

PROCEEDINGS
OF
38th ALL PAKISTAN SCIENCE CONFERENCE
On
“Energy Crisis and their Solutions in Pakistan”

Organized by
**PAKISTAN ASSOCIATION FOR THE ADVANCEMENT OF
SCIENCE**

In Collaboration with
College of Earth and Environmental Sciences,
University of the Punjab, Lahore

ON
10th & 11th DECEMBER, 2018

At
Punjab University Law College Auditorium



PAKISTAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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Theme

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Edited By

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Organized By

**Pakistan Association for the Advancement of Science,
Lahore, Pakistan**

In Collaboration with

College of Earth and Environmental Sciences,

University of the Punjab, Lahore

Special Thanks are due to

Pakistan Science Foundation, Islamabad

For the financial assistance for the conduct of

38th ALL PAKISTAN SCIENCE CONFERENCE

EXECUTIVE SUMMARY

The 38th All Pakistan Science Conference 2018 was organized by the Pakistan Association for the Advancement of Science in collaboration with College of Earth and Environmental Sciences (CEES), at Punjab University Law College Auditorium Lahore, the conference was organized to give the solution and remedies of Energy Crisis and their Solutions in Pakistan.

After the inaugural session, the respectable scientists / Speakers presented their deliberation in befitting manner, the whole program comprised of technical and recommendation sessions which included:-

- I. The Presidential Addresses by the all the sectional Presidents.
- II. Presentation of the papers in all the sections.
- III. Presentation of the recommendations.

The inaugural session of the conference started with the recitation of the Holy Quran. Before the start of the regular program, the participants of the conference stood up in respect of national anthem. The welcome address was presented by Dr. Sajid Rashid Ahmad, Principal, College of Earth and Environmental Sciences, where he gave the heartiest welcome to the very honorable chief guest Engr. Ijaz Ahmad, Additional General secretary Pakistan Tehreek-e-Insaaf Pakistan (PTI) and the renowned scientists from all over the country.

Prof. Dr. Muhammad Saleem Chaudhary, the General Secretary of the Pakistan Association for the advancement of Science, gave his observations regarding the activities and the hardships, face by the Association before the honorable chief guest.

Dr. Muhammad Arshad, the General President, Pakistan Association for the advancement of Science, presented his presidential address before the august house.

The honorable chief guest, Engr. Chaudhary Ijaz Ahmad, Additional General secretary, Pakistan Tehreek-e-Insaaf Pakistan (PTI) inaugurated the 38th All Pakistan Science Conference and delivered a thought provoking address, where he very kindly assured a full financial support to the Pakistan Association for the advancement of Science for the smooth running of the scientific activities of this organization.

At the end of inaugural session, souvenirs were awarded to the various dignitaries by the chief guest. The vote of thanks was extended to the participants of the conference by Dr. Sajid

Rashid Ahmad, Principal, College of Earth and Environmental Sciences, University of the Punjab, Lahore.

After the short break for refreshment, the technical sessions were started. These sessions were presided over by various dignitaries. Immediately after the inaugural session, the presidential addresses were presented by the various sectional presidents in their fields of specialization

After this session was over the participating scientist presented their paper in their respective sections.

At the end the overall recommendations were finalized by the recommendation committee and were presented to the house for approval.

Main Khalid Mehmood Minister for disaster management, Government of the Punjab, Lahore, honored the concluding session of the conference as a Chief Guest, in his address he appreciated the efforts of Pakistan Association for Advancement of Science and the host organization CEES Lahore.

He further praised the organizers for providing a forum for disseminating the knowledge in the various disciplines for future collaboration adopting multidisciplinary approach for addressing the various issues and concerns at National and International level.

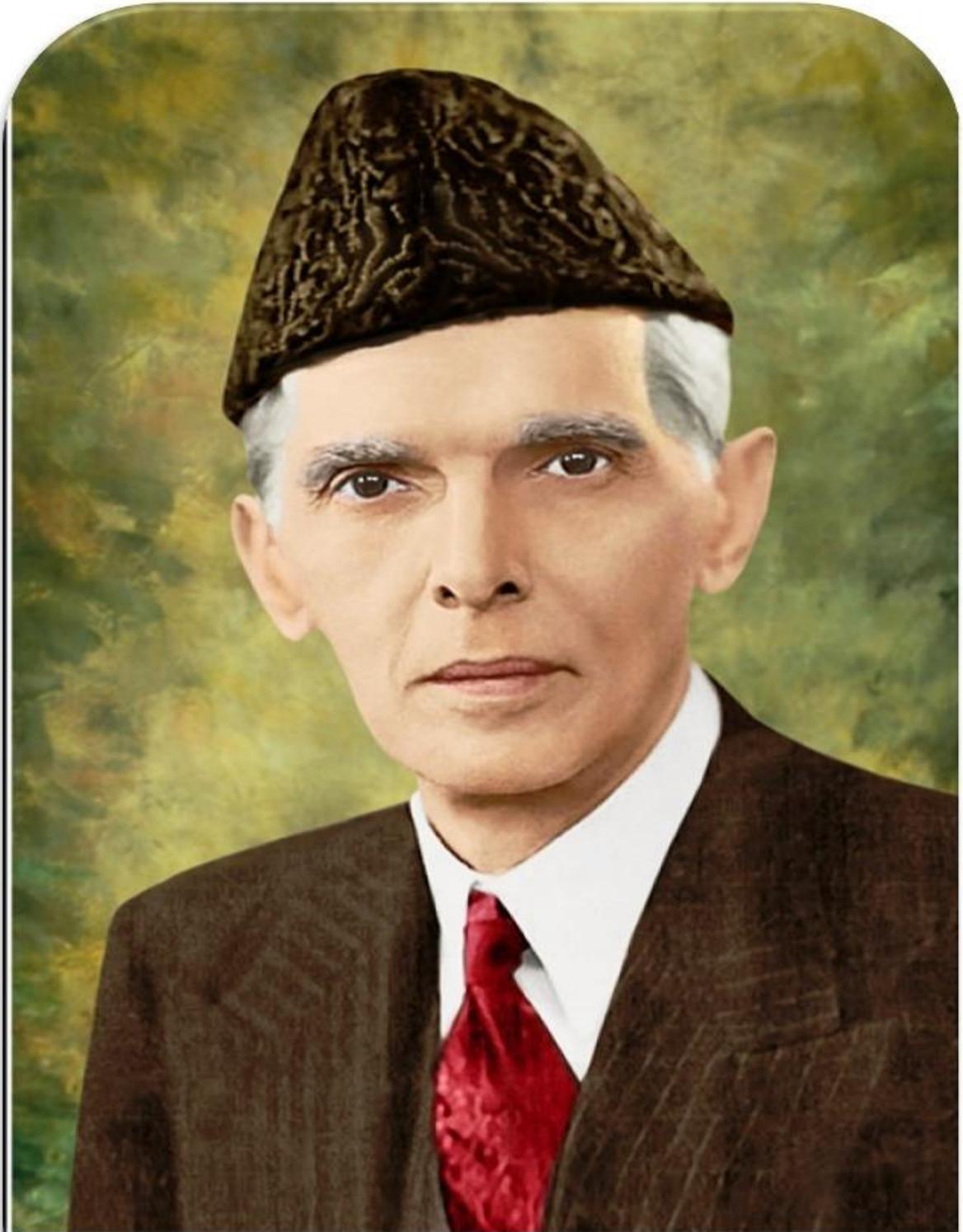
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QUAID'S MESSAGE

There is immediate and urgent need for training our people in scientific and technical education in order to build up our future economic life and we should see that our people undertake scientific, commerce, trade and particularly well planned industry.

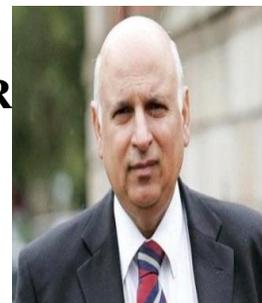
Message to the all Pakistan Education Conference November 27th, 1947



QAID-E-AZAM MUHAMMAD ALI JINNAH
Father of the Nation

MESSAGE

CHAUDHARY MUHAMMAD SARWAR THE HONORABLE GOVERNOR, PUNJAB



I am pleased to know that 38th All Pakistan Science Conference is being organized by the Pakistan Association for the Advancement of Science (PAAS) at College of Earth and Environmental Sciences (CEES), University of The Punjab, Lahore on 10th and 11th December 2018. I think such conferences have become an essential part of progress because of the exchange of new finding through free diversified gathering. We are passing through an age in which science is making rapid progress and therefore scientist have splendid opportunities of service to humanity. All peace loving people wish that the scientists should continue ceaselessly their noble efforts to abolish disease ignorance and poverty.

This conference will also provide a chance to exchange latest scientific knowledge achieved in different areas of the world and to determine new lines for research. In fact research will bring no good to the country or to its people unless it is done on the proper guide lines to overcome the deficiencies of that particular area in what-so-ever discipline it may be.

The results of any research must be applicable to a common man and must solve its economic or other related problems. How efficient the researchers are and how efficient the extension services are, can be evaluated from the economic progress of the respective countries. I hope that with the inspiration of our heritage of scientific thoughts and pioneering spirit we shall be able to overcome the difficulties that lay in our way.

The resources available in Pakistan are not that scanty but the only thing to be kept in mind is that the research should be targeted with the national goals. I wish this conference to bring new fruitful ideas to our scientists for our prosperity. I wish the organizers and participants all success in the laudable venture.

(Chaudhary Muhammad Sarwar)
Governor, Punjab

MESSAGE

IMRAN ISMAIL
THE HONORABLE GOVERNOR,
SINDH



I am pleased to learn that Pakistan Association for the Advancement of Science is holding its 38th All Pakistan Science conference in collaboration with College of Earth and Environmental Sciences (CEES) at University of the Punjab, Lahore, where large number of eminent scientists will be participating to discuss on a very vital issue of energy crisis faced by the country.

Revolutionary changes in the field of Science and Technology have significantly changed the paradigms of economy, culture and developmental requirements. In this age of cyber space, international collaboration in all the scientific fields can never be overemphasized, exchange of information, quick dissemination of knowledge and personal contact have materially contributed to the scientific advancement.

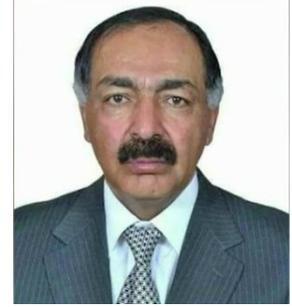
I am confident that the deliberations and exchange of ideas in this conference would focus on the problems that we are facing in this vital energy sector. I am sure that the government would encourage all the practical suggestions presented at this forum by the eminent scientists and researchers.

I wish the organizer and the participants a success.

(Imran Ismail)
Governor Sindh

MESSAGE

**AMANULLAH KHAN YASINZAI
THE HONORABLE GOVERNOR,
BALOCHISTAN**



I am pleased to learn that Pakistan Association for the Advancement of Science is holding its 38th All Pakistan Science conference in collaboration with College of Earth and Environmental Sciences (CEES) at University of the Punjab, Lahore, where large number of eminent scientists will be participating to discuss on a very vital issue of energy crisis faced by the country.

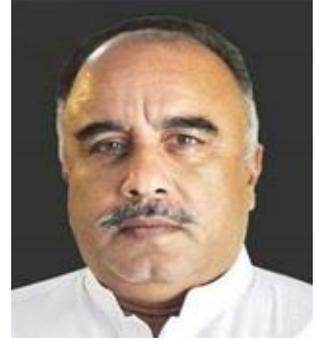
The development of the country's economy depends largely on its scientific growth. Pakistan, with its manifold problems of economic and of industrial nature must be looked into by the scientists for accomplishment of its immense nation building program.

The Pakistan Association for the Advancement of Science is destined to play an important role in shaping the scientific future of our country. I wish a success for 38th all Pakistan science conference, where a large number of eminent scientists and researchers would definitely give the solutions for energy crisis in Pakistan.

Muhammad Khan Achakzai
Honorable Governor
Balochistan

MESSAGE

**SHAH FARMAN,
THE HONORABLE GOVERNOR,
KHYBER PAKHTUNKHWA**



I am pleased to learn that Pakistan Association for the Advancement of Science is holding its 38th All Pakistan Science conference in collaboration with College of Earth and Environmental Sciences (CEES) at University of the Punjab, Lahore, where large number of eminent scientists will be participating to discuss on a very vital issue of energy crisis faced by the country.

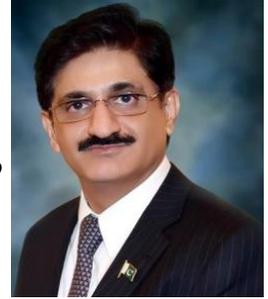
The advancement of scientific knowledge is undoubtedly is a prime objective of the scientists of Pakistan. During the early period of Islamic history Muslims played a vital and very significant role in the development of the human knowledge.

The Science has placed in the hand of man colossal power to do both good and evil, to heal or kill and to build or destroy. At the present juncture in history, humanity is standing at the crossroads of its destiny. The imperative need of the moment is, thus, to make sure that scientific knowledge is utilized for the good of mankind. I wish the conference a success.

Shah Farman
Governor, Khyber Pakhtunkhwa

MESSAGE

**MURAD ALI SHAH,
THE HONORABLE CHIEF MINISTER,
SINDH**



I am glad to learn that the Pakistan Association for the Advancement of Science is holding its 38th All Pakistan Science conference in collaboration with College of Earth and Environmental Sciences (CEES) at University of the Punjab, Lahore.

Today Pakistan's imperative need is more scientists and technicians, who may apply their scientific knowledge to studying Pakistan's problems with particular reference to local conditions. Basically an agriculture country, Pakistan needs measures which can help to better the condition of its agriculture and its agriculture produce and place them on scientific and industrial basis. This is essential in addition to steps to accelerate the pace of industrialization. Our country is full of resources, but, unfortunately, during the pre-Independence period no serious effort was made to exploit and utilize them for the advancement of the people. It requires a large number of technical personnel and specialists in the various fields, fully conversant with modern techniques and methods, and fully equipped to handle the most recent instruments and implements devised to utilize these resources.

It is gratifying to note that Pakistani scientists are conscious of their duty as individuals as well as members of a society, which is a welcome sign for the future of Pakistan. I hope the present conference will prove more fruitful than the previous ones and the deliberations and the results achieved will go a long way in shaping the destiny of our nation.

Murad Ali Shah
Chief Minister, Sindh

MESSAGE

RAJA JALAL HUSSAIN MAQPOON THE HONORABLE GOVERNOR, GILGIT, BALTISTAN



I am pleased to know that the Pakistan Association for the Advancement of Science is holding its 38th All Pakistan Science Conference in collaboration with College of Earth and Environmental Sciences (CEES) at University of the Punjab, Lahore.

