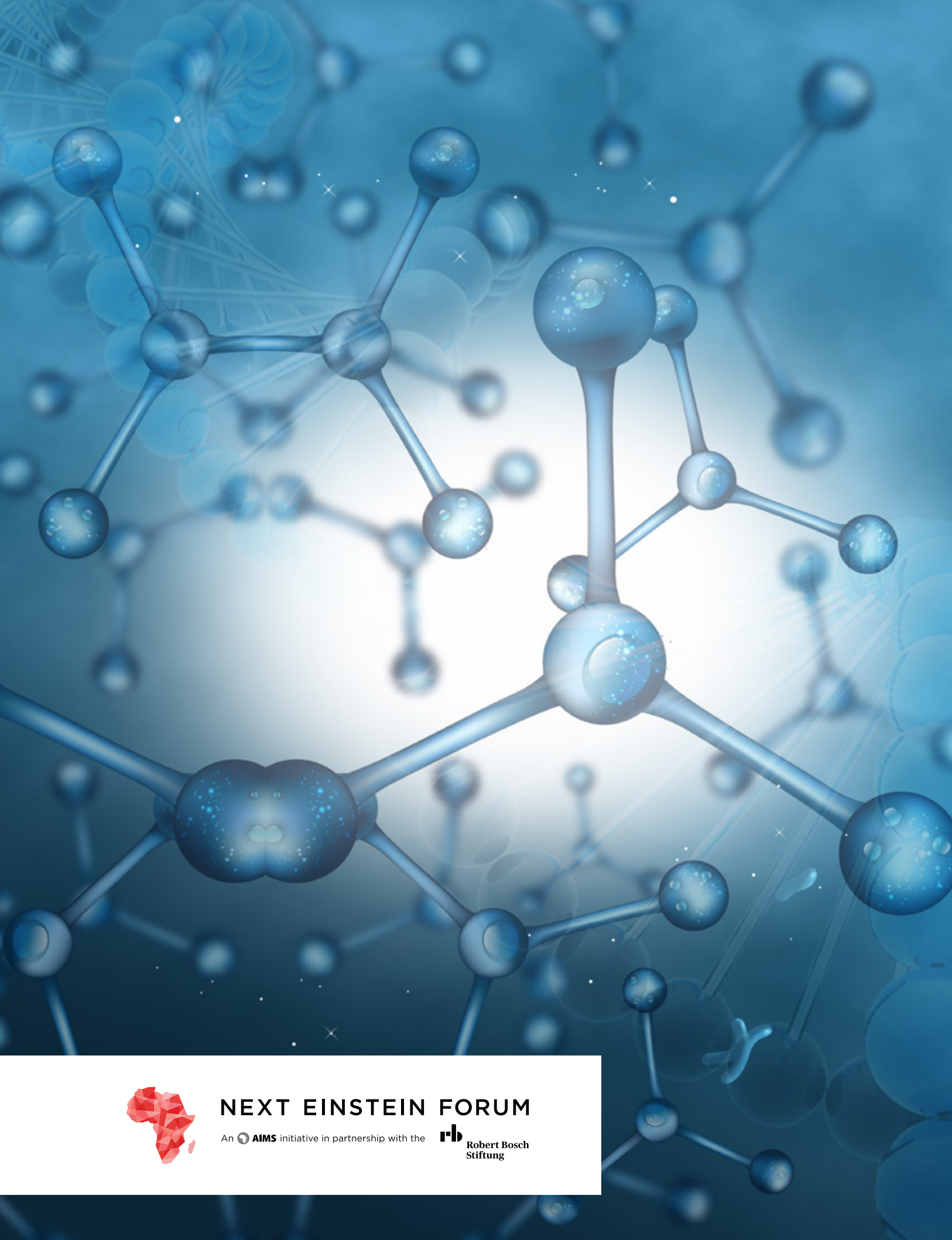
Dec 2018
Vol. 1 Issue 1

Scientific African Magazine

NEXT EINSTEIN FORUM



NEXT EINSTEIN FORUM

An AIMS initiative in partnership with the Robert Bosch Stiftung

DECEMBER 2018

VOLUME 1, ISSUE 1

Scientific African Magazine

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ON THE COVER
An ambitious project called Robotic Hand depicts the various fields of science that are driving the technological breakthroughs that are solving the world's problems.

Illustration by iBU Proactive Comms

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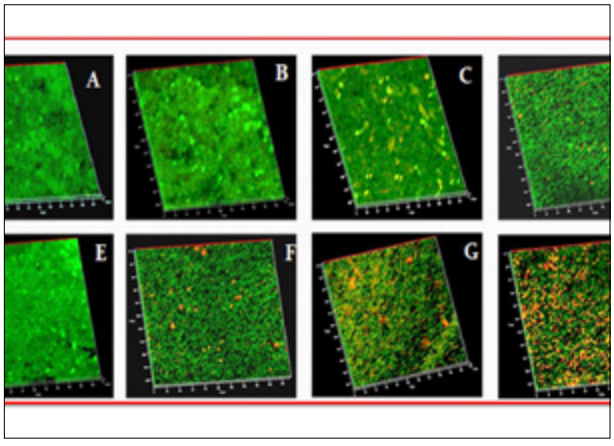

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About the Magazine

Scientific African Magazine documents science and technology developments in Africa and from Africans for the general public. We review innovations that matter. We ask the hard questions. We highlight best practices. The Magazine is published by the Next Einstein Forum (NEF). The NEF seeks to shape Africa's scientific agenda and build a vibrant, high impact community of scientists.

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FROM THE EDITOR IN CHIEF

Nathalie Munyampenda is the Managing Director of the Next Einstein Forum

We're very excited

to launch this first issue of Scientific African Magazine this month. When we launched Scientific African, a peer reviewed, open access, inter-and multidisciplinary scientific journal that is dedicated to expanding access to African research, we got a lot of questions about how we would make sure policy-makers and the public more broadly would know about the research being published and ultimately how the research could have an impact.

We had already anticipated this question and Scientific African Magazine is our answer. Published every two months, we hope that the content, derived from Scientific African and other journals across the world, will bring science to the people, and ultimately have an impact on policy, spurring increased investments in research and development.

We are not shy about the importance of having a journal like Scientific African, or a magazine such as ours. If I take the research around baobab enriched cookies that you can read about in this issue, as a mother, this caught my attention immediately. Given Baobab is not native to Europe or North America, would this ever be published in other prestigious journals, or other scientific magazines? I am not so sure. Given the challenges of stunting in Africa, the research is highly relevant for the continent. Connecting science to humanity. That has always been our goal at the Next Einstein Forum and we hope this magazine helps us all bridge that gap.

If you thinking we should be covering an important, science and innovation driven, Africa relevant story, write to us at: magazine@nef.org

"Connecting science to humanity. That has always been our goal at the Next Einstein Forum and we hope this magazine helps us all bridge that gap.

Scientific African Magazine

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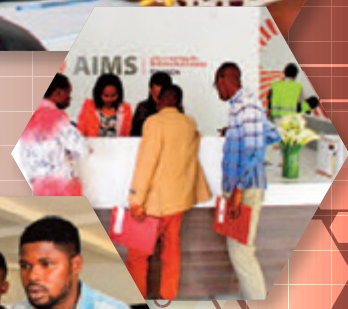

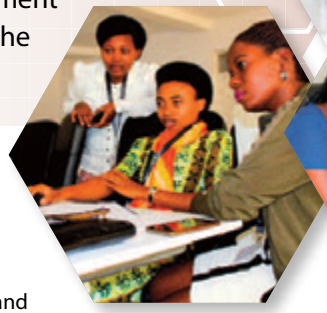

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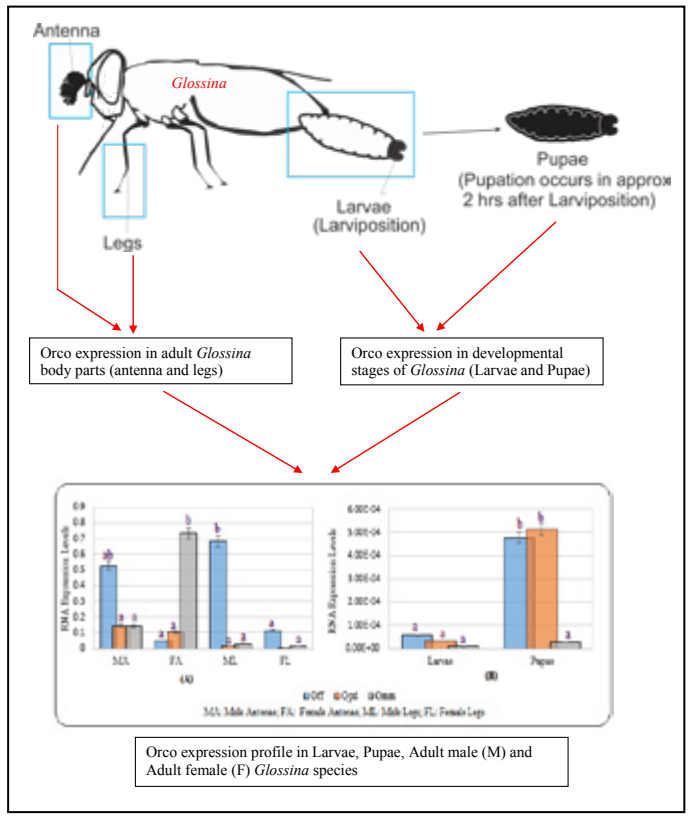

Orco expression profile in Larvae, Pupae, Adult male (M) and Adult female (F) *Glossina* species

Understanding how tsetse flies smell their prey could save lives

By Linda Nordling

Scientists are examining how tsetse flies, which transmit deadly sleeping sickness in humans and nagana—its animal counterpart—in Africa, locate their prey using their sense of smell, raising hope for better ways to control the deadly pest.

Before the 18th century, sleeping sickness, or Human African trypanosomiasis, was a manageable threat on the African continent. But European colonial expansion pushed humans to farm and settle in infested areas, causing deaths to rise into the hundreds of thousands.

