorbent for sulphur
2 ZERO HUNGER
13 CLIMATE ACTION
Kolanut Nanobiotechnology for SUSTAINABLE DEVELOPMENT GOALS
3 GOOD HEALTH AND WELL-BEING
Antimicrobial activities of nanoparticles
Antioxidant activities
Anticoagulant activities
Thrombolytic activities
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
6 CLEAN WATER AND SANITATION
Antimicrobial activities of nanoparticles
Production of nanoadsorbents
Dye degradation
Conversion of agrowaste to nanomaterials
Innovative production of nanomaterials
Nanobinder for bitumen
Corrosion inhibition of mild steel

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Chairman, LOC

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