This is an age of science and technology. Nations who have developed scientific means to exploit natural resources have brought numerous benefits to their people. Reduction of manual toil and labor and availability of goods and services at an increasing speed have not only brought material benefits to their people but have also provided leisure time for culture activities.

Pakistan has an abundance of human material and natural resources but awaits the dawn of scientific of the Commission on National Education are implemented and more scientific and technological institutions are established in the country, it will be possible to exploit these resources and Marshall our rich human material for the creation and exploitation of national wealth. The whole future of Pakistan will in fact depend on how we apply ourselves to exploiting scientific means. That is, provided our scientists place these mean at the disposal of our workers.

I feel sure that the conference of scientists will prove fruitful in exploring new avenues of scientific development. May I take this opportunity to suggest that scientists should devote themselves to serving the human race? The aim of all research in scientific and technological fields should be to bring greater wealth and resource at the disposal of the human race and thus contribute towards the happiness of all mankind.

I wish the Conference and the participants all success.

Raja Jalal Hussain Maqpoon
Governor, Gilgit-Baltistan

WELCOME ADDRESS

PROF. DR. NIAZ AHMAD AKHTAR
VICE CHANCELLOR, UNIVERSITY OF THE PUNJAB, LAHORE

Worthy Guest of Honor Engr. Ijaz Ahmad and dear participants, I appreciate you all for your presence here today! Your presence reflects that we realize our shared responsibility to deal with the energy and power issues faced by our country. The face of Pakistan's energy sector has seen a variety of fuel-based eras starting from thermal dominance during the period 1947-1959, shift to hydropower from 1960 to 1963, back to thermal during 1964 to 1968, return of hydropower era during 1969-1975 followed by one year thermal dominance in 1976, revival of hydropower in 1977-1988 and subsequently thermal during 1989 - 2012, and the present era of efficient and alternative energy sources starting from 2013. However, the existing energy crisis has emerged as a major threat to the national economy. The past several years of planned and unplanned electricity and gas load-shedding has badly affected the economy and society of Pakistan. The existing supply-constraints are due to multiple factors that have compromised the sustainability of energy systems. Following the 1970's global oil crises, countries started exploring more reliable and efficient means for energy generation and supply. However, in case of Pakistan, the only notable step taken was the formulation of the Renewable Energy Policy in 2006 with little outcomes till now. Also the goals of country's National Power Policy-2013 regarding complete eradication of supply-demand gap by 2017 and a power surplus for regional-trading by the end of five-year could not be realized. In addition, no local or community level disaggregated plan has been formulated for sustainable management of energy demand till yet. During a couple of last years, various short-term efforts made by the government in this regard included increase in indigenous fuel supplies, varying fuel imports, and encouraging inter-regional collaborations like the China-Pakistan Economic Corridor (CPEC). This however, resulted in considerable cuts in the frequency of load-shedding in urban areas i.e., up to 6 hours during 2015-2016 compared to 16 to 18 hours in 2013. The resultant energy crisis worsened with domestic and industrial sector reliance upon inefficient electricity generators and illegal compressors for natural gas which, in turn, has increased average energy usage cost as well as GHG emissions that indicates a deeper crisis in energy policy making, governance, and regulation. During recent years, the increasing trend in population and urbanization has further exhausted the inefficient and limited energy and electricity installed capacity. In year 2018, installed capacity of electricity reached 29,573 MW, whereas electricity generation remained 69,956 GW/h. There has been a noticeable decline in hydel power generation over the last five years mainly due to less water availability. The electricity supply situation of Pakistan is not only indicative of poor energy mix for the power generation but at the same time shows lack of expansion in the supply side capacities as well as efforts to reduce the T&D losses to an acceptable level. As per government estimates, the installed electricity capacity of Pakistan faces world's highest rates of Transmission & Distribution losses causing shortfall peaks upto 7000 MW. In terms of energy-economic dynamics, the power sector is also facing the worst ever financial crises of its history with a soaring circular debt of USD 7.6 billion. This has been reasoned to the absence of effective planning, applicable policy, and well-defined framework to ensure sustainable electricity supplies. In order to maintain sustainable electricity supplies to meet the demand with optimal investment and reduced emissions, Pakistan should undertake energy efficiency and conservation measures as well as increase renewable energy share in the overall energy mix of the power generation in the long run. This will not only eradicate the supply-demand gap but also ensure green and sustainable energy generation. Pakistan has limited indigenous reserves of conventional energy resources of oil and gas. Although

oil is considered as an expensive and dirty fuel but natural gas is a clean, safe, efficient and environment friendly fuel. Indigenous supplies of natural gas contribute about 38 percent in total primary energy supply mix to cater the requirement of more than 8.9 Million consumers across the country. During year 2018, average natural gas consumption was about 3,837 MMCFD with highest consumption by power sector, followed by the domestic sector. In contrast to the limited indigenous reserves of conventional energy resources of oil and gas, there are over 186 billion tons of coal reserves including Thar coalfield which await mining for harnessing through efficient technologies. Import of coal has substantially increased in year 2018 due to commissioning of new coal based power plants at Sahiwal and Port Qasim. The vast untapped renewable energy resources of Pakistan have huge potential to overcome power deficit of national grid. Renewable resources that are technologically viable and have prospects to be exploited commercially in Pakistan include wind energy, geothermal, solar energy, tidal energy, micro/small-hydel, bioenergy and emerging technologies like fuel cell etc. At present, the share of renewable energy on the national grid is only 2.16% (i.e., 0.6 M.TOE.CO₂) which is non-existent as against a wind power potential of 63,000 MW in the country. The total current installed capacity of all renewable energy projects in the country is 1,568MW. In terms of clean energy, renewable energy constitutes only of the total electricity generation in Pakistan. This small proportion is made up of solar (23.6%), bagass (26.7%), and wind (49.7%) energy resources. The hydropower contribution is only 9.7% (i.e., 7.7 M.TOE.CO₂). Some solar hybrid with wind power projects are expected to be commissioned by the end of year 2019. On the other hand, energy losses have reached 18%. With increasing pressure on traditional fossil fuel resources in future years, renewable options are important to consider. Other reasons which led to the growing emphasis on renewable energy penetration in energy sector especially power generation sector at global level is the increasing concern over climate change and energy. However, one of the major barriers in the way of high level of renewable energy based electricity generation is higher initial cost. To overcome this barrier, a number of policies are being used for renewable based energy promotion in different parts of the world. These are categorized as regulatory policies, fiscal incentives and public financing. International policy researches and experiences of energy-rich countries also emphasize upon promotion of clean energy. This involves demand and supply side resources that deliver clean, reliable, and low-cost ways to meet energy demand and reduce peak electricity system loads. Some of the benefits include meeting load growth with fewer environmental impacts, reduction in energy emissions, increased fuel diversity, beat rising fuel cost, and increased economic development with sustainability. This calls for immediate measures to meet the energy needs of the growing population and relative development needs. However, such measures must recognize all aspects of energy sustainability requirements. In this crucial hour, we hope and look forward to a coherent and cohesive governance to mitigate the issue and to provide a long term realistic decision making. Thank you very much!

ADDRESS

Prof. Dr. Muhammad Saleem Chaudhry

**THE GENERAL SECRETARY,
Pakistan Association for the Advancement of Science**



Honorable Additional General Secretary
Pakistan Tehrik-e-Insaf, Pakistan

Engr. Ijaz Ahmad Sahib

Distinguished guests, ladies and gentlemen. **اَلسَّلَامُ عَلَیْكُمْ**

I have the honor to brief you about the Pakistan Association for the Advancement of Science which was founded on December 12, 1947 at a largely attended scientist meeting held at the Institute of Chemistry, Punjab University, Lahore. The foundation of this premier Scientific Association in the country proved a land mark for the promotion of science and Technology in Pakistan.

Honorable Chief Guest you will allow me to bring to your kind notice certain important activities of the Association. The most important feature is the holding of All Pakistan Science Conferences, seminars and symposia. These conferences were held in different parts of the country and so far 37th conferences had been held and some of these were inaugurated by the Heads of the State. For example 2nd conference was inaugurated by Khawaja Nazim ud din, the Governor General in 1950, 6th conference was inaugurated by Mr. Ghulam Muhammad, the Governor General in 1954, 11th 12th 15th 16th were inaugurated by field Marshal Muhammad Ayub Khan in 1959, 1960, 1963 and 1964. 21st and 22nd were inaugurated by General Muhammad Yahya Khan, 26th and 27th were inaugurated by Muhammad Zia Ul Haq in 1979. 9th conference was inaugurated by Ch. Muhammad Ali, The Prime Minister of Pakistan in 1957. It is worth mentioning that Ch. Muhammad Ali also remained General President of this Association during the same year. Which was a great honor for this organization. The silver Jubilee session of this Association was inaugurated by Mr. Zulfikar Ali Bhutto the Prime Minister of Pakistan in 1974.

These conferences have attracted large number of scientists from different fields of science and technology with in the country and also many eminent scientists from abroad have attended their sessions.

The second prominent and significant scientific and academic activity of the Pakistan Association for the Advancement of Science is the publication of the Pakistan Journal of scientific Research and Pakistan Journal of Science.

The association also publishes the proceedings of science conferences, scientific articles and other materials for the interest of intelligencia of the country. These Journals have provided and produced such research articles. Which established a tradition of publishing standards research work of international level.

Sir, to achieve our goals and to bring our nation at par with the leading nations and to be successful during the 21st century which is said to be century of science and technology, we will have to fix our targets practically,

Sir, we the community of scientists have gathered here to pin point our short comings, the weakness and deficiencies which I feel can be over come by the sincere efforts of the scientists.

If we have to enjoy the scientific developments of future, Sir, let us be realistic in fixing the targets of our future program, I honestly feel that though it will be bitter to listen that our politicians, industrialists and Feudal lords and even press do not have the time to listen the scientists. Sir, let me quote an example of our neighboring country India where sister organization i.e. **India Science Congress** conducts all India Science conference on 1st of January every year. It has also been decided by the Government of India that this conference will be inaugurated by the president of the India every year. Sir, let me further add that full television coverage is being given to this inaugural session through satellite and scientists from all over the world come to attend the deliberations of the conference. A sum of rupees 5 crore is being spent by the Government of India for its conduct.

Sir, here it is difficult to get even few lac for the conduct of such events. This is all which I have faced here for the conducting this conference.

We being the patriotic Pakistani Scientists and technologists feel proud on the sympathetic and thought provoking legacy of Islam. There are hundreds of verses of the Holy Quran which invite us to conquer the treasure of universe, Muslim scientists have a long and tremendous history of their Scientific Achievements. Our prophet Hazrat Muhammad ﷺ also taught the Muslims to get every kind of knowledge from any part of the world.

Sir, this premier organization which has always tried to play its role but due to the financial difficulties it has not been able to work effectively,

I am sure that our honorable Chief Guest Additional General Secretary Eng. Ijaz Ahmad Sahib in his personal capacity is definitely in such a strong position that for him it is a very minor job to get it arranged by the government. I assure you sir, that this forum of scientist will never forget your love and devotion for science in the country during the years to come. In the last, I pay my gratitude to all of you for your patience.

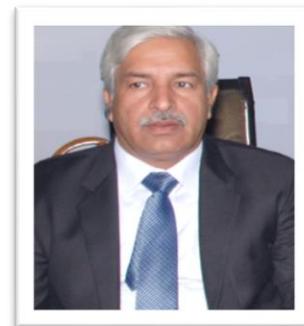
Thank you all very much sir

Pakistan Paindabad.

Prof. Dr. Muhammad Saleem Chaudhry
The General Secretary,
Pakistan Association for the
Advancement of Science

ADDRESS

THE GENERAL PRESIDENT, Pakistan Association for the Advancement of Science



Pakistan's acute energy crisis is posing a serious predicament for its feeble economy and volatile national security environment. The country's energy problems are deep and complex, being rooted more in shortages of governance and political will than of pure supply. This stems from (1) the absence of a comprehensive and integrated energy strategy, resulting in interagency turf wars and a lack of coordination, (2) insufficient revenue to support energy generation and infrastructure, owing to low liquidity in Pakistan's struggling economy and high rates of tax default, and (3) the leadership's unwillingness to implement politically unpopular changes to address the situation.

Resolving Pakistan's energy crisis will thus require political will, additional funding, and new power-generation sources. As the country lacks significant internal sources of revenue, opportunities exist for international donors to finance its energy recovery. However, indigenous energy solutions should not simply be discarded, and the Pakistani government should explore the Thar coalfields and alternative energy sources, among other options. Pakistan's energy problems are deep and complex, and are rooted more in shortages of governance and political will than of pure supply. If the nation is to overcome this crisis, it will need to begin with whole-scale institutional energy sector reform—a politically unwelcome, yet utterly essential, prerequisite for energy relief.

Origins and Nature of the Current Crisis

The origins of Pakistan's energy crisis can be traced back to the 1990s. A major energy crisis was actually averted in the 1970s, when the government launched the massive Mangla and Tarbela dams, leading to a short-lived period of robust hydro-driven energy generation that ably responded to demand. However, after a period of strong economic growth in the 1980s, energy demand soared, and supply and infrastructure could not keep up. The government sought to ramp up generation but was unable to satisfy demand. As Pakistan's population has risen, and as urbanization has spawned the rise of new industries and other corporate energy customers, the situation has continued to worsen to the present day. Electricity shortfalls reached a peak of 8,500 megawatts (MW) in June 2012—more than 40% of national demand.

In fact, Pakistan is blessed with ample indigenous energy resources; it is especially rich in natural gas, hydroelectricity, and coal. However, in the case of the two most utilized sources of energy—oil and gas—consumption levels are so high that these domestic resources are being rapidly depleted. Pakistan's national oil and gas company, Oil and Gas Development Company Limited (OGDCL), predicts indigenous oil reserves will be exhausted by 2025, and that Pakistan will run out of domestic sources of natural gas by 2030. Meanwhile, hydroelectricity supply is imperiled by climate change, with less rainfall reducing river flows. At the same time, governance shortfalls are key challenges for the power sector. Pakistan's energy policies come under the purview of several government ministries and agencies, but coordination is lacking, clear lines of authority are absent, and interagency turf wars are legion. The sector also suffers from gross inefficiencies (including 30% transmission and distribution losses), and electricity theft is rife; Pakistanis can regularly be seen hooking onto power lines.