Lately, management and prevention schemes have made the disease less common—cases dropped from close to 28,000 in 1999 to less than 1,500 in 2015 according to the World Health Organization. However, in remote areas where health systems are weak, it remains a threat. And the parasite also infects and kills livestock, causing an estimated US$628 million in damage every year.

Like most biting insects, tsetse flies locate their prey using their sense of smell. They have olfactory receptors in their antennae and their legs, which send signals to their brains. This signaling system—and how to manipulate it—is now in the sights of a group of Kenyan scientists.

"If you can interrupt the communication between the host and the fly, it means the fly will not transmit the parasite," says Steven Nyanjom, the corresponding author on new research on the topic published in Scientific African.

Nyanjom and his colleagues at Jomo Kenyatta University of Agriculture and Technology in Nairobi say they are the first to study so-called odorant co-receptors in adult and developing tsetse flies. Odorant co-receptors, or Orco, are thought to be important to the sense of smell for many different types of insects. Research published in 2015 on the gypsy moth, Lymantria dispar, found that interfering with Orco interrupted the moths' sense of smell.

Understanding the mechanisms behind Orco could offer a new avenue for tsetse fly control says Nyanjom. He adds that the work of his team could also improve tsetse fly traps, which are used together with repellents to manage the pest populations. "It can help us design synthetic analogues which are better attractants, or repellents, than what we currently have."

The Kenyan team studied Orco in three different tsetse fly species: *Glossina morsitans morsitans, Glossina pallidipes, and Glossina fuscipes fuscipes.* They looked for Orco in the larvae, pupae, legs, and antennae of all three species. They found the receptors in all tissues, although there were more in the pupae than at the larval stage, suggesting this to be an important developmental stage for the fly's sense of smell.

The findings add to a growing body of work to map the biology of the tsetse fly. In 2014, a collaboration between more than 140 scientists worldwide published the entire genome of Glossina m. morsitans in Science magazine. To date, six species of tsetse fly have been sequenced, Nyanjom says.

However, he adds, there is more to be done. There are more than 30 species of tsetse fly, and all of them have the potential to spread the parasite that causes sleeping sickness and *nagana*. "For us to effectively control transmission we have to get more people involved in the research," he says.

Dan Masiga, who heads up animal health at the Nairobi-based International Centre of Insect Physiology and Ecology, and who was not involved in the research, told Scientific African that while the study was useful, it was limited by focusing on single-gene analysis. "[That] gives no indication of functional information, for example what stimuli the flies are responding to."

Nyanjom says he is working with colleagues at ICIPE on that. "They have started profiling the response of each odorant receptor to specific stimuli," he says.

> **"If you can interrupt the communication between the host and the fly, it means the fly will not transmit the parasite."**

Exposing radioactivity in the building blocks that make up Accra

By Linda Nordling

African cities are growing rapidly, with buildings mushrooming in major centres around the continent. But scientists in Ghana are concerned that building materials could be radioactive and play havoc with occupants' health.

"Normally, when you mention radiation, people think about a bomb," says Francis Otoo, a scientist with the Ghana Atomic Energy Commission based in Accra. But radiation is present most of the time, he points out. Soil and rock, in particular, often contains some radioactive material—and this can cause health problems when they are used in buildings like residential houses and office blocks.

Otoo and his colleagues have set out to measure the risk in Accra, Ghana's biggest city. One quarry site, in particular, is cause for concern. Their results are published in Scientific African.

In developed nations, radioactivity in buildings is usually monitored to ensure it falls below safe levels. But in developing countries where building codes are weak and seldom enforced, it is a growing concern. Africa is urbanising faster than any continent in history, and mega-cities like Accra, Lagos and Nairobi are already straining to meet the transport and housing needs of their growing citizenry.

Ghana is a case in point. Accra's population is growing by more than 2% each year. But a study published in 2013 by the Bank of Ghana highlighted major challenges in the construction sector. "There are serious shortfalls in materials handling, safe working practices, quality and timeliness of construction," it said. Where regulations exist they are often infringed upon, and infringements are rarely punished, it added.

To study the radiation levels in building materials in Accra, Otoo and his colleagues collected samples including soil, bricks, cement, rock and concrete from 17 sites around the city. They tested them for three radioactive isotopes of Uranium (U), Thorium (Th) and Potassium (K), all three of which are known to cause problems for human health. They also monitored levels of radon, a radioactive gas that forms when radioactive elements break down.

Radon is particularly sinister, as it accumulates in enclosed spaces and causes lung cancer after extended exposure. In the United States, where radon is the second biggest cause of lung cancer after cigarette smoking, the Environmental Protection Agency recommends regular radon testing in homes below the 3rd floor. But In Ghana there are no such regulations.

Living conditions in Ghana make radon a particular concern, Otoo adds, because many houses are insufficiently ventilated. Ghana is hot and humid most of the year, and most new buildings are fitted with air conditioners. While this may make life more comfortable for their occupants, it can also result in radon gas accumulation, he says, since doors and windows stay closed most of the time. Indeed, in a study published by Otoo and others earlier this year in the journal Radioprotection, Ghanaian houses with air conditioning had higher radon levels than those without.

Thankfully, the radiation levels in the construction materials studied for the most recent paper found little cause for concern. All samples had levels below the world standards bar one: Gneiss rock quarried in the Shai Hills in the northern suburbs of Accra. Overall, the radiation safety concerns were "negligible", Otoo and his co-authors write. But he says more sampling needs to be undertaken, as radioactivity levels in mines and quarries vary not only with geographical location, but also with depth. "Most of the time the deeper you go the more exposure you get."

The paper is important, says a soil radioactivity expert in South Africa. "This is a very interesting study and agrees with our findings that gneiss has a high risk of cancer," says Mannie Levin, an independent consultant who works on research projects related to radon gas around old gold mines in Krugersdorp. "The findings that the materials are safe for building construction is good." However, he says more work needs to be done to study basements and enclosed spaces for radon. "Air circulation in such areas is required to ensure low radon exposure."

Otoo says the study is part of a larger project to monitor radiation exposure in Ghana. This is not just looking at soils and building materials, but also at radiation exposure through food and water. The end product of the work, he says, is to produce appropriate reference levels to inform building regulations. "We don't want to cause fear and panic. We want to be able to tell the people who mine or quarry: If you reach this depth, you need to get an investigation to see if the rock is alright to use."

One of the main challenges Otoo and his team faced was the lack of locally-available technical equipment to do the testing. "We did most of the work in Italy," he says.

Otoo's link with Italy came about as a result of receiving a PhD training fellowship grant by the International Atomic Energy Agency. This fellowship saw Otoo spend 18 months at the Centro Regionale di Radioprotezione in Udine. "This eventually contributed to my academic research especially the experimental work leading to this publication and also award of my PhD from the University of Ghana in 2015," says Otoo. His Italian supervisor, Massimo Garavaglia, is a co-author on the paper.

Next, Otoo and his colleagues would like to monitor radiation levels in other cities in Ghana. There's a huge amount left to do, he says, and the stakes are high. Buildings built today will house generations to come, he points out. "At the end of the day we want to make an impact on people's lives. The effect is not going to be seen now. It will pass on to the next generation."

Photo Credit: Google Stock

Scientists fight drug-resistant fungal infections with light

By Linda Nordling

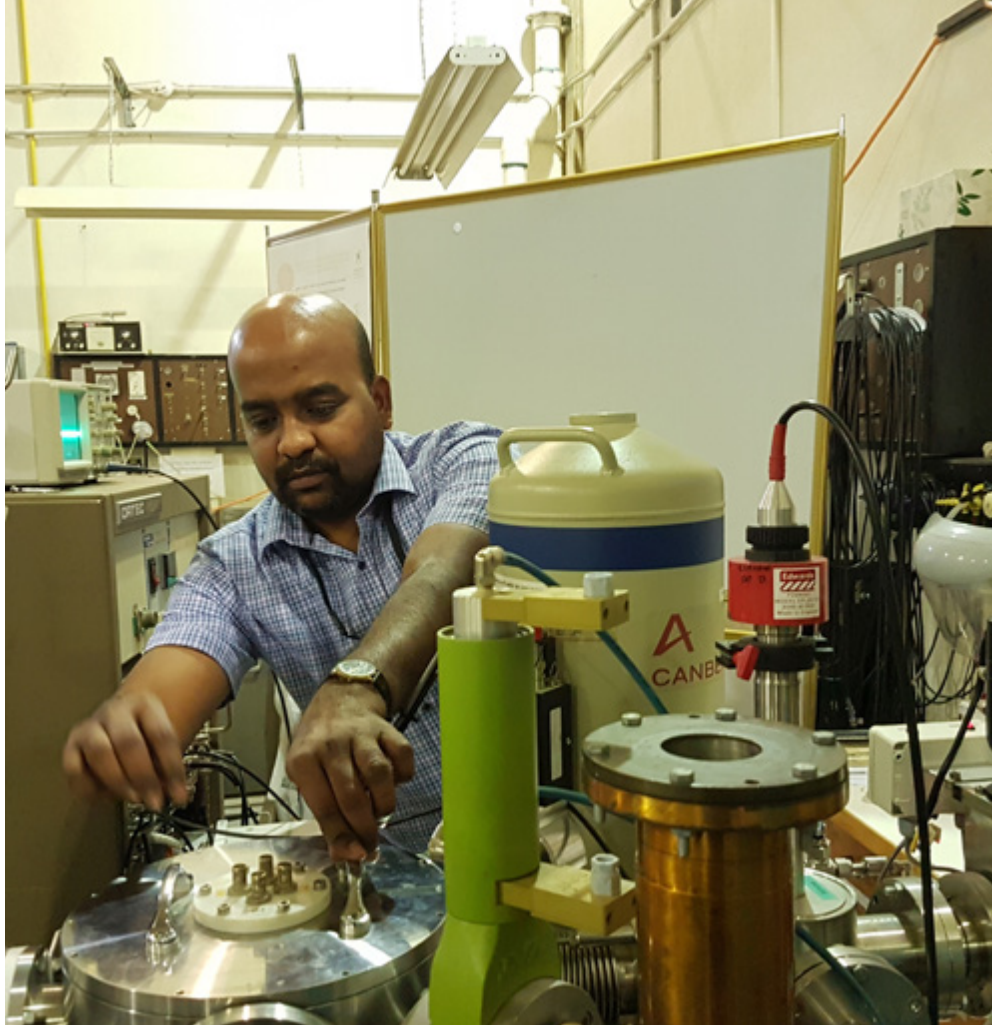

Photo Credit: K. Kaviyarasu

A group of scientists hailing from India, Saudi Arabia and South Africa are using light to fight drug-resistant infections.