ENERGY SHORTFALLS

Pakistan has long needed more power than it can produce, with the energy deficit currently around 4,000 MW. According to the International Energy Agency (IEA), average energy demand in the country is around 19,000 MW, against generation of around 15,000 MW. Demand soars beyond 20,000 MW during peak summer months of May to July, when air conditioning systems place an extra burden on the national power grid, often causing power cuts. The IEA forecasts that total electricity demand will rise to more than 49,000 MW by 2025 as the country's population increases. Only 67 percent of Pakistan's approximately 190 million people have access to electricity, according to the World Bank. To improve access and keep pace with economic growth, the country needs to invest between 3.7 percent and 5.5 percent of its GDP each year in increasing electrical production, the bank said in a report on South Asian infrastructure published in 2013.

Part of the motivation for building coal-powered plants lies in the availability of the fuel within Pakistan. The sprawling desert region of Tharparkar in southern Pakistan, home to some of the world's largest coal reserves, cannot be left unexploited. "Pakistan must tap these unutilized vast underground reserves of 175 billion tonnes of coal, adequate to meet the country's energy needs for several decades, for powering the country's economic wheel, creating new jobs, and fighting spiking unemployment and poverty." Pakistan currently ranks 135th in the list of global emitters of carbon on a per capita basis, accounting for less than 1 percent of total global carbon emissions, according to World Bank data. According to the report submitted by Pakistan to the U.N. Framework Convention on Climate Change last year, the country's emissions in 2015 stood at 405 metric tonnes of carbon dioxide equivalent (MTCO₂ eq.). However, emissions are increasing at a rate of 3.9 percent (16 MTCO₂ eq.) annually.

A Lack of Strategy and Political Will

A subset of the energy financing problem is an inability or unwillingness to muster the necessary political will to address the money shortage. More broadly, Pakistan has never developed a comprehensive, integrated energy strategy, and country's haphazard policies have failed to address the crisis's deep roots. The problem lies not with civil servants, bureaucrats, and technical experts who focus on developing energy policies but rather with the non-expert, high-level political appointees spread across the energy sector and beyond who are charged with implementing them.

Pakistan announced a national energy plan in 2010, though it was dominated by much-mocked—and likely ignored—conservation measures, such as bans on all-night wedding parties and neon billboards, along with the required early closures of street markets. (A more realistic demand-management strategy, announced last year by the Asian Development Bank, calls for the distribution of twenty million low-energy light bulbs.) Other well-intentioned initiatives have likewise not produced results. Pakistan has established the National Electric Power Regulatory Authority (NEPRA), charged with ensuring fair energy competition and consumer protection, but political interference undermines its autonomy and effectiveness. Tariff decisions must be approved by Islamabad, and NEPRA's four members are all selected by the government. Furthermore, government officials have been known to outright ignore the body's decisions. Recent recommendations put forth by Pakistan's Planning Commission, however, offer some hope. In 2011, the commission released what it described as a "new framework" for economic growth, which calls for more focus on the private sector, cities, and youth. If implemented, the impact would be immense, as the plan would represent a paradigm shift in Pakistan's development philosophy.

Recommendations and Conclusions

Above all, Pakistan must bring some urgently needed order and efficiency to its chaotic and dysfunctional energy sector. A better coordinated and integrated energy sector can best be attained through the consolidation of the country's many energy-related institutions into a single ministry.

A tighter institutional set-up would allow Pakistan's energy sector to enjoy better coordination of planning, decision-making, and above all implementation. This would in turn enable it to do away with the reactive, haphazard, and ad-hoc policy environment that has characterized the energy sector for years. Although such a transformation will certainly be difficult to achieve, the seeds have already been planted. Back in the early 1980s, Pakistan experimented with establishing a more coordinated system, but those efforts petered out due to capacity constraints. Today, some influential players in the energy scene—including policymakers—have indicated their support for revisiting the idea. After a new institutional arrangement is in place, Pakistan could move on to policy reform. This should include new pricing measures that remove not all, but many, energy subsidies. Tax reform is another imperative—and should be designed to provide Islamabad with more revenue not just to address the energy crisis but also to assist poor Pakistanis harmed by the phase-out of subsidies.

Pakistan should also make improvements on the energy-demand side—such as by aiming to reduce by half the 30% in losses arising from distribution and transmission (a goal that will entail crackdowns on energy theft). Both federal and provincial authorities should be more vigilant about keeping up with necessary maintenance and repairs at all generation, distribution, and transmission facilities in order to minimize leakage and other losses. Any efforts to improve energy governance will need to occur in tandem with measures to curb wasteful water consumption. Decades of water-intensive agricultural practices—including widespread and subsidized flood irrigation—have helped deplete surface water tables and prompted farmers to expend excessive electricity on tubewells to extract groundwater.

Finally, Pakistan should better diversify its energy mix. This can be done initially by importing clean coal, which is often cheaper than imported oil and gas. With time, if the political spats over Thar's reserves can be worked out, then the nation would ideally begin to focus on developing indigenous supplies—though a variety of challenges, such as transporting the coal across the nation and overcoming possible resistance to environmental costs, would remain.

Pakistan is already making an effort to diversify by pursuing separate pipeline projects with Iran and with Turkmenistan, Afghanistan, and India. However, a variety of factors (international sanctions—based with the former and security-oriented with the latter) suggest that these projects are far from being consummated. Already, the two nations have concluded a deal to export electricity to Pakistan, and they have created a joint working group on petroleum to explore further possibilities for energy trade. Ultimately, there is just one obstacle to the implementation of these measures, and that is leadership. For years, Pakistani officials have had promising policies at their disposal; yet they have been unwilling or unable to move forward.

With much of the world pouring investments into renewable and clean energy, Pakistan is drawing criticism for welcoming Chinese investment in coal-fired power plants as part of a plan to boost urgently needed generating capacity. Officials at the Water and Power Ministry reported that Chinese companies and their partners are expected to spend around \$15 billion over the next 15 years to build close to a dozen coal power plants of varying sizes around the country. That is the \$54 billion China Pakistan Economic Corridor (CPEC), which includes spending of about \$33 billion on a total of 19 energy projects, including coal-fired and renewable power plants, transmission lines, and other infrastructure. “Hefty investment under the CPEC project has held out hopes of significantly spiking domestic power generation (by) around 6,000 megawatts by the end of 2019.”

Combined, the projects will eventually generate 16,000 megawatts (MW) of electricity, which the government says is urgently needed. About three-quarters of the newly generated power will come from coal-powered plants, and the government insists that these will be fitted with the latest technology to reduce pollution and climate-changing emissions. But environmentalists and energy experts have lambasted the plans for coal-fired plants as a waste of money that will badly damage the environment

and tarnish Pakistan's image as one of the lowest-carbon emitters. Such plants would only accelerate the rising trajectory of the country's carbon emissions, (accelerating) environmental degradation that costs billions of rupees to the national exchequer annually.

Pakistan's power sector is in a state of acute crisis.

From chronic load shedding to electricity theft, heavy transmission and distribution losses to massive non-payment of built-up dues, and the sector is prone to every problem imaginable despite attempts by various governments over the years to fix the system and provide some relief to the populace. The issues, however, are severer than the consistent, yet occasional, hours spent at the mercy of the urban heat without the relief of fans or air conditioners. Pakistan's electricity woes adversely affect the competitiveness of the country's industry, lower the standard of living by creating an artificially low demand due to excessive prices and cost the national exchequer billions in the form of subsidies and import bills.

Self-perpetuating cycle

The high cost of a core necessity in today's environment prompts those living on an edge to seek cost-efficient alternatives even if they are illegal, such as kundas. These losses prompt the distribution companies to resort to systemic load shedding while the government is left to pick the tab via subsidies to the power distributors. Lack of maintenance and upgrade of the national transmission infrastructure leads to further losses and bottlenecks throughout. The high expenses passed on to the consumer, coupled with unsteady supply, raise cost of doing business in Pakistan and is partially responsible for the country losing export competitiveness. Some may call for the government to increase its contributions to the power sector to aid the people, but that doesn't shift or reduce the burden — it merely realigns it from energy bills to tax bills.

What's the remedy?

The only long-term, sustainable solution to all these chronic problems is to reduce the cost of generation. Unfortunately, precious little has been done in recent years to that affect. Large hydropower plants operated by the Water and Power Development Authority are the country's cheapest source of power and imported fossil fuel-based thermal generation companies some of its most expensive. 'We are more than 20 years late in steps being taken for water conservation'

Neptra's forecasts of Pakistan's energy generation mix by 2025 is a small, but unrealistic, step towards the right direction. Although the share of renewable wind and solar (which can offer non-fuel based clean energy at attractive rates once the initial payback period runs its course) will still be abysmally low, that of hydropower is expected to increase to 32pc from 26pc in 2017, with no further addition to non-coal based thermal generation beyond 2018.

Dr. Muhammad Arshad

The General President

Pakistan Association for the Advancement
of Science

ADDRESS

CHIEF GUEST

ENGR. CHAUDHRY IJAZ AHMAD

ADDITIONAL GENERAL SECRETARY, PAKISTAN TEHREEK-E-INSAF, PAKISTAN LADIES AND GENTLEMEN! السَّلَامُ عَلَيْكُمْ!

Hello everyone and my warm greetings to the foreign and national delegates! It's my great pleasure to be here today among learned professional and experts. I would also like to extend my special thanks to Pakistan Association for the Advancement of Science for providing platform for this dialogue. I greatly admire the effort and hard work of Prof. Dr. Muhammad Saleem Chaudhry in organizing this event. Energy sector is the integral component for economic boost of a country. It is worth mentioning that increase in energy demand is reflective of economic prosperity of a society. In case of Pakistan, the total electricity demand has increased at an annual average growth rate of 4.54%, since the beginning of 21st century. Whereas, the domestic sector alone has posted an average annual growth of 5.94%. However, the country's energy and power supply growth is inconsistent with the soaring demand to meet the development needs of its 207.774 million population. Hence, the electricity consumption per capita is only 452 kWh, an approximate one-fourth of the world's average. Further, around 51 million of the population has no access to electricity mainly due to limited generation capability and minimum expansion in T&D network alongside higher T&D losses.

LADIES AND GENTLEMEN!

Energy sector of Pakistan has faced serious negligence on part of administration and policy makers. Hence, it has come out to be one of the most challenging sectors to be dealt with by the new government. The deep-rooted crisis must not be blind-folded with the supply-shortfall alone. It is confronted with many other associated challenges which multiplied its magnitude manifolds. The energy issue is being taken seriously by the Prime Minister of Pakistan himself. Accordingly, fixing the long prevailing energy issue has become the government's core agenda and top manifesto. Current Government is making sure that it combines forces, wherever reasonable and purposeful, working together along an overarching long-term energy strategy. Such a policy would evolve with expected technological and financial changes in the sector structure and provide a road map for future energy sustainability, pricing issues and setting high standards for power consumers. Currently, the government is carrying out various energy projects with technical and financial corporation of international bodies. Dedicated efforts are being made to ensure that China Pakistan Economic Corridor translates into a game changer. Pakistan is blessed with a huge solar potential of more than 5-6 kWh/m²/day of irradiation in many areas which promise technical and financially viable solar energy projects, on-grid or off-grid. The Coastal Belt of Sindh is blessed with a wind corridor that is 60 km wide (Gharo–Kati Bandar) and 180 km long (up to Hyderabad). This corridor has the exploitable potential of 50,000 MW of electricity generation through wind energy. In addition to that there are other wind sites available in Coastal Area of Balochistan and some in Northern Areas. Technically the grid can take up to 30-40% of wind energy. Most of the remote villages in the south can be electrified through micro-wind turbines. But the lack of proper planning, cost analysis, availability of wind data and provision of adequate incentives to investors are perhaps major obstacles. Pakistan is already heavily dependent on biomass as fuel.

LADIES AND GENTLEMEN!

The rural population meets more than 95% of their domestic energy needs by burning bio-fuels. As promised, steps are being taken to achieve our Green Growth Agenda. It is expected that the new installed capacities will have more shares from hydel, renewable, coal and nuclear and less dependence on oil. As per the government future energy projections, the expensive energy generation from Furnace Oil and High Speed Diesel based power plants will reduce to a negligible level in coming years. Also, indigenous gas and LNG based energy though a fossil fuel, however being a relatively clean fuel, is expected to account for around 40% of total energy generated in the FY 2019-20 compared to 29% in the FY2016-17. This will ensure the security of sustainable supply of energy, development of natural resources and minerals, and deliverance of affordable and sustainable clean energy for all. Lastly, I would like to reiterate the Government's strong commitment to overcome energy challenges. Moreover, the government openly welcomes innovative solutions to join the common cause. Do enjoy your stay here and please contribute to the ceremony. Thank you very much!

PAKISTAN ZINDABAD

VOTE OF THANKS

PROF. DR. SAJID RASHID AHMAD

**Principal, College of Earth and Environmental Sciences (CEES),
University of the Punjab, Lahore**



السَّلَامُ عَلَيْكُمْ!