Their work, published this month in Scientific African, is part of a global dash to come up with new antimicrobial therapies. Antimicrobial resistance means that some of the relatively routine complaints that we successfully treat with antibiotics, like infected wounds, could once again become death sentences unless we find alternate therapies.

In January 2018 the World Health Organization released its first global status report on antimicrobial resistance. It found high levels of resistance among a number of dangerous pathogens in both high- and low-income countries.

New drugs are under development to treat resistant strains. But it's only a matter of time before they, too, are bested by ever-evolving bugs. As a result, scientists are looking for novel ways to fight pathogens without the danger of resistance.

One promising weapon in scientists' armory is photodynamic therapy, which uses light to destroy pathogens, says K. Kaviyarasu, who is based at iThemba Labs outside Cape Town in South Africa. Together with his co-authors at Pondicherry University in India and King Saud University in Saudi Arabia, he is working on one such method to kill the yeast Candida albicans.

C. albicans causes candidiasis—more commonly known as a yeast infection, or thrush. At best, it is a temporary discomfort; at worst, it can be life-threatening. C. albicans has an insidious quality in that it can form thin films over medical implants like stents, shunts, prostheses and pacemakers. These biofilms are highly resistant to treatment. As medical implants are becoming more common, there has been an increase in candida infection, especially in people who are immunosuppressed such as those living with HIV or on cancer treatment.

Photodynamic therapy involves staining the targeted cells with dyes that make them light-sensitive, and then zapping them with light that destroys the cells. In their paper, Kaviyarasu and his colleagues test a new type of photosensitizer dye, made by combining mesoporous silica nanoparticles (MSN) and rose bengal, a red-pink stain with many medical applications. MSN was added to improve the delivery of the dye into the target cells.

> **"Our motto is to do science that is suitable for applications, not just for publications."**

The group applied their dye to C. albicans, both in biofilm form and suspended in a solution. They then irradiated the cultures with green light, and found that this method was better at killing C. albicans than if they did not use the nanoparticles. More than 88% of cells were killed with the MSN-RB mixture, compared with only 40% for rose bengal alone. "This can be used to treat localized superficial infections caused by antifungal drug-resistant and biofilm-forming strains," the authors write. They add that the dye could also be used to remove such strains on medical devices before they are inserted into patients.

However, Michael Hamblin from the Wellman Center for Photomedicine at Massachusetts General Hospital, queries whether the effect demonstrated by the team qualifies as a success. The American Society of Microbiology decrees that any treatment must kill 99.9% of cells to even be called antimicrobial, he says.

Kaviyarasu said he and his co-authors "strongly agree with the ASM recommendations". He and his colleagues are working on two other projects linked to this work. They are testing two other experimental photosensitizers against two harmful bacteria - Staphylococcus aureus, which can cause a range of diseases including pneumonia and meningitis, and Pseudomonas aeruginosa, which is a common source of hospital-acquired infection.

He hopes the results of all the studies will eventually have a real impact on doctors' abilities to fight these infections. It is this desire that unites the team. "Our motto is to do science that is suitable for applications, not just for publications," he says.

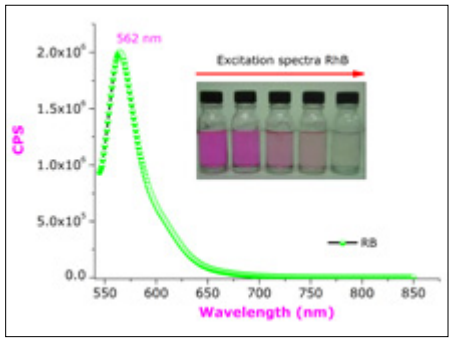

Photo Credit: K. Kaviyarasu

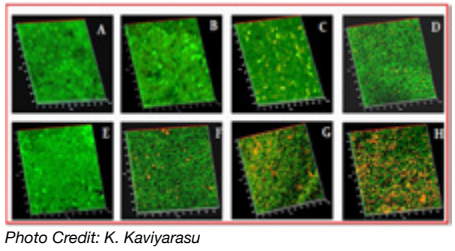

Photo Credit: K. Kaviyarasu

Fufu for modern times

> **This new method will encourage customers to patronage fufu outside home especially when prepared by commercial food vendors."**

Photo Credit: Google Stock

By Linda Nordling

If you're from West Africa, chances are you have strong opinions about how your fufu should look and taste. The much-loved springy porridge—made by pounding starchy foods like cassava and plantain together—is a regional mainstay, traditionally served with fragrant soups.

But today's busy lifestyles are at odds with the traditional way of preparing fufu. This involves boiling the tubers, mashing them, and pounding them into a smooth springy paste using a large wooden pestle and mortar, which can take a lot of time.

As a result, there is a growing demand for fufu-making shortcuts. Supermarkets already stock so-called 'neat' fufu—a dry, pre-milled mixture, to which you add boiling water before serving. But for fufu connoisseurs, it just doesn't taste as good as the real thing. And because plantain browns when exposed to air for long, these premixes often contain chemical dyes to mask their unappetising colour. One of the additives is yellow tartrazine, which some studies have linked to hyperactivity in children.

But now a group of Ghanaian scientists is working on a way to make premixed dry fufu powder that tastes and feels more like traditional fufu. They also want to develop ways so it doesn't brown, eliminating the need for potentially harmful additives. And it might have health other health benefits: By using cassava-derived starch powder instead of milled cassava, and adding it to plantain puree which they later will dry, they hope to reduce the amount of cassava, which has a high glycemic index and is therefore not suitable for diabetics who need to keep their blood sugar levels down.

Traditionally made Ghanaian fufu can have cassava levels as high as 90% says Gifty Serwaa Otoo, a food scientist at Kwame Nkrumah University of Science and Technology in Kumasi, and the lead author on the paper. "My work was to find out if fufu could be prepared in different ways where the proportion of cassava and plantain could be varied with low cassava content, and at the same time achieve that viscoelastic texture that makes the Ghanaian love his or her fufu," she says.

In their article in Scientific African the four scientists describe how they settled on an ideal ratio of 20% cassava starch to 80% plantain puree. Made in the microwave in five minutes, this formulation could be consumers' answer to quick fufu. Regular fufu-eaters rated it higher than 'neat' fufu. Of the 30 testers, 22 said they preferred the scientists' fufu in terms of its softness, smoothness, smell and taste.

Beating the browning

Getting the texture right was an important first step, says Edward Essuman from the Department of Nutrition and Dietetics at the University of Health and Allied Sciences in Ho. Now, he and his colleagues will work on perfecting their recipe.

The next step in their research will be perfecting their fufu's colour. According to their data, colour was the only category in which the testers preferred the 'neat' fufu. To prevent the plantain going brown, Essuman and his colleagues will pre-treat it with lime water, or salt water, before drying and milling it. "We want to try and see if we can use natural means to mask the colour," he says.

If they manage to do this, their product could make a big difference to busy Ghanaians hankering for a plate of fufu and soup, says Vida Gyimah, a co-author, who is based at the Department of Hospitality and Tourism Education at the University of Education, Winneba. "This modern method saves time and energy because it makes use of a microwave. It can be done by one person, compared to the traditional method that needs two people: one turning the the fufu in the mortar and other one pounding the fufu with a pestle," she says.

Gyimah says it could also prove popular with hotel and catering industries, since the traditional way of preparing fufu is sometimes considered unhygienic. "This new method will encourage customers to patronage fufu outside home especially when prepared by commercial food vendors," she says. Microwave preparation is another advantage that their fufu has over other varieties, both modern and traditional: It allows for speed and economies of scale. "This will be very convenient for the hospitality industry," Gyimah says.

To Essuman, the work on fufu is a small but notable step towards a future where traditional Ghanaian food is served and enjoyed in modern, hygienic, but above all delicious ways. "Our local food needs to be standardised," he says.

> **This modern method saves time and energy because it makes use of a microwave. It can be done by one person compared to the traditional method that needs two people, one turning the the fufu in the mortar and other one pounding the fufu with a pestle."**