I welcome everyone attending this event today. My special and foremost thanks to Guest of Honor. In global energy scenario, about 1.3 billion people in the developing world still lack access to electricity. Additionally, 2.5 billion people lack access to safe cooking fuels. Where available, more than 80% of the power generated dissipates due to irresponsible consumer behavior. The future of world energy hence relies upon developing countries, especially those in Sub-Saharan Africa and Asia. Among these countries, Pakistan has one of the highest electrification rates. Contrarily, more than a quarter of its population does not have access to modern energy. Moreover, the rate of access to clean cooking fuels and technologies in Pakistan is only 43.32%. Consequently, the energy sector, although considered as backbone of the economy, is unfortunately the major contributor to Pakistan's Green House Gas emissions. As per the latest GHG emissions assessment by the Federal Ministry of Climate Change, the energy sector contributed 46 percent of the country's total emissions, followed by agriculture (43 percent) and industrial processes (5 percent), with growth expected in both energy and industrial processes. Conversely, in wake of the recent international and national commitments on energy-environments nexus, Pakistan is bound to shift its development on the sustainable trajectory. Achievement of a long-term, modern, efficient, reliable, affordable energy supply is also one of the common goals of the UNFCCC and Kyoto Protocol- Paris Agreement, Sustainable Development Goals (2030), Pakistan Vision-2025, Pak Energy Vision-2035, and National Power Policy (2013). These global pledges have not only triggered socio-environmental consciousness but also vowed for reduction of carbon foot print through cleaner technologies, expansion of carbon markets and less fossil dependency. These obligations call for immediate response from Pakistan to reduce its energy sector emissions. Hence, in its Nationally Determined Contributions (NDCs) submitted to UNFCCC, Pakistan has committed to reduce 20% GHG emissions against the projected value in 2030. In order to achieve this target, priority has been allocated to mitigation efforts in energy sector. As per the mitigation plan of Pakistan's NDCs, the total implementation cost of the energy sector plan is US \$40 billion. With the aim of increasing energy security and reducing energy poverty, induction of efficient technology has been proposed for generation, supply, conservation and promotion of clean energy. Additionally, 7650 MW coal power plants are to be installed with an investment requirement of US \$27.6 billion through the China-Pakistan Economic Corridor (CPEC). Although relevant financial and technical support is available for developing countries but these opportunities cannot be fully utilized due to major capacity issues. The China Pakistan Economic Corridor is also envisioned to bring energy-prosperity in the region. But at the same time, it requires great attention that the energy solution road must not be paved upon compromising environment compatibility. Therefore, positive outcomes of these commitments rely upon a long term integrated plan which must address all aspects of sustainability. Such energy system is indispensable in view of existing energy crisis and recent global initiatives that impose bigger challenge to Pakistan. This warrants an energy mix plan which considers both the

provision of energy supplies and role of efficiency in meeting the demand. At academia level, University of the Punjab has taken various initiatives and research projects to harness the potential of low-cost and environmentally favorable renewable energy resources. We have model Bio-Gas plant at the CEES in operation. To highlight the energy crisis and corresponding sustainability challenges of Pakistan, College of Earth and Environmental Sciences recently organized an Energy Conference. The significant findings of the Conference were also shared with government for implementation. I believe that every individual has to contribute his significant role in combating the energy crisis. Here, I would emphasize upon the efficient consumer role which goes a long way in energy saving and conservation. As per the latest estimates of the World Bank, energy conservation and efficiency especially in household sector can reduce energy needs by 15%. To successfully remove energy side bottlenecks and to attain high growth trajectory, long term integrated planning is required with clear policies. Availability of strong transmission and distribution infrastructure is a pre-requisite for continuous and reliable electricity supply. There is need to diversify energy supply to meet energy needs in a sustainable and affordable manner. In order to reduce dependence on imported fuel, new explorations and induction of indigenous gas should be encouraged. To promote environmentally clean energy and renewable energy technologies in the country, policy level ambiguities and technical issues must be resolved and small hydropower plants must be encouraged. DISCOs must strive for loss reduction, maximizing recovery ratios, in addition to atomized metering and tracking of electricity flow from high voltage grids to end-consumers. We can also learn from the successful experiences of other countries. The challenges posed by energy crisis can only be dealt with through concerted and planned efforts. The developed countries are restructuring their energy systems to integrate renewable energy, with visible changes being made on the technological front through switching to low carbon technology in order to ensure energy efficiency and mitigate environmental hazards. China has recently introduced 'Energy Production and Consumption Revolution Strategy (2016-2030) encompassing a regulatory framework to lessen air pollution and prescribing market reforms in oil and gas sector. India's ambitious energy policy aims at attainment of energy security by setting targets for universal electrification, reduction in oil imports, increasing renewable energy generation capacity and Nationally Determined Contributions (NDCs) commitments under Paris Climate Agreement to lessen the emissions intensity of the economy by 2030. I hope that with the continued commitment of the present government and responsible consumer behavior, energy situation will significantly improve over the coming years. Thank you very much!

RECOMMENDATIONS

38th All Pakistan Science Conference on “Energy Crisis and Their Solutions in Pakistan”

RECOMMENDATIONS

A. Dealing with Energy Problems Including Impact of Imported Fuel

Short Term Recommendations

1. Cut down out power demand by 30% on mandatory basis. Government should implement this solution in all Government owned buildings. Others should be educated and encouraged.
2. Introduce Ethanol as fuel that can replace Diesel with some changes in the motor engines, power plant engines, all diesel generators. Up to 25% reduction in fuel can be made.
3. Introduce cheap electric cars and scooters to replace existing vehicles, motor cycles and scooters. Move towards an electric and ethanol based economy.
4. Convert trains to battery drives or hydrogen using ethanol.
5. Make double glass windows and insulation mandatory in all Govt sponsored or private sector supported new buildings.
6. Start a massive solar PV program in existing buildings; 7,500 MW to 10,000 MW over a 5 year period. Ask investors to participate.
7. Start a 5,000 MW solar PV program under the 5 million houses program. Also investor supported.
8. Build 5,000 MW hydro projects over a 5 year period.
9. Introduce massive program of solar geysers for heating to replace gas heating.
10. Introduce heat pipes in existing air-handlers to reduce cooling load.
11. Introduce Phase Change Materials (PCM) for thermal heat storage to balance peak power demand.
12. Introduce high demand charges and low energy charges based capacity tariff with the aim of reducing existing demand by 30%.
13. Abolish the upfront tariff contracts for power plants with guaranteed returns. Move towards competitive bids on BOT (Build Operate and Transfer) basis.
14. Renovate the existing transmission & distribution system.
15. Introduce new legislation for curbing electricity and gas theft. 75% of the so called losses are theft.

Long Term Recommendations

1. Ethanol to replace petrol, diesel or furnace oil
2. Raise building standards to cut down cooling and heating by 50%.
3. Exploit major part of the 100,000 MW potential of wind power.
4. Exploit major part of 100,000 MW potential of solar power.
5. Exploit major part of 100,000 MW potential of hydro.
6. Use coal to produce gas and carbon capture to produce Hydrogen and other carbon based products.
7. Decentralize power system with 20 MW per grid station. Have a solar PV or CSP (Concentrated Solar Power) based electricity generation hooked up to the grid station.
8. Convert DISCOS into companies at Circle level for better governance and control. Award professional management contracts to local and foreign Joint Ventures. China could be a worthy partner in this effort.

9. Install solar PV on all tubewells.
10. Introduce support programs including awareness campaigns. Position papers on all the above solutions should be prepared.

B. Recommended Plan for Controlling Oil Imports

Recommendations for the transport sector

1. Green cars using E85 fuel (15% Ethanol, 85% Petrol).
2. Green trucks using ED95 fuel (95% Ethanol, 5% additives).
3. Green buses using bio-gas or bio-ethanol ED95 fuel.
4. Green rail engines running on bio-gas, bio-diesel or batteries or LNG.
5. Green motorcycles using E85 fuel.
6. Green rickshaws using E85 or CNG.
7. Green tractors using ED95 or CNG
8. Introduce electric cars.
9. Introduce electric motorcycles.

Recommendations for Power Sector

1. Convert diesel engines to bio-diesel ED95.
2. Convert furnace oil based plants to LNG or bio-diesel or Syngas from coal...
3. Convert combined cycle gas fired plants to Syngas or CO₂ driven gas turbines.
4. Add solar power and heat to power plants.
5. Add waste heat recovery and use CHP concepts.
6. Add CO₂ capture and storage at coal power plants.
7. Add combined heat, cooling and power concepts as in district heating or cooling.
8. Add thermal energy storage to flatten the plant power output.
9. Add equipment for energy efficiency improvement.
10. Install heat pipes in all air handlers.
11. The industry and Government use fuels for standby diesel generation and fuel oils for vehicles.
12. The green vehicle concept should be used.

Recommended Measures

1. Production and distribution of bio-fuels.
2. Setting up new petrol pumps for E85 and ED95 bio-fuels.
3. Conversion of existing vehicle and power plant engines to run on bio-fuels.
4. Introduce bio-ethanol and bio-diesel crops.
5. Initiate Research, Development and Demonstration (RDD) projects for new technologies.
6. Set ambitious national fuel replacement goals.
7. Initiate training and support programs including subsidies.
8. Sign umbrella technology transfer and training programs along with pilot projects with internationally recognized firms.
9. Provide a Policy Framework and Directives as in EU.
10. Adjust tariffs and regulations to stimulate the proposed programs.
11. Provide detailed feasibility studies for each solution.
12. Invite investors to participate in the proposed program.
13. Establish partnerships with countries and firms where the technology was implemented successfully.
14. Develop national standards using the EU documents as a reference.
15. Initiate national Bio-Fuel Awareness program.

16. A Comprehensive National Program for Bio-Fuels should be prepared at the Federal and Provincial level.
17. There are many details to be handled under the above program. Collaboration with other countries can shorten our development time.
18. The analysis of an integrated energy supply and utilization system requires a suitable energy model applicable to our needs.

C Recommended Plan for Introducing Biogas

Recommended Measures for Biogas

1. Prepare a National Biogas Development Plan for Pakistan. China has encouraged biogas as an integral part of their rural development program. Pakistan can learn from China in this area.
2. In Europe, Germany, Italy and UK are three countries where biogas has been developed through national support programs. Germany is the biogas leader in Europe. Pakistan can learn from these countries and establish cooperation in this field.
3. An intensive Biogas Research, Development and Demonstration (RDD) Program should be established in all technical universities and research centres.
4. The Federal and Provincial Governments should allocate funds for grants to successful biogas plants. A one window operation should be set up. A Biofuels Research Foundation should be set up to own this effort.
5. Mass awareness campaigns should be started to educate people about the biogas program.
6. RDD centres should be used as training centres.
7. Chinese manufacturers should be encouraged to set up joint-ventures with Pakistani firms and RDD centres for design, manufacturing and installation of biogas plants.
8. Private sector companies should be encouraged to install and operate biogas plants, as continuous monitoring and control is necessary for quality control.
9. Custom duty and taxes should be reduced for biogas installations.
10. Large biogas plants with proper gas cleaning should be set up to feed biogas to the natural gas networks.
11. Higher Education Commission should allocate funds for research projects covering all aspects of biogas.
12. At least 1,000 scholarships should be obtained from China, Germany, Italy and UK for higher studies by Pakistani students at graduate level in Biogas Technology.
13. Under agreements with China, about 1,000 technicians should be sent to China for hands-on training in design, manufacturing, installation and monitoring of biogas plants.
14. An attractive feed-in tariff should be introduced for surplus energy from biogas plants.

E Institutional Development

Recommendations for Institutional Development

1. Plan for Energy reliance.
2. Introduce biofuels to replace fossil fuels.
3. Develop a Decentralized Energy System
4. Introduce Support Programs including Research, Demonstration and Development at University level.
5. Support large scale skills training in new technologies.

ENERGY CRISIS

A. Q. Paracha

Pakistan is in energy crisis. What are the reasons everyone knows about reasons? We think positive every crisis can be converted into opportunity. If it is crisis for some it can be converted in to opportunity for some others. Crisis can be solved by our own resources if we take loans or help from other crisis become more strengthen and if we solve it by our own resources, we can not only solve the problem we become more powerful and developed nation. We are a country of agriculture base we can solve our many problems if work on this base. Our population is scattered in villages and our more than 60% population is still rural based but our most of the projects of every type are for populated cities not for the more than 60% of the population.

Net result is we have lack of resources for mega projects and disturb the both sides urban and rural population. Today I want to discuss the problem larger part of population rural population whose economy and everything based on agriculture. Rural population fuel is cow dung, wood, natural gas, LPG, kerosene oil first two are not clean fuel and others are very expensive. Our villages have sewerage problems, cleanliness problems and solid waste management problems. My idea of biogas is the solution for our energy problem as well as sewerage, burning of farm waste and cleanliness of the villages. We can develop biogas plant on large scale for whole village and run by the local government on commercial basis. Our raw material for the biogas is cow dung household sewerage and green waste of the farm. Green waste has 6 to 7 times more biogas generation than cow dung. If we develop one or two biogas plant for the whole village according to its population than we have clean fuel with clean village having solution of waste water and no fire of our farm waste we will convert it into energy. We achieve the target of clean, green and healthy villages having resource for small local projects. By this we can solve problems of our at least 60% of population which is a big deal but without importing anything no use of foreign exchange no need of loans only commitment is required. We can convert biogas into electricity if required.

CHALLENGES AND OPPORTUNITIES FOR COAL UTILIZATION IN PAKISTAN

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ABSTRACT

Pakistan is rich in Coal reserves ranging from lignite to sub-bituminous rank. The major on-going coal fired power plants in public/private sector utilize imported coal due to some technical demerits of indigenous coal reserves. The technical lecture will mainly be focused to discuss the key challenges of current operational activities including coal transportation, handling and combustion methodologies with significant technological advancement for utilization of low rank utilization for mega projects in accordance to environmental policies. Furthermore, a brief aspects of coal quality issues for on-going active coal mines in Pakistan along with recommendations for its visible solution to achieve clean coal combustion technologies for future country demand.

Keywords: Coal, quality issues, lignite, industrial utilization

LOW QUALITY COALS UTILIZATION – KEY COMMERCIAL, ENVIRONMENTAL AND PLANT EFFICIENCY CONSIDERATION

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ABSTRACT

Coal blending process is practiced for combustion and gasification, particularly in coal-fired power generation. The Coal blending techniques go a long way in reducing the cost of power generation. The low-grade coals abundantly available in Pakistan can be mixed with high grade coal while retaining thermal performance of the boiler. Generally, any two coals can't just be blended. Successful blending occurs with respect to non-additive properties (likes combustion reactivity of coal, ash characteristics, grindability index, and swelling characteristics) of two coals. Presently, coal utilization industries (cement, power generation, steel) are using single type coal which ultimately enhance fuel cost hence coal blending is strongly recommend to reduce overall plant cost and to sustain efficiency keeping in view environmental constraints. Taking an environment-friendly approach in thermal power plants with coal blending requires an understanding of the interaction of inorganic components of coals in the blend process and how it affects ash behavior including its emissivity, and thermal conductivity. Conventional and advanced analytical techniques were used for characterization. Fuel ratio, burnout profile, ash chemistry and carbon burnout are key factors. This work will assist utilities to decide on the choice of coals for blending. Combustion efficiency and carbon loss of blended coal, other aspects of slagging, fouling and emission characteristics like NO_x, SO_x and emission of particulate matter are to be studied. Optimisation in process helps in ensuring cost effective and environment-friendly power generation in coal-fired thermal plants. The strict quality parameter monitoring for fuel (coal) recommended to reduce operational & maintenance (OM) cost of project and to use latest off-line and on-line (ash gauges) devices to control blending process. The technical paper highlight the significance of coal raw mix and various blending methods such as blending in bed, blending by silo, blending by ground hopper and blending on moving belt economical viable for commercial applications. Among them, the most common is the blending on moving belt which is used for all coal processing industries.