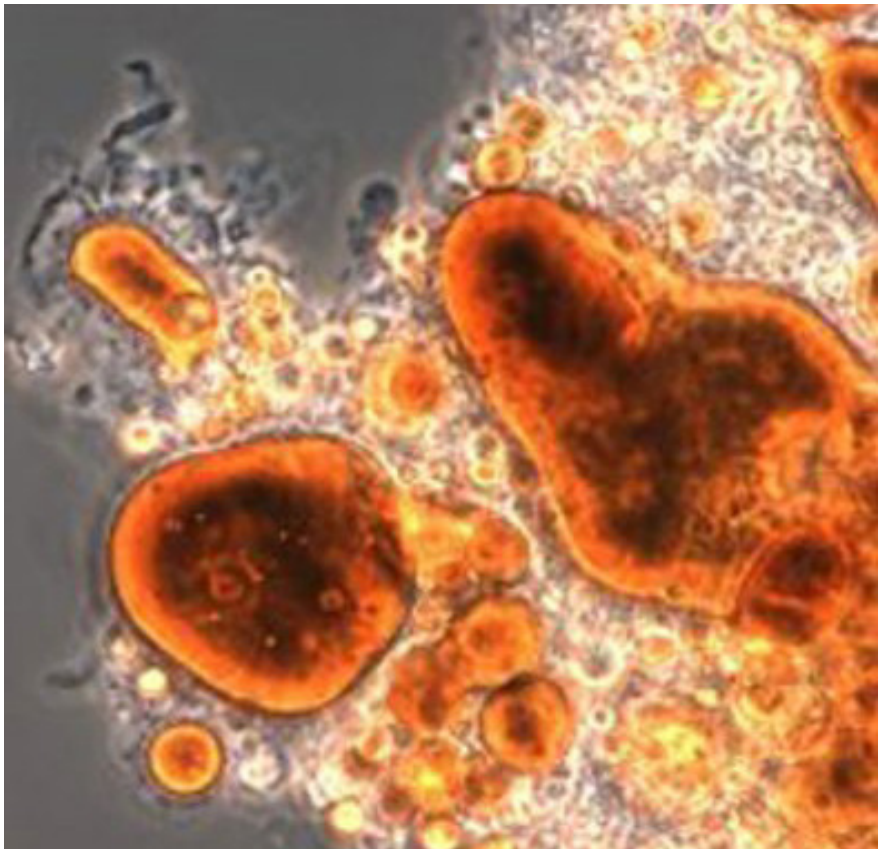

Photo Credit: Google Stock

On the lookout for oil-eating microbes

By Linda Nordling

In Nigeria, once thriving ecosystems have been devastated by decades of oil exploitation—including oil spills caused by sabotage or illegal refining. But Chioma Chikere, an environmental microbiologist at the University of Port Harcourt in Rivers State, is working on a solution. She speaks to Linda Nordling about her work using oil-consuming microbes found in nature to clean up such polluted sites, while at the same time improving the lives of the people who live there.

Nigeria is one of Africa's largest oil producers. In October this year, the country's wells were producing about 1.8 million barrels of crude oil every day. This wealth comes at a high environmental price, however. Many oil wells are located in ecologically delicate wetlands, and transported via pipelines to industrial refining sites. But decades of spills—from routine exploration, accidents, sabotage or illegal artisanal refining, where locals break open pipelines to siphon off crude oil to refine and sell on—have devastated local plant- and wildlife, and made people ill in nearby communities.

But the wastelands caused by the oil industry may harbour the key to their own salvation: oil-consuming microbes that could restore the soils to their former glory. Chikere, who has spent over a decade hunting these microbes, talks about her latest insights published in this issue of *Scientific African* and her plans for bringing oiled soils back to life.

How did you become interested in this field?

I did my MSc in industrial microbiology at the Federal University of Technology in Owerri, in Nigeria. My supervisor, Jude Ogbulie, was a consultant for some of the oil companies in the country. One day he observed something strange near an abandoned oil well: an algal bloom in the middle of all that pollution. That brought about my research project, which established that algae could live in and even digest the oil. I realised that if we can find ways of restoring the environment using those natural biochemical reactions, it could be a game-changer. That sparked my passion.

What is your Scientific African paper about?

My co-author Emmanuel Fenibo and I collected soil samples from two sites that had been used for illegal oil refining. One was an island on the Sombrero river, the other a site close to the Bodo-Bonny bridge. These sites, both in Rivers State in southern Nigeria, were so degraded that the soil was calcified. There was no plant life, no greenery. The places were stripped bare to the eye, but we still found microorganisms in the soil. These microorganisms are able to use hydrocarbons as sources of energy.

We took the samples to the lab where we studied their hydrocarbon concentrations, especially polyaromatic hydrocarbons (PAHs), which pose high risk to human health. In fact, they can cause cancer. We then isolated bacteria from the samples that were able to feed on PAHs, extracted their DNA, and studied it.

We found that bacteria from both sites contained nahAc and PAH-RHDa-GP, two genes which express proteins that are able to digest hydrocarbons. That showed the bacteria were most likely helping to degrade the dangerous hydrocarbons in these soils.

Was it difficult to get access to the sample sites?

It was very hard! The local communities are distrustful of strangers. They do not see the benefits from the oil industry, and sometimes they break open pipelines and siphon off oil to crudely refine and sell. It's a messy business.

Luckily, my co-author, who was my MSc student at the time, hails from one of the communities. He was able to negotiate access. We explained to the communities that we believed the research would benefit them; not just by restoring their land, but also by generating income. We paid locals to use their boats to access the field sites.

We now have another ongoing project to try to rehabilitate calcified soils. That project is creating even more employment.

How are you restoring the soil?

The bacteria we found are aerobic, which means they need oxygen to break down the dangerous hydrocarbons. We are trying to see whether we can speed up the process in the soil by tilling it to get more oxygen into it. We employ local youth to till the soil. Then we add manure as a fertilizer, which we buy from locals as well, and we pay locals to transport it.

What are the results so far?

A little over three months after starting the rehabilitation process, known as bioremediation, the sites have been transformed. A place that was stripped bare of vegetation now has full vegetation. Gradually, the soil is bouncing back. It's a very simple and affordable way of treating the soil, that the locals can do themselves. This was important—any technology we developed had to be applicable in the local context.

How healthy is the soil afterwards? Can you use it to grow food?

That's the next thing we want to look at. At the moment what's growing at these sites is wild weeds and shrubs. The next stage will be to look at the plants;, are they concentrating the chemicals in their parts? As we speak my co-author, who is now my PhD student, is working on this.

We also want to look closer at the bacteria we have found to see if we can identify among them especially voracious consumers of hydrocarbons that may have evolved in these soils. We'd like to do high-throughput and whole genome sequencing of these microbes so we can isolate the enzymes and genes that allow them to break down oil so efficiently.

Unfortunately, in Nigeria, we are limited by a lack of equipment and facilities. At the moment, we have to do some of our advanced laboratory analyses in South Africa. We hope that in future, we will be able to apply for grants and get funding that can help us address this lack of equipment at home.

Could cooler cigarettes lessen harm to lungs?

By Sarah Wild

"Cooler" cigarettes could reduce the damage to smokers' lungs, according to new research published in Scientific African this month.

Tobacco consumption kills up to 7 million people annually, according to the World Health Organization (WHO). Although smoking affects every organ in the body, it has been conclusively linked to lung cancer. The United States' Center for Disease Control reports that smoking is responsible for nine out of 10 lung cancer deaths.

But the demographics of smoking are changing. About 80% of the world's 1.1-billion smokers now live in low- and middle-income countries, says the WHO.

Part of cigarettes' deadliness is linked to the temperature at which they burn, the authors write in their paper, "Environmental inhalants from tobacco burning: Tar and particulate emissions."

"Most of the highly toxic pollutants usually evolve between 200 and 600 degrees Celsius," says Joshua Kibet, study co-author and a chemist at Egerton University in Kenya. Their study aimed to determine which toxins and particles form at which temperatures—and how these would attach to the lungs of a smoker.

Previous studies have found that tobacco smoke contains more than 5,600 compounds in its vapour and particle phase.

"The temperature at which maximum tar yields are produced is critical in designing cigarettes that can be smoked at lower temperatures and thus minimise the inhalation of harmful tobacco compounds," the authors, from Egerton University and the University of KwaZulu-Natal in South Africa, write.

To do that, the researchers mimicked a human lung, using a silica gel. This gel absorbed the tobacco smoke particles, which the researchers then analysed using an electron microscope to determine their size.

For legal reasons, Kibet says that they cannot disclose the brands of the cigarettes tested for the study, but he acknowledges that they were produced by major international tobacco companies.

Ultimately, the study found that cigarettes produced high yields of tar between 300 and 400 degrees Celsius, and that designing cigarettes that burn at lower temperatures could reduce the damage to smokers' lungs.

It also found that the particulates in cigarette smoke are ultrafine, meaning that they can cause more damage to the lungs. Scientists and governments usually measure air pollution, such as pollution from cars and factories or even dust, in particulate-matter size. For example PM2.5 and PM10 mean that the particles of pollution are 2.5-micrometres (μm) or 10μm in diameter. For comparison, a human hair is about 70μm wide.

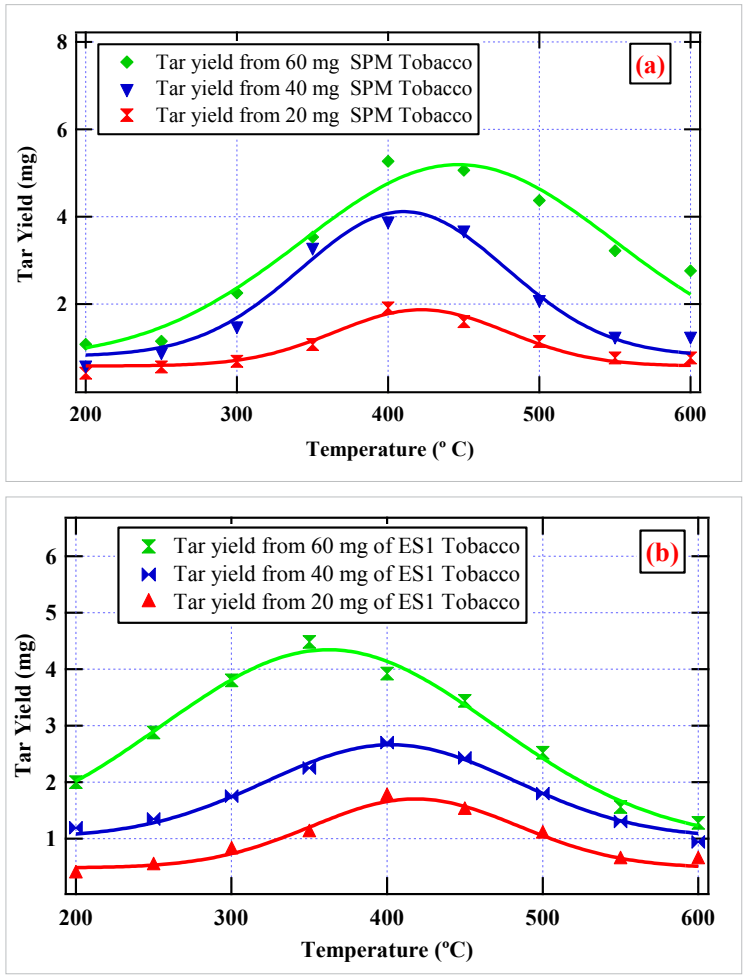

Fig.1: Distribution of tobacco tar at various temperatures for various tobacco brands.

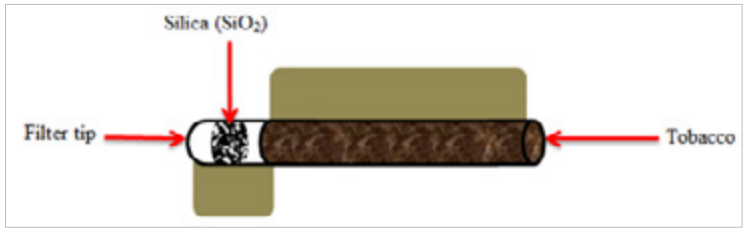

Fig. 2: The anatomy of a cigarette rod with silica encapsulated in the filter to trap tobacco tar

"Particulates from this study, and indeed most tobacco studies, are classified as PM0.1," says Kibet. "Particulates from tobacco smoke are very small, and may be inhaled deeper into a person's lungs causing serious biological harm."

Interestingly, smokers who smoke quickly are at greater risk of inhaling these ultrafine particles. The researchers found that the cigarettes of those who smoke quickly burn hotter than those who smoke slowly (time and a lower temperature allow these ultrafine particles to congeal into larger ones).

Kiset hopes that his research will enable cigarette companies to produce less harmful cigarettes.

However, Paul Garwood, a communications officer at the World Health Organization, is sceptical.

"Cigarettes are the most deadly consumer products on the market, which when used as intended have debilitating health outcomes," he says. "Several attempts have been made over the years to alter the characteristics of cigarettes, including light and mild cigarettes, and the inclusion of filter ventilation, with claims of reduced harm attributable to these modifications. However, science has proven that these modifications do not reduce the harmfulness of these products, as the resulting emissions from these cigarettes are just as harmful.

Reducing the size of the tar particles will not reduce the toxic chemicals to which the smoker is exposed," he says.

The next step in Kiset's research is to characterise the status of cigarette smoking in Kenya, and its link to socioeconomic variables such as education level and tobacco company marketing. "The results of [such a] study should be used to educate people on tobacco cessation strategies and minimise the economic burden caused by tobacco-related diseases such as cancer, oxidative stress, respiratory problems, and [premature] ageing."

Baobab cookies: A tasty way to fight malnutrition in Africa?

By Sarah Wild

> The use of baobab pulp in pastry is an innovation."

Photo Credit: Pauline Mounjouenpou

The iconic African baobab could soon be used to fight malnutrition on the continent—in the form of rice cookies. New research, published this month in Scientific African, has found that pulp from the baobab, also known as Adansonia digitata, when added to rice cookies significantly increased their nutritional content and made them tastier.

Between 2000 and 2015, nearly all African countries showed reductions in the rate of children under 5 years old who were stunted, underweight, or suffered from wasting, according to a study published in Nature earlier this year. However, the World Health Organization cautions that undernutrition and stunting persist in many countries on the continent.

Fortified foods are considered one weapon in governments' and communities' arsenal to fight poor nutrition. By fortifying staple foods, people can obtain nutrients that they would otherwise not be able to get due to a lack of affordability or access.

"The choice of baobab to fortify cookies was made based on its nutritional composition," says Pauline Mounjouenpou, a co-author on the paper and researcher at the Institute of Agricultural Research for Development in Cameroon.

Numerous studies have confirmed the high nutritional content of baobab pulp, fruit, and seeds. One 2002 study found that baobab fruit pulp had a vitamin C content seven to 10 times higher than that of oranges. Another investigation in 2010 identified baobab seeds as a good source of phosphorus, calcium, and magnesium.

The baobab is native to the African continent, where it is considered an important cultural and medicinal plant. It grows from northern South Africa to the southern Sahel.

"Because of the richness of baobab pulp fibre, sugar [content], and vitamin C, several researchers have worked on variations for the production of fortified juices, jellies, sauces, and creams," says Mounjouenpou, who collaborated with five Cameroonian researchers. "The use of baobab pulp in pastry is an innovation."

It is an innovation that, according to their research, consumers appreciate. In their study, they incorporated baobab pulp-derived flour into cookies. They offered a group of 30 tasters four different types of cookies: unfortified rice cookies; ones in which 10% of the rice flour was replaced with baobab flour; ones with 20% baobab flour; and cookies with 30% fortification.

An important factor in the successful uptake of fortified foods is their tastiness. The researchers asked the tasters to judge the cookies on a number of sensory parameters, including taste, aroma, and overall quality.

All of the tasters rejected 30% baobab-fortified cookies, whereas 20% cookies were the clear winner and were more popular than undoctored rice cookies.

A nutritional analysis of the popular 20% cookie indicated that it retained the high nutritional content of the flour. This is a strong motivation to include baobab pulp-flour in rice cookies.

Charles Parkouda, a researcher at the National Centre for Scientific and Technological Research in Burkina Faso, welcomed the study. "The authors have to be congratulated for their contribution for the value-adding of baobab products," he says. However, he did query some of their methods and wanted to know the type of equipment used in the milling process.

The next step in their research, the authors write, is to study the ecological impacts of producing baobab cookies, as well as their lifespan, to see whether it is possible to manufacture them commercially.

> Because of the richness of baobab pulp fibre, sugar [content], and vitamin C, several researchers have worked on variations for the production of fortified juices, jellies, sauces, and creams."

Embedding traditional birth attendants in clinics and hospitals in Ghana could save mothers

By Sarah Wild

Photo Credit: Google Stock

Despite government efforts to boost access to maternal health services in Ghana, many women still choose to go to traditional birth attendants, rather than midwives, nurses, or doctors. The University for Development Studies' Leander Allou tells Sarah Wild about his research into the birth practices of women in a remote district of Ghana—and what can be done to make childbirth safer for women.

In Ghana, on average 310 mothers per year will die during or after childbirth for every 100,000 live births, according to the country's 2017 maternal health survey. That is substantially higher than the United Nations' Sustainable Development Goal 3 target to reduce global maternal mortality to less than 70 per 100,000 live births by 2030.

Allou interviewed women in the Tolon district in northern Ghana about their birth practices, and here he speaks to Scientific African about his research.

Tell us about your latest paper.

The paper is about women's preference for traditional birth attendants (TBAs) rather than trained midwives and the reason for their choice. I wanted to find out why women chose to go to TBAs, who assist the mother during childbirth. The TBAs learn these skills through delivering babies themselves or through apprenticeship to another TBA, rather than formal medical training.

TBAs are found in most rural communities. They are accepted members of these communities, and mothers-to-be are more likely to trust them. However, we do not know how many TBAs there are in Ghana. In the Tolon district, where I undertook this study, there are a number of community-based health and planning services compounds, which aim to provide primary healthcare to rural citizens. However, almost every community in the area has more than two TBAs.

I spoke to 360 women who had used the services of a TBA in the last five years. The women ranged in age from younger than 20 to older than 41. For some it was their first child, others had had more than nine.

I only chose women who had used the services of TBAs because I wanted to understand why they preferred the women in their communities to the health officers at government facilities.

And what did you find?

The major factor was cost. More than a quarter of respondents said that it was cheaper to use the services of a TBA than going to a government health centre or compound. This is interesting because maternal health services in Ghana are meant to be free.

About 26% of respondents thought that TBAs were culturally acceptable, as these women were known to the pregnant mothers. One woman said: "I cannot go and show my private part to someone I do not know; my husband will not agree."

Other reasons given were that TBAs were more caring than health care officers and that these birth assistants live nearby and so are easier to visit once labour begins than travelling to a clinic or compound. For a small percentage of women, TBAs were the only maternity care they knew of.

How did you become interested in this field?

I am interested in maternal health issues because I lost the only two females in my nuclear family—my mother and sister—during childbirth.

In terms of this study, my university, the University of Development Studies, runs a programme in which a multi-disciplinary team of students collects data on various aspects of development in rural communities. During one such programme in the Tolon district, I was the district coordinator for the programme and realised, from the students' data, that there were TBAs in almost all communities.

There were also clinics in the communities, but I realised that most of the women visited the TBAs when it was time for them to give birth. So I went in to find out the reasons why the women preferred to use TBAs rather than trained midwives.

Why do you think that this is a necessary area of study?

Ghana has put in place a lot of policies to improve maternal health, but, interestingly, the country continues to record unacceptably high maternal mortality rates. It is necessary to find out what is wrong with the policies.

What do you think needs to change?

The policies must be made to be culturally acceptable. Policies on maternal health should include how TBAs can be part of mainstream maternal health care. This has been done with traditional health practitioners, such as herbalists and bone setters, who are now attached to hospitals in most parts of Ghana. TBAs could also be given training in subjects like infection control measures, the use of surgical gloves during procedures, and basic modern midwifery skills to complement what they already do. Women in rural and peri-urban area will continue to want to use TBAs because they trust them. It is important that these services are regulated to ensure improved services are delivered to pregnant women.

What is the next step in your research?

One of the things that came out strongly during this study was birth positions. The TBAs allowed women to choose the positions they wanted to be in during birth, and that was one of the reasons why women preferred them to other healthcare providers. My next project will be to find out if Ghana's health institutions have the required facilities and skills to offer women the ability to give birth in different positions.

Photo Credit: Aminu Imam

Ancient herbal remedy rallies a global science collaboration

By Sarah Wild

Nigella sativa goes by many names: black cumin, black caraway, Roman coriander. But one name in particular caught the interest of Aminu Imam, a neuroscientist at the University of Ilorin in Nigeria. Muhammad, the founder of Islam, is claimed to have dubbed it "Habbatus sauda" and "a cure for all diseases except death."

Purveyors of natural medicines containing N. sativa offer these products as a panacea for many ailments, from eczema to anorexia.