Keywords Coal Blending; Combustion; plant efficiency; environment

POTENTIAL ENERGY SOURCE THROUGH THERMAL DEGRADATION OF REFUSE DERIVED FUEL FROM MUNICIPAL SOLID WASTE

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ABSTRACT

Islamic Republic of Pakistan is a developing country and Ratifier of International Protocols. Especially, when it comes to Kyoto Protocol (1997) and reduction of greenhouse gases emissions. Landfill gas (CH₄) is a potent greenhouse gas that can be cut down substantially by diverting the waste from the landfill. Open burning of solid waste contributes towards elevated CO₂ emissions. It is also one of the major reasons behind production of Smog in Lahore. Utilizing waste into resource does not only control Global Warming and Smog but can also be used for waste to energy (WtE) purposes and overcome the energy crises. In the current Scenario, Municipal Solid Waste (MSW) from Ravi Town, Lahore was segregated into combustibles and other waste. The combustible fraction of MSW was feasible for Refuse Derived Fuel (RDF) processing; projected as 162.14 tons/day. The combustible laboratory samples were paper and cardboard (PC), shopping bags (SB), *polyethylene terephthalate* bottles (PET), other plastic composed of *polystyrene* (OP), food and drinks tetra-pack packaging made with a mixture of *low density polyethylene*, cardboard and aluminium (TP), textiles (TX) in the form of rags (mixture of cellulosic material and synthetic polymers) and toffee/chips wrappers (a blend of *polypropylene* and aluminium foil) represented as others. The RDF pellets were found in accordance with the *European use for responsible incineration and treatment of special waste* (EURITS) RDF standards. Thermogravimetric analysis (TGA) along with derivative thermal gravimetric (DTG) profile and chemical kinetics were performed on the samples to optimize the batch type pyrolysis unit design and operating conditions. Incineration of plastics constituents has been very controversial due to the release of dioxins at the elevated temperatures. On the other hand, the current study suggests that the pyrolysis is carried out in the controlled conditions using nitrogen as a purge gas. The effect of heating rates (10 °C min⁻¹, 20 °C min⁻¹ and 30 °C min⁻¹) rates was significant on the decomposition patterns. The decomposition temperature of the RDF samples under consideration was optimized as upto 500 °C at the heating rate of 10 °C min⁻¹. Kinetics study included estimation of activation energy, pre-exponential factor and regression analysis. The values of the activation energy indicated the need of an auxiliary fuel to initiate the decomposition reaction, pre-exponential values were in the favour of fast reactions and regression analysis suggested both simple and complex reactions happening during the pyrolysis of the RDF samples. Thus, a heating source and two outlets were added in the design of the pyrolysis unit. The RDF samples were run to obtain seven oil samples. The oil samples were tested by Fourier Transform Infrared Spectroscopy (FTIR). The hydrocarbon functional group of alkanes was very dominant among the results showing feasibility.

DEMAND RESPONSE PROGRAMS FOR GRID MAINTENANCE AND PLANNING IN PAKISTAN

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ABSTRACT

Demand Response (DR) Spinning Reserve can be a critical arsenal in future planning and maintenance of Electricity Grid. DR can provide Active Power Balancing when dealing with contingencies that cause a sudden drop in electricity. An extreme form of DR is 'Load-Management' which is frequently executed in Pakistan to balance supply and demand. These measures, however, can create an excess of Reactive Power in the system due to Ferranti Effect and can cause Bus Over-Voltages in High-Voltage Transmission Systems, a phenomenon that must be catered to preserve system stability. This paper explores this phenomenon by conducting Load Flow studies and sensitivity analysis on IEEE systems. We present an in-depth analysis of the effects of DR Load Magnitude, Location and Power Factor on the Bus Voltages, relevant to grid planning in emerging markets.

Keywords: Demand Response, MATPOWER, Load-Flow Study, Spinning Reserve, Sensitivity Analysis

REMOVAL OF LEAD FROM WASTE WATER THROUGH IRON DOPED BIOCHAR NANOCOMPOSITE

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ABSTRACT

The nanocomposite was synthesized using biochar of Eucalyptus leaves impregnated or doped with Iron by adopting co-precipitation technique. The functional groups, size, structure, morphological features and chemical composition of nanocomposite were determined by XRD, FT-IR, SEM and EDX techniques. Batch studies were conducted for removal of Pd from wastewater by studying the effect of different equilibrium parameters like shaking speed, contact time, pH, temperature, adsorbent dose and different concentrations of Pd. Maximum removal efficiency of Pd was attained at 250 rpm by using 0.2 g of adsorbent dose with 200 mg/L initial adsorbate concentration for 150 minutes at room temperature and neutral pH. The adsorption isotherms and kinetics were applied to batch studies data and found that fit to Freundlich and pseudo first order and pseudo second order models. Hence, the results of the current study illustrated that the synthesized nanocomposite is an efficient adsorbent for removal of Pd from the waste water and can be employed as environment friendly at industrial scale.

Keywords: Lead, biochar, iron doped nanocomposite.

**UTILIZATION OF MUNICIPAL SOLID WASTE IN THERMAL POWER PRODUCTION:
A TECHNO-ECONOMIC STUDY OF KASUR CITY, PUNJAB, PAKISTAN**

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ABSTRACT

This techno-economic study reports the feasibility of generating thermoelectric power from municipal solid waste (MSW) of Kasur City by incineration process. The data was gathered from different establishments of Kasur, through appropriate permission from their heads, and processed to design different alternative projects for installation of a thermal power plant in the city of Kasur. A technique of discounted cash flow was used to evaluate alternative projects so that their Benefit to Cost Ratio, Net Present Value, Internal Rate of Return and Payback Period can be determined. The study revealed that Kasur City currently consumes 18MWh electricity and generates 179 tons/day MSW. The generated waste has the ability to produce 2.1MWh electricity at the cost of USD 0.0581/unit with an expenditure of USD 3,907,692 as initial fixed investment of forming about 1/7th of consumption of Kasur. The cost from this source when compared to current rate of electricity in Pakistan (USD 0.1346) is roughly half.

A PSYCHOLOGICAL APPROACH OF BEHAVIOR SHAPING TO ENERGY EFFICIENT APPROACH TRAINING FOR YOUTH

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ABSTRACT

This research was laid out to examine the efficacy of Psychological approaches of behavior shaping in instilling in the consumers energy efficient and conservation approaches. Helping people to green their homes and be more *energy efficient by adopting a consummate approach of energy consumption is the rationale behaving this impetus. Experimental research design with pre-post strategy was employed.* This was hypothesized that energy conservation can be taught to people through subtle means of behavior shaping techniques. Information based *energy conservation* experiments were designed and conducted in a college set up on a group of 20 participants; out of which 10 were boys and 10 were girls; within age ranges of 18 to 20 years. The goal in this empirical work was to promote behavioral economics measures. All the respondents were matched on age and grade. They were given a pretest screening with inventory on energy conservation awareness. This was followed by a rigorous sessions based and activity based two weeks program; executed at intermittent days. Their behaviors were monitored in campus set ups as well. After two weeks sessions time, they were assessed again on inventory for energy conservation awareness. This was observed that respondents had become much more vigilant in their attitude towards energy consumption and were noted to express the frugal approach towards general energy consumption. This highlights the evidence that such psychoeducational approaches for environmental safety and conservation of energy sort challenging issues need to be included in regular curriculum of young learners.

STRUCTURAL INVESTIGATION OF MOLYBDENUM LITHIUM VANADIUM PHOSPHATE AS A CATHODE MATERIAL FOR LITHIUM ION BATTERIES TO BE USED FOR ENERGY STORAGE

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ABSTRACT

With the passage of time the world has endured various calamities, ranging from atmospheric pollution to rise in earth's temperature, caused by prolonged periods of global warming. Excessive usage of fossil fuels for energy production has largely contributed to the global warming. Furthermore, it has resulted in depletion of reserves. Transportation industry is the one of the major contributors of global warming via exhaust fumes. With the advancement in technology, electric vehicles seem to be the only sensible option which can help curb the emission of dangerous fumes that are leading to global warming. Batteries are the major component of electric vehicles which are the energy source for them to move. Lithium ion Batteries are the most promising energy storage systems for electric vehicles. Cathode part of batteries are the ones that play decisive role in deciding the storage capacity of a battery. LiCoO_2 was the first commercial cathode material to be used in Lithium ion Batteries but it had some drawbacks in the form cost and safety. So, scientists are the working for the alternative materials to overcome these drawbacks. Lithium vanadium phosphate ($\text{Li}_3\text{V}_2(\text{PO}_4)_3$) has emerged as a good option for a cathode material its attractive electrochemical properties, including high specific energy, high working voltage, good cycle stability, and low price. We added various amount of Molybdenum in to Lithium vanadium phosphate ($\text{Li}_3\text{V}_2(\text{PO}_4)_3$) using hydrothermal synthesis. Characterization of the material was performed by using X-ray powder diffraction (XRD), SEM, EDS and thermogravimetric analysis (TGA). When the results were compared with the results of principal sample i.e Lithium vanadium phosphate ($\text{Li}_3\text{V}_2(\text{PO}_4)_3$) it was seen that there was change in structure from crystalline to amorphous.

ENERGY CRISIS AND THEIR SOLUTIONS IN PAKISTAN

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ABSTRACT

Energy is considered a pre-requisite to improving the human development index of a country as well as key for the sustenance and development of economic activities which in-turn improves the quality of human life. To maintain needs of accelerated human growth the economy needs reliable, uninterrupted and affordable supply of energy. Pakistan is among those developing countries where the need to tackle the challenges is significant. Ensuring availability of usable and affordable energy is therefore, the foundation of Pakistan's current and future developments. In recent years, the energy demand has increased significantly in Pakistan owing mainly to accelerated economic growth. Consequently, the energy supplies remained deficient to offset the growing demand of domestic, industrial, commercial and power generation needs. This study aims to explore needs, demands in Pakistan. This study also provides the recommendations about potential solutions to fulfill the energy needs and demands. The growth of the energy sector has remained slow due to a host of factors such as inadequate institutional framework, financial constraints, sky-rocketing oil prices, low interest of private sector, lack of political will and mismanagement towards energy resource development. To address the issue of energy crunch, the government must work towards a multi-faceted approach involving short term measures in bridging the demand-supply gap through energy conservation measures with awareness towards efficient use of energy and full utilization of existing capacity by reducing the line losses and associated upgradation of obsolete electrical grids along with long term measures of accelerated import of electricity and gas from other countries, utilize its vast coal reserves, develop small Micro Hydro-Power Projects (MHPP's) in run-of-the-river schemes for the short-term and large conventional dams with reservoirs in the long term, accelerate current and future programs of alternate energy development from wind, solar and nuclear power so as to overcome the crippling energy crunch faced by Pakistan.

**LIVING LIGHTS: MERGING THE WORLDS OF NATURE AND TECHNOLOGY TO
COMBAT ENERGY CRISES**

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ABSTRACT

Energy crisis has proved to be one of the biggest issues in accordance to day-by-day increase in world's population. The knowledge of synthetic biology, biotechnology and genetic engineering has proven to be the best, environment friendly and cheap approach towards this problem. In order to cope up with these energy needs, Bioluminescence can be put to use. The incorporation of the lighting phenomenon into other living organisms such as trees and algae can lead to many significant products to meet the needs of energy demands. This process involves the incorporation of illuminating enzymes from bioluminescent organisms into organisms of desired needs. The proper incorporation of these enzymes in organisms may lead to a lighting solution without the use of electricity. This phenomenon can be put to use in the production of bioluminescent trees, bioluminescent algae and a relatively new concept of bio-photovoltaic panels that may prove to be the new lighting source in near future.

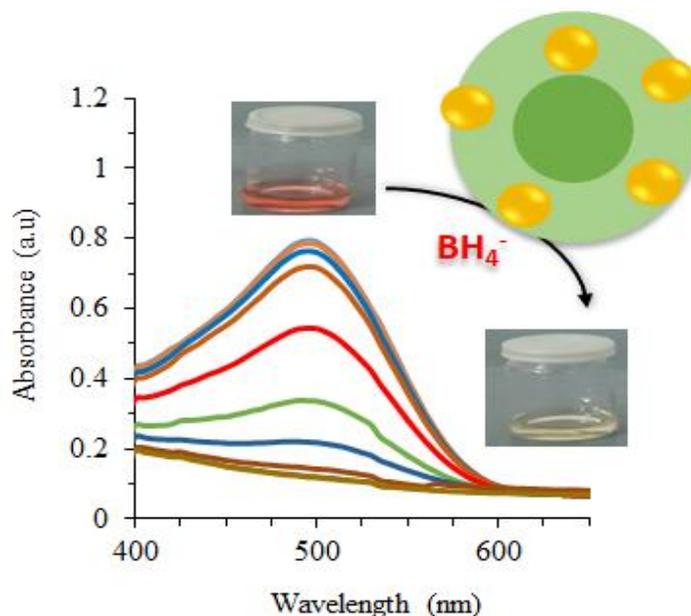
SILVER NANOPARTICLES ENDOWED CORE/SHELL COMPOSITE MICRO PARTICLES FOR CATALYTIC DEGRADATION OF TOXIC CONGO RED

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ABSTRACT

Core shell microgels consist of polystyrene (pST) core and single layered poly(N-isopropyl methacrylamide (pNM) shell were prepared by seed mediated precipitation polymerization method. Single layered shell was endowed with Ag NPs by in-situ chemical reduction method using Ag NO₃ salt as silver ions precursor. Core shell micro and composite micro particles were characterized by different techniques such as Uv-visible, FTIR spectroscopy, TEM, DLS and TGA. TEM analysis showed that core shell micro particles were spherical in shape. DLS analysis showed the particle size, size distribution and pH sensitivity. Catalytic activity of Ag-pST-pNM core shell composite micro particles was investigated by reducing the Congo red as benchmark reaction and reduction reactions were monitored on Uv visible spectrophotometer. It was observed that restriction of Ag NPs in single layered shell around the pST core facilitated the diffusion of reactants by reducing the mass diffusion barrier and enhanced the rate of reduction reaction. Due to single layered thickness of shell our reported catalyst showed high activity as compared to previously reported core shell and homogeneous hybrid microgels. Solid pST core induced the easy removability of catalysts from reaction mixture by mild centrifugation. Polymerized pNM monomer in shell of core shell microgels shifted the volume phase transition of particles to high temperature (44°C) and make possible of their use at high temperature as compared to already reported poly(N-isopropylacrylamide) based core shell microgels which show volume phase transition temperature around 32°C. Catalytic reduction of Congo red was also performed under different reaction conditions such as NaBH₄, Congo red and catalyst to optimize the value of k_{app}. Reduction reactions followed the Langmuir Hinshelwood mechanism.