Imam was curious to study the efficacy of the plant, which is native to parts of Asia, Europe and North Africa and used in both seed and oil form globally. It was an interest he shared with colleagues at his institution. But their curiosity—and collaboration—has spread to partners in countries all over the world. Their most recent paper, which pits N. sativa against a dangerous pesticide, has co-authors in Nigeria, South Africa, Taiwan, and Zimbabwe.

Samson Chengetanai, an anatomist at the National University of Science and Technology in Zimbabwe, says: "In my discussions with my co-authors, I discovered that there was a religious basis for the use of N. sativa and its extracts, and this piqued my interest."

The plant is widely available in natural products in African countries and extensively used, even though it does not grow in large quantities below the Sahara. Natural products and remedies, in general, have seen a spike in mainstream interest, Chengetanai says. "In countries like South Africa, where I am currently studying, it has come to the point where natural medicines are sold in some of the largest pharmacies."

In their paper, published in Scientific African this month, the authors investigate how N. Sativa could potentially repair brain damage caused by chlorpyrifos, a widely-used pesticide.

A high-stakes chemical

Chlorpyrifos acts on a broad spectrum of species (including humans) by attacking their nervous systems. In 2018, an American court ruled that the pesticide should be banned in the United States, following evidence that residual amounts in food could harm babies' brains.

However, the chemical is still registered in more than 100 countries and widely used, says Victoria Williams, a neuroscientist at the University of Witwatersrand in South Africa. "We even find evidence of chlorpyrifos-residues on citrus after it has been washed and peeled," she says. "As a mother of a two-year-old boy, my biggest concern is the negative impact that chlorpyrifos has on the cognitive functions of the developing brain. Infants and children are particularly vulnerable to the neurotoxic effects of chlorpyrifos exposure, as their organs are still developing."

Chlorpyrifos is used in West Africa to control agricultural pests and mosquitoes, says Musa Ajibola, a neuroscientist at the Institute of Neuroscience at National Yang-Ming University in Taiwan. "People are exposed to chlorpyrifos mainly by inhalation or indirect ingestion. It is difficult to ascertain the level of human exposure," he says.

Positive signs

In their study, the authors found that N. sativa oil seemed to mitigate damage to rats' brains when administered at the same time as chlorpyrifos. They divided 32 rats into four groups, to which they administered either a saline solution, only N. sativa oil, chlorpyrifos, or both the oil and chlorpyrifos.

Rats fed just the oil or the saline solution showed no changes in behaviour. However, chlorpyrifos seriously compromised those exposed to it. Their brains shrank and many brain cells died in the hippocampus, a part of the brain associated with memory. Both their short- and long-term memory were particularly affected, something researchers determined through a series of maze tests.

"However, intervention with the oil of N. sativa was sufficient to normalise most of the changes caused by exposure to chlorpyrifos," says Imam. In fact, these co-exposed rats sometimes performed better in the memory tests than those given just the oil, according to their data.

Carine Smith, head of the Multidisciplinary Stress Biology group at the Department of Physiological Sciences at Stellenbosch University in South Africa, says that, given the huge health implications of organophosphate poisoning, any research on the matter is to be commended.

However, she says that the efficacy of the N. sativa oil in damage prevention is minor to mild, and questions the lack of comparison with current treatments for exposure.

The team recognises that this is just the beginning for their research, with many future avenues to investigate. "The next step is to better understand the specific mechanism by which N. sativa oil rescues chlorpyrifos-induced neurotoxicity, so that a particular pathway for drug development and therapeutic target can be established," says Ajibola.

A team effort

The authors all credited international collaboration for the success of their research. "It exposes us to different cultures, resources, and ways of thinking," says Williams. With each researcher bringing their own skills and expertise, they were able to approach the problem from multiple disciplines.

Initially, the team began as a core group in the University of Ilorin, Nigeria, with a number of publications between 2014 and 2016, but grew as members travelled overseas to do their doctorates. Three of the paper authors—Williams, Chengetanai, and Imam—met while reading for their doctorates at the University of Witwatersrand. "Each member of the team has been really instrumental in the outputs, from intellectual contribution, laboratory experimental work, statistics, interpretation, editing, to proofreading," says Imam, who coordinates the team.

However, the collaboration has not been without its struggles. These are mainly practical, the researchers say. Different geographic locations and time zones make communication difficult in the first place, but this is compounded by poor internet connections.

"We do have challenges, including how to fund our research, communications problems, access to materials, and others," says Imam. "But realising that most of these challenges are common in African settings, we have learnt over time not to just complain, but [to make] do with the limited resources, and bank on individual sacrifices."

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Investigating barriers between potato farmers and markets in Uganda

By Sarah Wild

With its verdant mountainous slopes, Kabale in western Uganda is well-suited to potato cultivation. But simply because potatoes will grow there does not mean that it is possible to thrive as a farmer.

This is a problem. The root vegetable features prominently in the Ugandan government's agricultural ambitions. Its Development Strategy and Investment Plan for the agricultural sector sees the potato, which is widely consumed in the country, as an important way to bolster food security and support rural livelihoods.

However, there are barriers between farmers and markets. New research, published in Scientific African this month, investigates where these breakdowns occur in Kabale and the eastern district of Mbale—and what can be done to bridge them.

"In many developing countries, there is a disconnect between farm production and the market," says co-author John Mugisha, a professor of agricultural economics at Makerere University in Uganda. "Although there are seemingly developed and perfectly competitive commodity value chains, smallholder farmers continue to complain of limited market access in terms of low prices, limited outlets, and hence low net returns."

Smallholder farmers are not the only ones complaining. On the other side of the commercial equation, traders protest irregular farm supplies, low-quality produce, and high marketing costs, Mugisha says.

In their research, he and his co-authors found that farmers' market access correlated with whether they had pre-existing contracts with buyers, the size of their farmland, the number of forked hoes they owned, and whether farmers added value to their produce before selling it. However, the challenges varied with location, they found.

"There were differences between Kabale and Mbale in terms of the volumes of potatoes produced and marketed, the number of value-chain actors, the ease of accessing the market, and the efficiency," Mugisha says. In each of these variables, Kabale had the upper hand.

The researchers found that if a farmer added value to their potatoes after harvest, they could earn 25% more money than if they did not. Value-adding activities ranged from washing the produce through to transporting the potatoes to the market themselves.

The research yielded some findings which surprised the researchers. It is widely assumed that brokers—who help link farmers to markets, while also taking a cut—reduce farmers' profit margins, but that is not what the data indicated. "We found no evidence of such," says lead author Harriet Kyomugisha, who is based at the Institut für Agrarpolitik und Marktforschung at the Justus Liebig University Giessen in Germany.

Mugisha says that the finding that surprised him the most was that farmers who accessed extension services—which are meant to boost farmers' skills and efficiency—actually seemed to have less market access. "The reason for this could be that the messages the skills extension workers imparted to farmers were not appropriate for their situation at that time," Mugisha notes.

However, two Ugandan economists who wrote a report on the country's extension services published in March 2016, questioned the finding that such services reduced farmers' market access. "Something must be wrong with the data they used to arrive at such a conclusion," says Mildred Barungi, who is based at Makerere Economic Policy Research Centre. She and her colleagues had analysed extension messages, and had not found them to be inappropriate.

Kyomugisha says she will now turn her attention to different varieties of potatoes grown in different areas. "The current study mainly concentrated on the highland potato because the crop has traditionally been grown in mountainous areas," she explains. She will study the adoption of lowland potato varieties and whether they can entice consumers.

As for Mugisha, his next step is to expand the scope of his research. He is involved in a four-year project, funded by the Mastercard Foundation through the Regional Universities Forum for Capacity Building in Agriculture. This project looks at the seed potato value chain, the intensification of potato production, and value addition, as well as market linkages.

"In many developing countries, there is a disconnect between farm production and the market," says co-author John Mugisha, a professor of agricultural economics at Makerere University in Uganda. "Although there are seemingly developed and perfectly competitive commodity value chains, smallholder farmers continue to complain of limited market access in terms of low prices, limited outlets, and hence low net returns."

Photo Credit: Google Stock

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Submission

- Short bio and photo
- A 300-500 word story or 2-3 minute video that discusses the following topics:
  - How does science impact your daily life?
  - What does it mean to be a Champion of Science?
  - Why is it important to engage people of all generations and backgrounds to be Champions of Science?
  - Why is it important to tell stories of science and engage the public in understanding and supporting scientific innovation?
  - Why is science and innovation vital to advancing Africa's socio-economic development?

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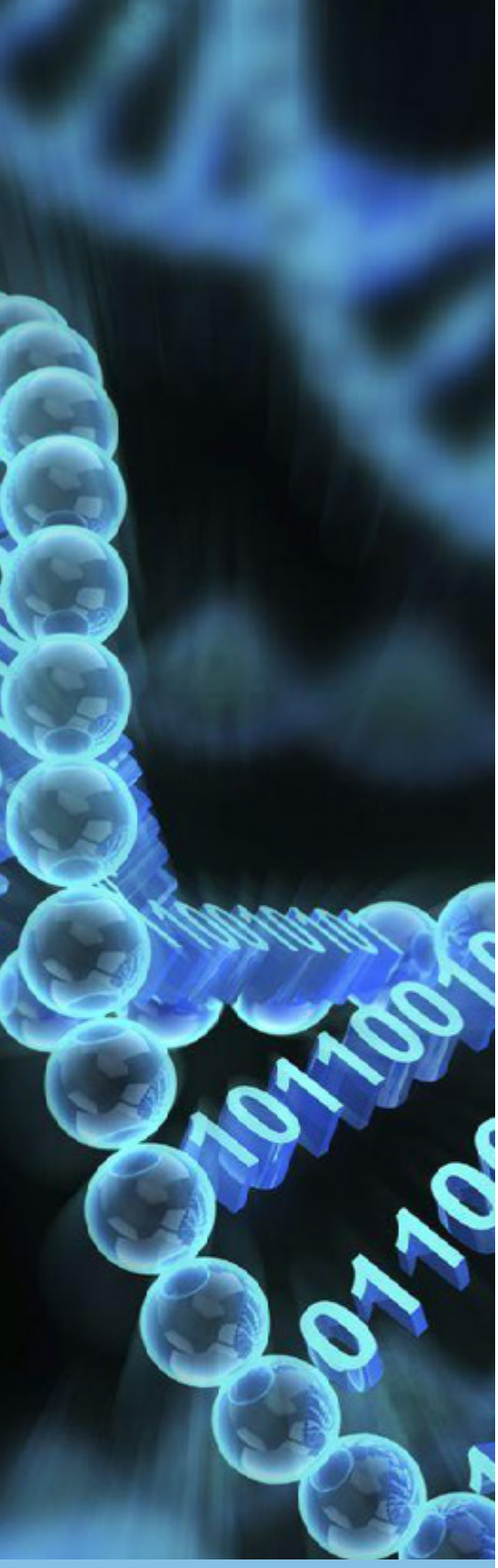


Look to Africa to advance artificial intelligence

> **If AI is to improve lives and reduce inequalities, we must build expertise beyond the present-day centres of innovation."**

By Moustapha Cisse

Artificial intelligence (AI) is changing society as profoundly as the steam engine and electricity have done. But unlike past technological revolutions, the AI revolution offers a unique chance to improve lives without opening up and exacerbating global inequalities.

That will require widening of the locations where AI is done. The vast majority of experts are in North America, Europe and Asia. Africa, in particular, is barely represented. Such lack of diversity can entrench unintended algorithmic biases and build discrimination into AI products. And that's not the only gap: fewer African AI researchers and engineers means fewer opportunities to use AI to improve the lives of Africans. The research community is also missing out on talented individuals simply because they have not received the right education.

I am happy to be returning to Africa as part of a chance to change that. Next month, Internet-technology company Google will open an AI Research Lab in Accra, Ghana, which will be the first of its kind on the continent and which I will lead. We plan to employ many engineers and scientists.

About 15 years ago, I started undergraduate studies in maths and physics in my native Senegal, and began to teach myself AI using courses downloaded from the Internet. I went to Paris to finish my graduate studies and then took up a position in Facebook's AI research division, working to make machine intelligence fair, transparent and more reliable.

There are many obstacles to an AI researcher from Africa making it into the global community. At a 2016 conference in Barcelona, Spain, attended by more than 5,000 people, I was one of fewer than 10 black people. In response, I co-founded Black in AI. It is now a thriving community of more than 1,000 students, researchers and AI enthusiasts ready to share ideas and foster collaboration to increase representation of black people. Despite the support, many of us still have trouble making it to conferences. I have had papers accepted at meetings but been unable to attend because Western countries such as Australia denied me a visa, even though I was already settled and working professionally in Europe.

We need more efforts to overcome these barriers and to ensure that the benefits of AI arrive globally. Many of the essential ingredients are already in, or coming into place. The human resources are there. Africa is home to the youngest and fastest-growing population on Earth. I am 33 years old, and that makes me older than most of the continent's inhabitants (the median age in Africa is 19; in the European Union, 43). Enthusiasm is huge. Last year, the Deep Learning Indaba gatherings across Africa hosted 300 students from 23 African countries, and had to turn down more applicants than it could accept.

Financial resources are also becoming available. Last year, venture capitalists poured US$560 million into tech start-ups in Africa. Google is supporting and advising more than 60 through Launchpad Accelerator Africa. According to the International Monetary Fund in Washington DC, six of the ten counties with the fastest-growing economies are in Africa.

There is a strong support among AI researchers. Last month, the African Masters of Machine Intelligence degree programme, which I organized with sponsorship from Facebook and Google, started courses with 30 students. More than 30 global experts have agreed to come to the African Institute of Mathematical Sciences in Kigali, Rwanda, to teach it. If the quality of a programme is judged by the quality of the lecturers, this is the best curriculum in the world.

The next step is to develop a coordinated plan to encourage AI education across the continent, incentivize entrepreneurship in the AI sector, and facilitate collaboration between AI researchers and experts in health care, agriculture and other sciences. We need a pan-African strategy: a set of ambitious goals for AI education, research and development and industrialization.

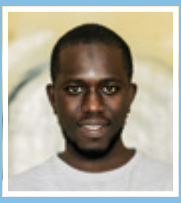
African nations must forge ties with their local AI expertise. Other countries, including China and France, have benefited from their country-specific initiatives. Canada, in particular, has cultivated a good synergy between a strong AI research community and receptive political leadership. As a consequence, the major tech companies all have centres in Montreal.

Another essential step is setting out a road map to mobilize human and financial resources, including a pan-African AI fund to support coordinated efforts. A network of African institutes of artificial intelligence, for example, could retain the best talents on the continent, enlist world-class African scientists to tackle AI challenges in the African context and collaborate with existing academic institutions. The network could also support policymakers and collaborate with the private sector.

Finally, African governments must create a standard legal framework and a set of values that will help to ensure that AI in Africa serves the good of humanity. There is a growing fear around the world about nefarious uses of AI. Fortunately, initiatives to prevent such uses are emerging. In the public sector, the European Commission this April outlined an approach to setting ethical guidelines for AI. In the private sector, Google published a set of standards this June to govern its AI research and product development.

Now is the time to build a foundation that ensures that AI helps bring better lives in Africa and beyond. With foresight and planning, the technological revolution that AI brings will be a force to empower a fair and prosperous society. The oft-overlooked continent has much to give and to get from AI.

This article was originally published in Nature and can be found here:



Moustapha Cissé is a research scientist at Google. He is the head of the Google AI center in Accra (Ghana) where he leads the research efforts in foundational machine learning and its applications to solving complex societal challenges. Moustapha is also a Professor of Machine Learning at the African Institute of Mathematical Sciences where he is the Founder and Director of the African Masters of Machine Intelligence (AMMI).

It's time to foster Africa's science revolution

By Thierry Zomahoun

Accelerating the knowledge-led development of Africa through science driven policy and investments is important for boosting long-term growth and well-being.

Photo Credit: Next Einstein Forum

Africa is a continent with a growing consumer base, entrepreneurial ambitions and home-grown innovation. With more than 300 technology hubs spread across 93 of the continent's cities, entrepreneurs are innovating in every sector from education and health to agriculture and energy. Africa is becoming a generator of knowledge, innovation, creativity and technology, rather than being simply an adapter of trends produced elsewhere in the world. There is no doubt that African government policy can accelerate this process. The knowledge-based development model is new territory for Africa. It should define our collective aims. Having a creative, skilled and educated young African population combined with the implementation of science and evidence-based pan-African and national public policies and investments can lead to large-scale social transformation and improved well-being.

The knowledge-based development model in Africa has been accelerated by the arrival of western and Asian innovators and knowledge creators. These innovators have been attracted by Africa's flexible regulatory environment. This has enabled Africa to welcome early versions of newly developed technology. Drone technology used for the delivery of medical goods as a transcendental solution to the medical infrastructure deficiency in Africa is a prime example.

This has demonstrated that knowledge and science-driven development is key to the following success equation: *Innovation -> job creation -> socio-economic inclusion -> progress of society -> gains for the whole population of a country*

To fulfil the above equation for success, African governments must first take concrete, specific actions to produce and disseminate knowledge around the continent. Deliberate strategies should be centred on three main challenges: (1) How to improve countries' regulatory frameworks to enable knowledge-led societies, most specifically in the two policy areas of industry and science; (2) How to foster the relevant skills and capacity for a scientific and creative culture to take root in Africa; and (3) How to design efficient partnerships and structured financing to build the first two pillars.

Take the *low-carbon circular economy,* for instance. In Africa, the rapid growth of the industrial economy brings with it an opportunity to leapfrog the classical linear economy and jump straight into more environmentally sensitive circular models, reaping the benefits of integrating social, environmental and economic factors into the balance. By looking at the environmental footprint of industrial processes from a life-cycle perspective, we have the opportunity not only to reduce their negative impacts, but to identify new opportunities for innovation and wealth creation. This can be done by using renewable materials and energy, designing and producing low-impact, repairable and upgradable products, and reusing constituent materials at the end of their life.

To support a rapid transition to the circular economy in Africa, policymakers, academia, the business community and civil society must work together to create an enabling environment for research and development towards a low-impact, low carbon economy. Ways to do this include using bio-based material and energy resources rather than petro-based ones; designing products composed of renewable resources, which minimise energy consumption; producing goods locally using local renewable resources; and supporting efforts to recover waste as a resource for new industrial processes, etc. In essence, this means focusing on the use of the renewable resources that surround us, and preventing them from going to waste.

In addition, African stakeholders need to focus on *energy independence*. The Fukushima nuclear catastrophe has been pivotal in driving the energy transition in Europe through the rapid development of renewable energy systems, a resource particularly abundant in Africa. The continent's economic and social fabric could be transformed in coming years. Nevertheless, there are major challenges to be overcome before achieving both universal energy access and energy independence. Despite rapid advances in the capture, storage and management of renewable energy, colossal investments are required to support infrastructures and systems that are both financially viable and technically feasible. This will necessitate strong political backing through incentives and regulation to support public and private investments, as well as partnerships to achieve technological advances. These are needed in energy storage, for example, to counter the intermittent nature of renewable energy.

The preferred route to renewable energy storage for the continent should be the production of synthetic gaseous or liquid fuels, as opposed to batteries. Through our Next Einstein Forum Roundtables, we continue to investigate other innovation pathways to prosperity. Besides its involvement in scientific and industrial policy, the African Institute for Mathematical Sciences (AIMS) is active in many academic and research areas including climate change, financial and pure mathematics, big data and machine intelligence.

AIMS strongly believes that a culture of open innovation built on partnerships along the education value chain is key both for commercialising Africa's expanding knowledge base and climbing the global value chain. This is where international co-operation could have long-term impact.