CHARACTERIZATION OF *MALLOTUS PHILLIPENSIS* FOR ITS ANTIBACTERIAL AND ANTIOXIDANT ACTIVITIES

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ABSTRACT

Phytochemicals present in medicinal plants are a major source of imparting different characteristics to the plant. Antibacterial and antioxidant activity of these bioactive compounds was tested in four medicinal plants i.e. *Ziziphus jujube* (Unaab), *Fagonia arabica* (Dhamasa Booti), *Mallatus phillipensis* (Kameela) and *Hemidesmus indicus* (Ushba). Ethanol and hexane extracts of these selected medicinal plants were prepared and phytochemical analysis was done. Antibacterial activity of these extracts was performed by qualitative and quantitative methods i.e. agar well diffusion and MIC assay respectively. Plant having maximum antibacterial activity was tested for its bacterial efflux pump inhibition potential and its components were separated by TLC. Component showing antibacterial potential was subjected to GCMS analysis. Antioxidant activity of these extracts was also estimated using different methods. Phytochemical analysis revealed the presence of various components in selected plants. Maximum antibacterial activity against gram positive strain was shown by ethanol extracts while for gram negative strain no considerable inhibition was observed by either of the extracts. *Mallatus phillipensis* (ethyl acetate) extract showed maximum inhibition potential and GCMS analysis indicated phthalic acid to be the component responsible for this activity. Significant antioxidant activity was also observed from *Mallotus phillepensis* extract. Phthalic acid, responsible for antibacterial activity of plant extract, can be used in medicine industry to treat certain bacterial infections.

Keywords: Phytochemical Analysis; Antibacterial Activity; Thin Layer Chromatography; Bacterial Efflux pump inhibition activity; Gas chromatography mass spectrometry.

PREVALENCE OF MASTITIS AND *IN-VITRO* ANTIBIOGRAM STUDY OF THE MASTITOGENS IN BHAG-NARI CATTLE

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ABSTRACT

Mastitis is a multifactorial disease of dairy cattle having multiple etiological agents and is considered to be the economically most costly disease of dairy animals worldwide. This study was accomplished to determine the prevalence and antibiogram against most common mastitogens in Bhag-Nari cattle breed in Balochistan province of Pakistan. For this, 323 Bhag-Nari cattle were screened for subclinical mastitis by Surf-Filed-Mastitis-Test (SFMT) while clinical mastitis was diagnosed by close examination of udder and milk. Milk samples from mastitis positive cattle were collected aseptically and were cultured for isolation and identification of *S. aureus*, *Strep. agalactiae* and *Streptococcus dysagalactiae*. Antibiotic sensitivity against mastitogens was tested on Muller-Hilton agar by disc diffusion method as per CSLI standards. Prevalence of subclinical and clinical mastitis was 13.62% and 2.16%, respectively. Underfed cows have higher prevalence (18.65%) than well-fed cows (5.63%). Likewise prevalence was significantly high ($P < 0.05$; 16.90%) in cows with no practice of teat dipping compared to cows with teat dipping (7.69%). Cows milked once showed high prevalence (17.06%) than cows milked twice or more. Out of mastitis positive cases, prevalence of *S. aureus*, *Str. agalactiae* and *Str. Dysagalactiae* was 50.98%, 29.41% and 19.60%, respectively. The antibiogram sensitivity tests showed that the *S. aureus*, *Str. agalactiae* and *Str. dysagalactiae* were sensitive to Ceftiofur, Oxytetracycline, chlortetracycline and Cephadrine. It was concluded that *Staphylococcus aureus* was the most prevalent mastitogens in Bhag-Nari cattle, and Ceftiofur, Oxytetracycline, chlortetracycline and Cephadrine effective against *S. aureus*, *Str. agalactiae* and *Str. dysagalactiae*

Keywords: Mastitis, cattle, antibiogram, prevalence

CLIMATE CHANGE AND FUTURE CROP PRODUCTION IN PAKISTAN – A CASE STUDY OF WHEAT CROP PRODUCTION TECHNOLOGY

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ABSTRACT

Climate is changing with forecasting for a consistent increase in temperatures and a gradual reduction in the winter precipitations in Pakistan and Khyber Pakhtunkhwa (KP). These changes in Pakistan is started since 2000 and are expected to be continue until 2030 with a stability after 2040. This increase in the seasonal temperatures, expected to be around 2^oC, with regular reduction of winter precipitation will have an adverse effect on crops production, crops life cycles, crop quality and crops existence in a cropping system. The productivity and land under cultivation of a crops is also at risk with equal opportunities for some existing or new crops. Wheat (*Triticum aestivum* L.) as staple food crop in Pakistan is grown on about 40% cropped area. Its cultivation in KP approaches on about 60% area as rainfed which yield a very low i.e. 60% of the national average yield of wheat (i.e. 2000 kg ha⁻¹). Protein content of the local wheat is also very low i.e. 12.8%. Yield comparison of high yielding variety (HYV) to optimize sowing time for an agro-ecological conditions (AEC) are in process since long ago but the quality issue of the wheat grain and expected climate change is equally important to be taken in consideration to minimize wheat production cost and improve soil with sustainable measures for the future growing population. This study aims to apply split N to what HYV and compare their yield with focus on grain protein under changing climate. Increase N showed a significant (p<0.05) increment in wheat grain yield, which was due to healthy traits of the plant tillers. The optimum N-rates for wheat was 140 kg ha⁻¹ in the cropping system for the soil. The split applications of N coincide with the plant demand as per crop growth and development is of major interest of the study. Three splits over the traditional two splits have shown better yield which associated with healthy traits i.e. spikes length, grain number per spike and grains weight. The longest spike with maximum grain number and their weight under three splits either 25:25:50 or 25:50:25 at the time of seedbed preparation, tillering (70 DAS) and close to anthesis (100 DAS), respective is the best N-application to wheat in future expected climate change. Three splits application to crops especially wheat has resulted better grain yield with higher grain quality (i.e. protein content) and ensures better soil fertility at crop harvest for sustainable cropping system.

ISOLATION AND ESTIMATION OF REDUCTION POTENTIAL OF CR(VI) REDUCING BACTERIA FROM TANNERY WASTES

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ABSTRACT

Chromium (Cr) is a heavy metal, naturally found in biosphere. The two oxidation states i.e. Cr⁺³ and Cr⁺⁶ are of biological concern. Cr⁺³ occurs in environment in less toxic and insoluble form whereas Cr⁺⁶ is soluble and more toxic to living cells. This study aims to isolate chromate resistant bacterial strains from tannery polluted site of Lahore, Pakistan. Sixteen (UT1, UT2, UT3, UT4, UT5, UT6, UT8, UT10, UT11, UT12, UT17, UT18, UT20, UT21, UT22, AKR2) different chromate resistant bacteria were isolated at an initial concentration of 1500 mg/L K₂CrO₄. Morphological and biochemical analysis showed gram positive cocci and catalase and oxidase positive character. Heavy metals and antibiotics resistant profiling exhibited multiple heavy and antibiotic resistance. These strains could tolerate 3000 mg/L of K₂CrO₄ in Luria broth. Strain UT8 and UT20 exhibited highest Cr(VI) reduction potential of 77% and 74%, respectively at an initial concentration of 1500 mg/L K₂CrO₄. Strain UT11 revealed maximum exopolysaccharide (EPS) production i.e. 31mg under Cr(VI) stress condition (1500 mg/L). These strains can be suitable candidates for the remediation of chromate contaminated sites.

Key words: hexavalent chromium; reduction potential; heavy metals; industrial effluents; environmental pollution

BIODEGRADABLE PLASTIC PRODUCING BACTERIA FROM TANNERY EFFLUENT

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ABSTRACT

Polyhydroxyalkanoates (PHAs) are the environment friendly, efficient, renewable and biodegradable plastics. They provide a good source to overcome the growing concerns of pollution especially regarding plastics. For the isolation and characterization of PHA producing microbes, sampling was done from tanneries industry, Kasur. Ten strains were isolated from the samples on nutrient agar, all these strains were purified and the Gram staining was done followed by the biochemical analysis. Catalase, oxidase and lipase tests were performed. Seven out of ten strains were gram negative and three strains were gram positive. Similarly, two strains were catalase negative and the rest of them were catalase positive. Moreover, strains were also streaked on MacConkey agar. Strains were then grown on PDA media with the supplementation of Nile blue. This media was used to observe the fluorescence of PHA producers in the UV illuminator. Sudan black staining was done to observe the granules inside the strains showing fluorescence. Two strains were selected and further proceeded. These strains were gram negative rod.

Keywords: PHA, tanneries industry, Nile blue, Sudan black staining, gram negative rods

ISOLATION AND CHARACTERIZATION OF LIPASE PRODUCING BACTERIA FROM TANNERY EFFLUENT

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ABSTRACT

Lipase are important hydrolytic enzymes that catalyze the hydrolysis of triacylglycerol to glycerol and free fatty acids. Microbial lipases are important extracellular enzymes because of their diverse applications in biotechnological and microbiological practice from many years. Lipase have been used for various industrial purposes and in the manufacture of many beneficial products. The main purpose of this study was to isolate and characterize the lipase producing bacteria from different samples collected from tannery effluents located in Kasur. Eight bacterial strains named as L1, L3, L5, L6, L9, L10, L11, L12 were isolated followed by screening on Tributyrin Agar Medium with Mustard oil. These bacterial strains were found to be gram positive cocci and rods. Five strains showed similarity with *Bacillus spp.* (L5, L6, L10, L11, L12) and three as *Staphylococcus spp.* (L1, L3, L9). The growth kinetic study revealed that these bacterial strains showed optimum growth at temperature 37° and pH 7. These bacterial strains were optimized for nutritional estimation of carbon sources and nitrogen sources. Sucrose and yeast extract were found to be best carbon and nitrogen source, respectively. This study revealed that tanneries can be the good source of lipase producing bacteria that can be used for potential industrial importance.

Keywords: triacylglycerols; lipase; effluent; biomass; bacterial strains; Tributyrin Agar

ANTIBIOTIC RESISTANCE IN BACTERIA ISOLATED FROM MEAT AND MILK SAMPLES

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ABSTRACT

In the recent years, there has been a significant increase in antibiotic resistance among food borne bacteria. In this study, antibiotic resistant strains were isolated from different meat and milk samples. The use of antibiotics in dairy industry is a major cause of increasing antibiotic resistance in bacterial strains. Antibiotic resistant strains were selected based on their resistance to Ampicillin. The resistance pattern of these selected strains was checked by disc diffusion method using five antibiotics from different antibiotic groups (Cefixime, Tobramycin, Nitrofurantoin, Doxycycline and Imipenem). The selected strains showed significant antibiotic resistance. The major threat associated with this problem is that resistance in foodborne bacteria can lead to the transfer of resistance genes to humans and pathogenic bacteria.

Keywords: Resistance, food, foodborne bacteria, Antibiotics

GROWTH PROMOTION OF *ZEA MAYS* BY EXOPOLYSACCHARIDES PRODUCING BACTERIAL STRAINS FROM AZAD KASHMIR

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ABSTRACT

Extremophilic exopolysaccharides (EPS) producing bacteria can play a significant role in plant growth promotion. Seven bacterial strains (BE1, BE2, BE3, BE4, BN1, BN2, BN3) were isolated from Tattapani hot spring, Azad Kashmir, Pakistan. All strains showed EPS production but three strains (BE1, BN1 and BN3) exhibited highest EPS production when screened on P-media. These strains had ability to solubilize phosphate and produce HCN when analyzed for plant growth promoting characteristics. Bacterial strains were used to inoculate globally important cereal crop such as *Zea mays*. All inoculated seedlings displayed significant increment in germination and growth parameters as compare to control. Alcian blue staining showed good colonization on roots of inoculated *Zea mays* seedling. Auxin and soluble protein content in *Zea mays* seedlings were also significantly increased due to bacterial inoculation. The optimum temperature, pH, carbon and nitrogen source for maximum EPS production by selected strains were 28°C, 9, fructose and peptone respectively. Phylogenetic analysis based on 16S rRNA sequencing revealed that bacterial strains BE1, BN1, BN3 were closely related to *Ochrobactrum intermedium*, *Bacillus pumilus* and *Enterobacter ludwigii*, respectively. Fourier-Transform Infrared (FTIR) spectroscopy of EPS produced by strain BN3 indicated the presence of various functional groups like amides, alcohols, carboxylic acids and aromatic compounds. Hence, this study suggested that EPS producing bacterial isolates from extreme environment can be used as biofertilizers to enhance crop yield.

Key words: Exopolysaccharides, Plant growth promotion, Tattapani, *Zea mays*, 16S rRNA sequencing, Fourier-transform Infrared Spectroscopy.

SEED PRIMING WITH POTASSIUM NITRATE IMPROVES THE SALINITY STRESS TOLERANCE IN RICE (*ORYZA SATIVA* L.)

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ABSTRACT

Salinity is one of the major abiotic stresses that affect the crop production. Adverse physiological and biochemical changes are caused by salinity stress. Potassium (K) is one of the vital elements required for plant growth and physiology. It helps in maintaining ion homeostasis and regulation of osmotic balance in plants under salinity stress. Seed priming is the most frequently used technique to enhance the crop establishment under salinity conditions. It stimulates the pre-germination metabolic processes. Antioxidant system activity and repair of membrane are escalated by Seed Priming. In the present study, a pot experiment was conducted to evaluate the influence of seed priming with Potassium Nitrate (KNO_3) on the growth, physiological and biochemical parameters of rice seedlings under salinity stress. The experiment was conducted at Botanical Garden, University of the Punjab, Lahore. The experiment was designed as randomized complete block design. Two rice cultivars i.e. Basmati 515, KSK-133 and two different concentrations of NaCl i.e. 75, and 100 mM, were used. Rice seed were soaked in different concentrations of KNO_3 i.e. 1, 1.5 and 2% for 12 hours at 25 °C. Different growth parameters i.e. leaf length, leaf width, leaf area, plant height, number of tillers and number leaves were observed during the experiment. Antioxidant enzyme activity, total Chlorophyll content, soluble Protein content, Proline content and total Phenolic content will also be determined to evaluate the effect of KNO_3 under salinity stress.

DYNAMIC STALL REDUCTION IN A 1KW VERTICAL AXIS WIND TURBINE ROTOR BY A PASSIVE FLOW CONTROL METHOD

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ABSTRACT

Wind power is a commercially-proven, fast growing form of electricity generation that provides a significant amount of clean, renewable, and cost-effective energy in many countries around the world. Wind power generation has so far favored the multi-megawatt horizontal axis wind turbine (HAWT) over the vertical axis wind turbine (VAWT) technology. Principal advantages of the VAWT technology are: (a) omni-directional operation independent of the directional changes in the wind, (b) heavy components such as the electric generator installed close to the ground, (c) simple design, less manufacturing and maintenance costs, (d) small operating space requirement (high farm power density), and (e) low environmental impact and noise signature [1, 2]. These properties support the application of VAWT in urban environments. However, the VAWT characterizes lower power coefficient C_p compared to the HAWT due to the presence of dynamic stall and associated blade-wake interaction induced vibrations. Dynamic stall occurs because of a large and periodic variation in the angle of attack (angle formed between the blade chord and relative wind speed) during rotation. Research has shown that an optimized/modified aerodynamic shape of the VAWT rotor can improve the flow characteristics and thus improve the power coefficient C_p [3]. This study is focused on applying a leading edge (LE) slat as a passive flow control device in order to reduce the dynamic stall over the rotor blades. The complex aerodynamics of the VAWT is analyzed using computational fluid dynamics (CFD) models and compared with the available test data. ANSYS Fluent and associated tools have been used as the CFD pre-processing and solver packages for the present study. A 1kW VAWT has been used as the test case. Two-dimensional (2D) unsteady simulations are performed for the baseline rotor design and the advance rotor design with the LE slats. Potential improvements in the rotor performance are observed.

Keywords: Dynamic Stall, Leading-edge slat, Power Coefficient (C_p), Computational Fluid Dynamics

ASSESSMENT OF LAHORE BRANCH CANAL IRRIGATION EFFICIENCY THROUGH APPLICATION OF GIS & REMOTE SENSING. MEHMOOD ASLAM

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ABSTRACT

Water is a valuable, limited and non-renewable natural resource. Water deficiency may occur in future due to climate change as Pakistan is said to be the climate hit country in the world. Thus, efficient use of water resource is the need of the time. Lahore Branch Canal (LBC) is the source of fresh water for Lahore city and some areas of Kasur district. LBC starts from BRBD link canal and its tail is near Rore in Kasur district. This canal was primarily designed to supply water for crop husbandry in its vicinity. Besides, it also serves some other purposes in like ground water recharge etc. Its efficiency with the help of GIS and RS was investigated over last one decade from 2007 to 2017 in this study. Cultivated area reduction from 2007 to 2017 due to urban sprawl and respected irrigation water requirement (IWR) for that cultivated land were calculated using Landsat images to see the efficiency of LBC. To check the reduction in crop area, one images for one selected year were taken with five-year gap from 2007 to 2017. For IWR, two images for one selected year were taken with three-year gap from 2007 to 2017, classification of images was done and area was calculated from the classified images. Results revealed that water entering in the canal is almost same from 2007 to 2017 with minor seasonal fluctuations, however, crop area has declined continuously over last decade. An overall cultivated area reduction of 5 percent was noticed from 2008 to 2013 and 6 percent from 2013 to 2017. Built up area also increased 3 percent from 2008 to 2011, 4 percent from 2011 to 2015 and 6 percent from 2015 to 2017. For IWR cropped area is reduced 3 percent from 2008 to 2011, 4 percent from 2011 to 2015 and 6 percent from 2015 to 2017. Thus, a water surplus of 22, 23, 23 and 23 percent in the years 2008, 2011, 2015 and 2017, respectively, was found being diverted into this canal. Findings of this study suggest that this surplus quantity could be saved if not diverted into this canal and be utilized for some other area wherever required.

THE ENERGY CRISIS OF PAKISTAN AND FUTURE PROSPECTS

It was expected that in 2018 Pakistan would be a load-shedding-free country as ongoing projects like Sahiwal Coal Power Plant (1,350MW), Port Qasim Power Plant (1,320MW), two nuclear power plants (650MW), Neel um Jhelum (950MW) and Tarbella 4 Extension (1,500MW) were expected to be completed in the mid of 2018. But the fact is that even in the urban Pakistan there is a 6-8 hours of load-shedding as a result of 5,000-7,000MW of shortfall, more than Rs1, 000 billion of circular debt and almost 30% transmission and distribution losses. Under current circumstances the energy sector of the country sector is in panic. Quantitative and Qualitative research methods were adopted to handle the issue. The National Transmission and Despatch Company and K-Electric Limited (KEL) data mentions that within the next three years by the year 2020, the power generation capacity of the country is expected to be 34,785MW that is about 3,000MW more than the estimated demand. But as the total population of Pakistan is 207.77 million and is growing at an alarming rate while during 2018 large scale manufacturing sector showed a growth of 6.24% which is highest during last 11 years as a result the demand for electricity is on the rise. On other hand, it has been forecasted by The International Energy Agency that by 2025 the power need of the country would exceed than 49,000MW. We can expect future of Pakistan would be load be a load-shedding-free as the government of Pakistan is seriously working to resolve this issue as early as possible.

Key Words: load-shedding, distribution losses, shortfall, power generation and alarming rate.

ENERGY OPTIMIZATION IN AN INDUSTRIAL FOOD DRYING PROCESS USING HYPERSPETRAL IMAGING (HSI) FOR THE ASSESSMENT OF REAL TIME DRYING CONDITIONS

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ABSTRACT

Real time data acquisition has become important in food drying which is a highly energy intensive process and needs to be optimized. The use of Hyperspectral imaging (HSI) is getting value due to its short measuring time, chemical-free technique, and can be applied to estimate more than one attribute at the same time. All these factors reduce energy requirements and costs of process. HSI was utilized for the determination of moisture content of potato slices with three thicknesses (5mm, 7mm, 9mm) at three drying temperatures (50oC, 60oC, 70oC) during convective drying in a laboratory hot air dryer. The Page, thin-layer drying model was found suitable to describe the drying process with a fitting accuracy of R² (0.96-0.99) and lowest reduced Chi-square (0.000246-0.000906), RMSE (0.01453-0.02685), and relative percentage error (1.49%-5.07%) under the used drying conditions. Spectral data was analyzed using the partial least squares regression (PLSR) analysis, a multivariate calibration technique, alongside MCUVE-PLS and CARS-PLS. The feasibility of both moisture content and CIELAB co-ordinate prediction with a reduced wavelength set from the VNIR region (400-1010nm) was investigated with these three models. The PLSR model (R² = 0.93-0.98, RMSE = 0.16-0.36 and the lowest number of optimal wavelengths = 6, for all drying conditions) was found suitable to implement for the moisture visualization procedure. The current study showed that hyperspectral imaging was a useful tool for non-destructively measurement and visualization of the moisture content and chromaticity during the drying process and let the user to know the process end time, thus saving energy consumption and retention of product quality as well.

Keywords: Hyperspectral imaging; Potato; Convective drying; Partial least square; moisture content; wavelength selection.

PROSPECTS AND GAPS OF RENEWABLE ENERGY IN PAKISTAN

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ABSTRACT

Renewable energy sources can contribute significantly to mitigate prevailing energy crises which could not only help to alleviating poverty through rural development but also to promote sustainable environment. Despite of huge potential of renewable energy (production potential from solar, wind, and biogas/biomass are 2.9 million MW, 20000 MW, and 5000 MW respectively) in Pakistan, the country remains unable to harness it fully which is essential to meet energy security. The main challenges are especially costs and the lack of sound policies, lack of appropriate technology, low technical capacity of power utilities/Government agencies, difficulties in grid integration and lack of private sector investment. Social and economic challenges are also need to be addressed keeping in view the success factors and hurdles to employ renewable energy at wider scale. Various organization like Alternative Energy Development Board (AEDB), National Productivity Organization (NPO), National Energy Efficiency and Conservation Authority (NEECA), Pakistan Council of Renewable Energy Technologies (PCRET), Small and Medium Enterprise Development Authority (SMEDA) are working to meet these challenges. The present study will cover the discussion on the development of renewable energy with perspective of socio-economic health of adopters, technologies and investment rate which will help to understand the major issues/difficulties in the implementation of renewable energy in the country.

Keywords: Renewable energy, challenges and opportunities, policy

**ANTICOCCIDIAL EFFECTS OF DIETARY SUPPLEMENTATION OF
TRACHYSPERMUM AMMI IN CHICKEN**

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ABSTRACT

Anticoccidial drug resistance development has been increased due to which alternative protocols are required to control this disease. Several strategies are available to treat the occurrence of coccidiosis in poultry. Moreover, new alternatives to these drugs are emerging, among some of these alternatives' plants have served as best alternatives against coccidiosis as proven by previous and recent studies. In current study, *Trachyspermum ammi* (Ajwain) was supplemented in crude form in feed of broiler chickens which were infected orally with mixed *Eimeria* species. Dietary supplementation of *Trachyspermum ammi* reduced *Eimeria* infection in terms of better feed conversion ratio, lower lesion and fecal scores in broiler chickens. It was concluded from experiment that *Trachyspermum ammi* can serve as alternative candidate against poultry coccidiosis however, further *in vivo* studies are needed to formulate its dose against coccidiosis.

Key Words: *Trachyspermum ammi*, *Eimeria*, Chicken, Coccidiosis

ANIMALS AS A DIRECT SOURCE OF ELECTRICITY: A NEW HYPOTHESIS

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ABSTRACT

Animals can act both as indirect and direct source of electricity. Consumption of Biogas as a fuel for power generation is an example of indirect source. Use of draught (Traction) power of animals for same purpose is the direct application. Since the invention of automobile vehicles, the horses and cattle were the main engines of transporting carts. Animals were also utilized for many other mechanical jobs as extraction of water from wells, Extraction of oils from seeds, ploughing, leveling, threshing etc. The new hypothesis is based upon the modification of older mechanism of extraction of water from the well. Only one animal can pull out tons of water from a well in a day. Hypothesis is that "If an animal can pull huge quantity of water from a distance of 100 feet underground, it can be tried for pushing the water 100 feet above the ground with traction power of one animal or two". To achieve this objective, the mechanism of old style well can be modified with two wheels, one at the surface of the earth being moved by the movement (Kinetic Energy) of the animal/ animals, second wheel at a height of 100 feet above the previous wheel. The chain of buckets will move with the movement of lower wheel, It will run over both the wheels and go down toward inside the well by taking U turn over the second wheel, the second wheel will move through upward movement of the chain of buckets. The buckets will pour the water in to a tank being 100 feet above the ground. The water collected in the tank will gain Potential Energy that can be converted in to Kinetic energy of turbines for production of electricity.

Keywords: Live Energy, Traction Power of animals, Power generation, Extraction of water, Kinetic Energy, Potential Energy, Environment Friendly Energy

***PHARMACEUTICAL EQUIVALENCE OF DIFFERENT BRANDS OF OXYTETRACYCLINE
USED IN VETERINARY PRACTICE IN PAKISTAN***

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ABSTRACT

Oxytetracycline is a broad-spectrum antibiotic frequently used in veterinary practice against many infectious diseases. The present study was designed to evaluate the pharmaceutical equivalence of various short acting, PVP and long acting brands of oxytetracycline hydrochloride available in market through HPLC. Dilutions of all the drugs were prepared in acetonitrile and 0.15M sodium acetate (1:1) to obtain final concentrations of 100, 50, 25, 10, 1.0, 0.5, 0.1, and 0.05 µg per ml. C-18 column was used and mobile phase was the mixture of 0.15 M sodium acetate and acetonitrile (50:50 v/v). Injection volume was 20 µl and flow rate was 1ml/minute. The Limits of detection and quantification calculated were 0.100(µg/ml) and 0.5(µg/ml) respectively. The acceptable percentage value of assay was 90-120%. The concentration of active ingredient (Oxytetracycline hydrochloride) in all preparations was in range except Terrasym PVP-100 (81%) and Onyx-LA (72%).

Keywords: Oxytetracycline, Chemical equivalence, HPLC, Short acting, Long acting, PVPs.

COMPARISON OF ANTIOXIDANT ACTIVITIES OF DIFFERENT COMMERCIAL VARIETIES OF TEA BY USING DPPH METHOD

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ABSTRACT

Determination of radical scavenging activity and the total content of antioxidants in foods, beverages, dietary supplements and herbal extracts have been in wide demand. This relates to the fact that antioxidants can prevent free radicals, primarily highly reactive oxygen and nitrogen species from damaging human health. Antioxidant activity of different types of teas i.e. Kashmiri Chaye, Pishawri Qehwa, Black tea and Lemon grass was determined in present study. For this purpose, ethanolic extracts of tea samples were prepared and free radical, 2, 2-Diphenyl-1-picrylhydrazyl (DPPH) which is widely used to test the ability of compounds to act as free radical scavengers was used. The free radical DPPH with an odd electron gives a maximum absorption at 517 nm. DPPH radical scavenging activity was observed by using different dilutions of the ethanolic extracts and taking ascorbic acid as a standard. Results showed the antioxidant activity of tea samples in order i.e. Lemon grass > Kashmiri chaye > Pishawri qehwa > Black tea. Different phytochemicals tests were also performed to determine the presence of various bioactive compounds i.e. Phenols and Tannins, Flavonoids, Carbohydrates, Saponins, Glycosides, Steroids and Terpenoids. Results showed that Flavonoids were present in high amount in all four varieties of tea studied. Phenols and Tannins were present in Kashmiri chaye and Pishawri qehwa but were lacking in lemon grass and black tea. Saponins were present only in Black tea and absent in other three varieties studied while Carbohydrates and Terpenoids were lacking in all the varieties, Glycosides were observed in all the four tea varieties studied. Presence of Steroids was observed in all varieties but the results were way more prominent for the lemon grass than other three varieties. It is being concluded from the results that lemon grass contains quite good amount of antioxidant than other types of tea studied. Phytochemicals analysis and data gathered about antioxidant content of these different tea samples can be used to estimate quality of tea.

PRODUCTION AND EVALUATION OF ANTI-TETANUS SERUM

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ABSTRACT

Tetanus is the most fatal disease of equines and human beings. The disease can be prevented either by active immunization (anti-tetanus toxoid) prior to entry of *Clostridium tetani* or passive immunization (anti-tetanus serum) post infection. Anti-tetanus serum can be raised, purified and evaluated biologically using mice experimental model. Female sheep (n=10) having 36 - 42 months of age were immunized with commercially available tetanus toxoid (ImatetTM, Amson vaccines and Pharma®) to raise anti-tetanus serum. Sera were collected fortnightly and sheep re-injected prior to collect the samples (nine times). Indirect ELISA was performed to determine the antibody (IgG) titer of all the serum samples. Out of 90 samples 21 (23.3%) revealed anti-tetanus antibody (IgG) titer of 100.8 IU or higher and 8 samples (8.9%) had titer of 160.9 IU or higher. Out of these 8 samples, 3 had anti-tetanus antibody (IgG) titer of 190.9 IU or higher. The highest titer observed was 195.4 IU. Immunoglobulins (IgGs) were mixed with saturated ammonium sulphate solution and centrifuged at 10000g for 30 minutes in refrigerated centrifuge machine and dialyzed against 10 changes of PBS at 4 °C. The purified anti-tetanus immunoglobulins (IgGs) were treated with papain to segregate Fab fragments (25~27 kDa) and analyzed by sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE). Anti-tetanus immunoglobulins and Fab fragments were evaluated qualitatively as well as quantitatively by toxin neutralization test (TNT) in mice. It is concluded that anti-tetanus Fab fragments produced in sheep can be used across the species in animals and human beings with trivial harmful effects.