Thierry Zomahoun is the President and CEO of the AIMS Global Group and Founder and Chair of the Next Einstein Forum

This article was originally published in OECD Observer and can be found here:

SCIENTIFIC AFRICAN JOURNAL EDITORS

Editor in Chief

Benji Gyampoh

Benji Gyampoh is a researcher, research manager and lecturer currently at the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. Benji is also an affiliate lecturer at the Institute of Climate Change Adaptation (ICCA) of the University of Nairobi. From 2012 till January 2018, he was a programme manager at the African Academy of Sciences in Nairobi, Kenya, where he had responsibility for the climate change programmes and postdoctoral research fellowships. Benji has extensive experience in training and capacity building; research management and administration; strategic thinking, policy influence and development; data analysis and reporting; fund raising and partnership development; communication and coordination; and writing and editing.

Agriculture and Food Security

Enoch A. Dako

Enoch Achigan-Dako is an associate professor at the University of Abomey-Calavi, in Benin. When he is not teaching multiple courses at the Faculty of Agronomic Sciences, he is partnering with the European Union (EU). One of the EU programs, "Enhancing training and research mobility for novel crops breeding in Africa (MoBreed)", is a European-funded project focused on training students with the latest technologies to tackle food issues in the continent. Moreover, he is the director of the MasterCard Foundation to support Africa's next generation of leaders. Enoch's interest in resolving food related issues started when he graduated in 1999 as an agronomist from the University of Abomey-Calavi.

Hannah Karuri

Dr. Hannah Karuri is a lecturer at the University of Embu, in Kenya. She is specialising in the study of nematodes (Nematology), parasites that can damage crops. She is currently working on a sweet potato project to create low cost nematodes management techniques that can be used by small farmers to increase the sweet potato yields. Through this research, Hannah's goal is to improve the output of food in Kenya, support small farmers. She first developed this passion during her PhD project. She received the African Women in Agricultural Research and Development award in 2014. This award provided Hannah with the opportunity to improve her research methods while participating in an internship to focus on Nematology.

Chemistry

Rabab El-Sherif

Rabab El-Sherif is currently working in the Faculty of Science, Cairo University as a professor of physical chemistry. She has finished a research project between Eni Exploration and Production Division, in cooperation with Venezia Tecnologie (Italy) and Cairo University. He focus is on improving the performance of fuel cells and solar cells efficiency. She is interested in energy issues and she has touched on how this issue is so critical and crucial for her country and the rest of the world. Her inspiration comes from the need for a clean, sustainable energy that we need for our daily life.

Conservation and Sustainability Studies

Edmond Sanganyado

Dr. Edmond Sanganyado is a researcher in China at Shantou University's Marine Biology Institute. He is currently studying sediments, to determine the history of contamination in estuaries. His primary concern is with sustainable development, as he focuses on developing ways of understanding contaminants that affect mental health and how we can try to remediate the environment after a contamination event. Edmond received the Fulbright Fellowship in 2011 and the Zhujiang Postdoctoral Fellowship in 2017. He was awarded the first prize in MDPI Science Writing Competition (2018) for his outstanding essay on open science.

Economics and Business

Grieve Chelwa

Dr. Grieve Chelwa works for the University of Cape Town's Business School, where he teaches at their MBA program. He focuses on multiple areas of research, including health and development economics, and is seeking to answer significant questions that are facing Africa, such as "What is development?" and "How does development occur?" Before doing academia, he was a Management Associate for Citibank in Johannesburg and interned with the Bank of Zambia, Zambia's Central Bank. This transition has led him to work with governments: for his latest project, he is helping the Zambian government motivate teachers to teach in the rural areas of the country.

Martha Munezhi

Dr. Martha Munezhi is the Assistant Director, Research at the Smith School of Business, Queen's University in Canada. She is a Fulbright Fellow (2011), Population Reference Bureau Fellow (2014-2015) and Philanthropic Education Organisation Fellow (2013-2014). Martha has in various research positions in state departments, academic institutions, non-governmental institutions and research organizations focusing on issues such as prison work programs, HIV prevention and reproductive cancer awareness among women in developing countries. Her current work in academia focuses on research development, promotion, and initiatives within Smith School of Business. She provides guidance to faculty for research funding applications for national and international research projects.

Environmental and Geosciences

Sherien Elagroudy

Dr. Sherien Elagroudy teaches Environmental Engineering at Ain Shams University in Egypt. She is also a Next Einstein Forum (NEF) Fellow. She established Egypt's Solid Waste Management Center of Excellence at the Ain Shams University—the first of its kind in the country—together with academic and industrial partners. The Center provides a forum for the fusion of cutting-edge research with practical experience. In 2013, Sherien was awarded the L'Oréal UNESCO Fellowship for Women in Science, and she is engaged in several research grants of more than $3.5 million in the fields of solid waste management, biochemical waste treatment technologies, and recycling into energy.

Lahbib Latrach

Dr. Lahbib Latrach is an Associate Researcher at the National Center for Studies and Researches on Water and Energy at Cadi Ayyad University, Marrakesh, Morocco. His research interests include climate change, pollution control, and wastewater treatment and management. Lahbib is also a NEF Ambassador for Morocco, organizing the NEF's Africa Science Week in Morocco which will be held in Marrakesh in December 2018. This event aims to promote access to science and education in Morocco, and to encourage and support young researchers and women in STEM, especially in rural and remotes areas.

Information Technology and Engineering

Amos Kabo-bah

Dr. Amos Kabo-bah is a Senior Lecturer and Head of the Department of Energy and Environmental Engineering of the University of Energy and Natural Resources (UENR) in Sunyani, Ghana. He is also a Programme Board Member for the Group on Earth Observation (GEO); an intergovernmental organization working to improve the availability, access and use of Earth observations for the benefit of society. Under this programme, he is working towards developing the strategic direction and implementation schedule for the GEO Land Degradation Neutrality (LDN). This initiative will assist countries, regions and others interested in addressing land degradation.

Axel Ngonga

Prof. Dr. Axel Ngonga is a professor of Data Science at Paderborn University. He studied Computer Science and Physics at the University of Leipzig and completed a PhD on knowledge extraction. Axel's current research interests revolve around Semantic Web Technologies, Natural Language Processing, Machine Learning and benchmarking. Over the last decade, Axel and his team have developed the development of several widely used frameworks. He has also (co-)authored more than 150 peer-reviewed publications and has received more than 20 research awards including the Next Einstein Fellow award 2016/2017, best research paper, and research challenges.

Mohlopheni J. Marakalala

Dr. Mohlopheni Jackson Marakalala is a Senior Lecturer at the University of Cape Town and a Wellcome Trust Intermediate. He is currently working on finding better methods for diagnosing and treating tuberculosis. His focus is on finding host-directed therapies that target the immune system. Jackson has received multiple funding grants and numerous awards for his scientific work and voluntary work. He was the chairperson of the Health Sciences Postdoctoral Association at the University of Cape Town and served as Workshops Chair and Secretary of the Harvard School of Public Health Postdoctoral Association. Jackson works directly with several South African communities as he believes in supporting disadvantaged youth.

Mathematics

Ibrahim Sidi Zakari

Dr. Ibrahim Sidi Zakari is an assistant professor at Abdou Moumouni University in Niger. His research focuses on statistical models to do pollution risk assessments, and he works with governments to find the best policies to solve this major issue in Niger. Ibrahim is also a member of the Global Young Academy (GYA). Through this program, Ibrahim is assisting future researchers by working on students' science projects. He has also served as a Next Einstein Forum (NEF) Ambassador for Niger. Ibrahim devoted his year as Ambassador to promote access to education and to push for more public investment in STEM in Niger.

Malik Maaza

Dr. Malik Maaza brings twenty-five years of experience as a Nanoscience technology researcher to Scientific African. His research focuses on resolving social problems like energy and water, in particular, green energy and materials related to solar energy. Malik also holds fellowship with multiple organisations, including the African Academy of Sciences, the New York Academy of Sciences, and the Islamic Academy of Sciences. He won the National Science &Technology Forum Green Innovation Award, the UNESCO-UNISA Africa chair in Nanosciences and Nanotech, and the Cambridge award, to name but these.

Simiso Mkhonta

Dr. Simiso Mkhonta is a senior lecturer at the University of Swaziland in the Physics Department, and the Head of the Department in the Faculty of Sciences. He was also the inaugural NEF Ambassador for Swaziland for the period of 2015 to 2017. His interest lie in promoting science to students and the general audience. He is currently working on a paper on disordered hyperuniform materials that belong to an exotic class of disordered states of matter that possess hidden spatial order at large length scales. He is also formulating a theoretical model to describe the dynamics of active systems that include motile bacteria.

Life and Health Sciences

Kevin Dzobo

Dr. Kevin Dzobo is a senior research scientist and lecturer at the International Centre for Genetic Engineering and Biotechnology (ICGEB), and the University of Cape Town in South Africa. His research focuses mainly on cancer and regenerative medicine and tissue engineering. He is the Founding Vice President of African Tissue Engineering and Regenerative Medicine International Society (ARTEMIS), a continent-based initiative to promote science, regenerative medicine, and tissue engineering on the continent. Kevin is also leading an inter-university collaboration between the ICGEB, UCT and University of Pretoria on the development of a stem cell- ECM patch for wounds and tissue repair. He also promotes science as a Next Einstein Fellow.

Physical Sciences

Mohamed Hassan Eisa

Dr. Mohamed Hassan Eisa Salim is an associate professor of Physics at the Physics Department at Sudan University for Science and Technology. His research interests lie in ion beam physics and its application. He is planning to work on ion beam modification of wide band-gap semiconductor nanostructures for applications in optoelectronics and biomedical materials. He also would like to pursue more theoretical studies of nanomaterials and their implications in biomedical materials, detectors and sensors.

Social Sciences and Policies

Adam Sneyd

Dr. Adam Sneyd is an Associate Professor with the Department of Political Science at the University of Guelph in Canada. His research focuses on the politics of economic development, primarily in African contexts, with emphasis on the politics of commodities in relation to social responsibility and sustainability. As a member of the Academic and Scientific Advisory Council of the African Institute for Mathematical Sciences (AIMS), he seeks to advance the scientific training of young African researchers. Through his position on the Next Einstein Forum's (NEF's) Scientific Program Committee he hopes to contribute to making African research more visible.

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