Key words: *Clostridium tetani*, Indirect ELISA, Immunoglobulins (IgG), Fab fragments, SDS-PAGE, Toxin Neutralization Test (TNT).

**ANTICANCER POTENTIAL OF *FICUS LYRATA* L. AGAINST INDUCED
HEPATOCELLULAR CARCINOMA**

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ABSTRACT

Hepatocellular Carcinoma is the 6th most predominantly existing cancer and the second largest contributor to human mortality the world over. The present study provides therapeutic as well as prophylactic method for the treating induced Hepatocellular carcinoma (HCC) by administrating a plant ethanolic extract and compared with standard drug Sorafenib (in medical use for the treatment of Hepatocellular Carcinoma). Hepatocellular carcinoma (HCC) was induced in *Oryctolagus cuniculus* (Rabbits) by the administration of Carbon tetrachloride. The induced animals were treated with plant extract afterwards. Curative and protective effects of plant extract were effectively analysed by monitoring physiological changes (pH of saliva, temperature, blood glucose, body weight) in induced Hepatic Carcinomic *O. cuniculus*. Furthermore, Hematological investigations (Hb, RBC, TLC, MCV, MCH, MCHC and Platelets), changes in Liver Biochemical Enzymes (Alkaline phosphatase, Aspartate amino Transferase and Alanine aminotransferase) and Hepatic Carcinoma Marker (Alpha Fetoprotein) efficiently marked Therapeutic as well as Prophylactic outcomes followed by Histo-Pathological studies of Carcinomic and healthy livers following Hematoxylin and Eosin Staining.

EVALUATION OF ANTIFUNGAL ACTIVITY OF ESSENTIAL OILS AGAINST TOXIGENIC ISOLATES OF *ASPERGILLUS FLAVUS*

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ABSTRACT

The genus *Aspergillus* comprised of round about 150 species and worldwide the most common environmental molds. *Aspergillus flavus* is reported in environment and present naturally in post-harvest infestation of grains, feed, food and nuts. Main route of infection is inhalation of conidia from environment. These conidia can be the source of infection in hospital air and enter in wounds during surgery. Drugs presently used against aspergillosis aren't responding. Resistance is big issue now-a-days. So, alternatives like essential oil can be a good option in growth inhibition of Aspergilli. Essential oils have ability to inhibit the growth of toxigenic Aspergilli. Essential oils have potential to be used as preservative in feed to restrict proliferation of toxin producing fungi. Toxigenic isolates of *A. flavus* (n=10) are identified by macroscopic characters and microscopic characters by cellophane tape method and slide culture method. *A. flavus* is screened for their toxin production by thin layer chromatography (TLC). Disk diffusion test is used for antifungal susceptibility testing. Antifungal activity of essential oils is determined by log reduction method. MIC of the essential oil *Syzygium aromaticum* (long), *Elettaria cardamomum* (Elaichi), *Ferula asafetida* (Hing) and *Curcum longa* (Huldi) is determined by using MTT (3[4, 5-dimethylthiazol-2-yl]-2,5diphenyl tetrazolium bromide) assay. Essential oil of *Syzygium aromaticum* (long) exhibited most noticeable antifungal activity against toxin producing isolates of *A. flavus* in comparison to other three oils *Curcum longa* (Huldi), *Elettaria cardamomum* (Iaychi) and *Ferula asafetida* (Hing). Minimum inhibitory concentration of *Syzygium aromaticum* (long) was from (0.0307±0.001µL/mL) to (0.07±0.00µL/mL). Cytotoxic effect of *Syzygium aromaticum* (long) evaluated by MTT assay that showed percentage livability from 50% to 77.3% at concentration 100 µL/mL to 0.19 µL/mL. Mycotoxin production is one of the most burning issues in poultry sector. *A. flavus* is one of the major mycotoxin producer in poultry feed and animal rations as well as causes economic losses by infecting crops. This study suggests that essential oil of *Syzygium aromaticum* (long) if mixed in below cytotoxic level in feed, animal rations and grains. Antifungal property of essential oil will inhibit the growth of toxigenic fungi ultimately no mycotoxin production.

Keywords: Antifungal, Essential oils, Soil, Thin layer chromatography, minimum inhibitory concentration and *Aspergillus flavus*

EVALUATION OF COPPER NANOPARTICLE IN TISSUE CULTURE MEDIA FOR CONTROLLING BIO CONTAMINATION

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ABSTRACT

The present study was aim to examine effect of Copper nanoparticles on biological contamination in tissue culture of *Coriandum sativum*. This herbaceous plant belongs to family Umbelliferae, which is highly reputed ayurvedic medicinal herb commonly known as the Dhanya. The sterilized and certified seeds of *C. sativum* were grown in petri plates which were use as explants for Tissue Culture. The MS medium supplemented with different PGRs in separate and combination was used. The best callogenesis was obtained in MS medium with 35g/L of sucrose, 2,4,D+BAP at 5.7 pH. The temperature was optimized best at 25°C. The synergetic effect of 2,4,D+BAP resulted in the best production of 88% whitish yellow callus after 21 days of inoculation. The Copper sulphate salt was used for the formation of copper nanoparticles from the leaves of *C sativum*. The nano particles prepared from water and ethanol were added in the MS medium. The Copper nano particles (ethanol) have shown dynamic effect on controlling biological Contamination (Fungal and Bacterial growth) at 5 mg/L of MS medium. The confirmation of Cu nano particle was done by Ultra Violet Spectrometry (UV) and Fourier Transform Infrared Spectroscopy (FTIR). The UV-Vis spectroscopy Absorption Spectra of Cu nano particle had peak range of 300 nm and 600 nm respectively. The FTIR results of Cu Nano particle showed the presence of bending and stretching vibration of biomolecules. We can claim that suggested that Copper nano particle can decrease and remove microorganisms in MS media and then the explants can growth very well. This was the first repost of use of Cu nanoparticle as an antimicrobial agent in tissue culture of *Coriandum sativum*.

PHYTOCHEMICAL ANALYSIS OF SOME VARIETIES OF *BRASSICA OLERACEA* L.

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ABSTRACT

Purple cabbage extract contained comparatively more photochemicals i.e. saponins, alkaloids, quinones, anthocyanin, sterols, flavonoids, carbohydrates than the green cabbage extract and cauliflower. Purple cabbage extract contained highest content of ascorbic acid i.e. 1.412g/100ml, while green cabbage and cauliflower contained 0.915g/100ml and 1.3737g/100ml respectively. Titratable acidity was measured by acid base titration, purple cabbage extract contained highest amount of titratable acidity i.e. 0.4%, while green cabbage and cauliflower had 0.2% and 0.1% respectively. Reducing sugars were measured by Benedict's test. Large amount of sugars were present in purple cabbage extract i.e. 1 to 1.5%, while cauliflower and green cabbage extract contained low amount of sugars i.e. 0.1 to 0.5% and 0.5 to 1% respectively. Antioxidant activity was measured at 517 nm by DPPH (2,2-Diphenyl-1-Picrylhydrazyl) assay. In purple cabbage extract antioxidant activity was 113%, in cauliflower it was 68% and in green cabbage extract it was 51%. According to above mentioned findings purple cabbage have more nutritional importance as compared to green cabbage and cauliflower due to which the nutritional value of purple cabbage is comparatively high as compare to green cabbage and cauliflower.

IN-VITRO EVALUATION OF DISINFECTANTS AGAINST INDIGENOUS ASPERGILLUS PARASITICUS

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ABSTRACT

Fungal spores are present in environment of food industry, indoor environment, hospitals, pharmaceutical industry and vaccine production units. These fungal spores are main cause of infection and threat to immunocompromised individuals by contaminating products and surgical instruments and producing mycotoxins in different food products. Now a day's people spent more time in indoor environment than outdoor environment. In indoor there is less air and maintenance is improper. As more time is spent indoor so the problem of headache, feeling of tiredness and pressure on head occur. Fungi are present everywhere in nature and cause serious problem to public health in indoor environment. From indoor environment many fungi are isolated. On natural and synthetic material fungus are able to grow especially when the humidity is present in environment. Inorganic material acts as good substrate for the growth of aspergillus. Fungus attacks on wood. On painted surfaces aspergillus mostly grows. Due to exposure to mycotoxin contaminated food the hypersensitivity pneumonitis occurs. Immunocompromised individual's spent more time indoor and exposure to aspergillus species result in serious respiratory disorders such as allergic Broncho pulmonary aspergillosis, semi invasive pulmonary aspergillosis and pulmonary aspergilloma. Disinfectants are chemical which reduce the number of microorganism which can cause infection to human health. Disinfectant should have following properties. Disinfectant should have broad spectrum of activity, in presence of organic matter the disinfectant act, disinfectant should have high penetrating power and act in both acidic and alkaline pH. Disinfectant should be nontoxic and cost effective. Disinfectant should be nonirritant for skin and store for long time. Different disinfectants are used to control fungal infections. Mostly alcohol, quaternary ammonium compound, biguanides, phenols, aldehyde are used. The proper and effective use of disinfectant is necessary to restrain infection related to health care. There is need to investigate the efficacy of disinfectants against fungal spores. Isolates of *Aspergillus parasiticus* (n=20) was procured from project entitled as "Purification and standardization of mycotoxins extracted from indigenous fungi under optimized experimental conditions". *Aspergillus parasiticus* was revived on Sabouraud's dextrose agar and identified on the base of macroscopic characters and microscopic characters. Macroscopic characters will be observed from obverse and reverse side of fungal growth on Sabouraud's dextrose agar. Microscopic features will be determined by cellophane tape method and slide culture method. Further DNA was extracted from fungal mycelia and then polymerase chain reaction (PCR) was performed. To confirm the result of PCR gel electrophoresis was performed. For this 2% agarose gel is made. After conformation through PCR *Aspergillus parasiticus* spore suspension 10^6 spores/mL (1 mL) was inoculated into Sabouraud's dextrose broth and incubated for 14-25 days at $25\pm 3^{\circ}\text{C}$ in dark for mycotoxin production. Then mycotoxin was extracted and mycotoxin was detected through thin layer chromatography (TLC). Thin layer chromatography plate was observed under UV light at 365nm. B1 and B2 toxin fluoresce blue while G1 and G2 fluoresce green under UV light. Toxicogenic isolates of *Aspergillus parasiticus* was selected. Antifungal susceptibility of disinfectant

was checked through well diffusion method. Disinfectants Terralin (quaternary ammonium compounds), Alpha guard (biguanides), Instru Star (amine), Hypochlorite (Halogens) and Isopropanol (alcohols) were checked through well diffusion method. Then check minimum inhibitory concentration by broth microdilution method of disinfectants Terralin (quaternary ammonium compounds), Alpha guard (biguanides), Instru Star (amine), Hypochlorite (Halogens). Then perform log reduction method for disinfectants and count CFU/mL at different incubation time.

Keywords: Disinfectants, *Aspergillus parasiticus*, thin layer chromatography and Mycotoxin

**INVESTIGATION OF ANTIMICROBIAL POTENTIAL OF *GERANIUM WALLICIANUM*
D.DON EX SWEET RHIZOME**

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ABSTRACT

The use of herbs and medicinal plants as a first medicine is a universal phenomenon. All drugs of the past were the chemical substances with a particular therapeutic action extracted from plants. Leaves of *Geranium Wallicianum* have been used in many medicines including eye trouble, mouth ulceration, toothache, diarrhea etc. Therefore, the present study was undertaken to investigate the antibacterial activity of medicinally important plant. The experimental design was split block RCD. The experiment comprised of four concentrations of different solvent extracts. The extraction of plant was done by maceration method in various polar and non- polar solvent i.e Petroleum ether, chloroform, methanol, distilled water and their concentrations were prepared in a series of 30%, 50%, 70% and 100%. Well diffusion method was used for this purpose. The zones of inhibitions were measured against these strains and results were compared with commercially available standard antimicrobial discs. Fucanazole used as standard to determine the maximum inhibitory zone. All the concentrations were run through experiment and later on their combinations were prepared by selecting best results. In case of *Brucella* sp, 50% distilled water extract showed the maximum value of zone of inhibition i.e. 56.5+21.9^a. The maximum value of zone of inhibition was due to the presence of secondary metabolites like alkaloids and tannins that have antibiotic potential.

Key words: Antimicrobial, Cold maceration, Phytochemical constituents

**ASSOCIATION BETWEEN DRD2 GENE POLYMORPHISM AND AGGRESSION
AMONG CONVICTED PRISONERS**

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ABSTRACT

There is an alarming rise of aggression among Pakistani population, especially among teenage. There are various neurotransmitters which are responsible for extreme aggressive behavior. Dopamine receptors have vital role in behavior. Dopamine receptors polymorphism is association with aggressive and violent behavior in man. D2 receptor (DRD2) polymorphisms were examined in convicted persons (n= 10) and normal (n= 10) human samples. Our preliminary results suggest that three polymorphisms in DRD2 are associated with childhood aggression. Future studies are required to replicate the current results and to further explore the relationship between the dopamine system and aggressive behavior in prisoners.

**GENETIC CHARACTERIZATION OF PAKISTANI PIGEONS USING
MITOCHONDRIAL GENE**

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ABSTRACT

Birds are significant component of an ecosystem and play an integral role in maintenance of an ecosystem. Many birds are of economic importance as they are source of food and their guano used as fertilizer. In Pakistan there is diversified array of avian fauna. Pigeons are most common striking feature of the avian pool of Pakistan with significant usage. Conventionally they have been characterized only on the basis of phenotypic and physical characteristics. Present study has been designed to characterize them more authentically on the basis of mitochondrial molecular markers to know more about the evolutionary relationship among local and with the avian fauna of other regions of the World. Mitochondrial *Cytb* gene was partially amplified and sequenced of 25 Dab Walay pigeons. Unique SNPs were found in their haplotypes which could be used as molecular markers for their identifications.

ROLE OF MITOCHONDRIAL *ND2* GENE IN IDENTIFICATION OF AVIAN SPECIES

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ABSTRACT

Pakistan is bestowed with the diversified avifauna due to wide range of habitats and climatic conditions. Among the avifauna of Pakistan, birds of prey are the most diversified forms on the planet. Birds of prey or raptors include familiar birds such as hawks, eagles, kites, falcons, vultures etc. But there is very less data available about the taxonomic characterization and evolutionary relationship. The morphological identification systems are not considered much reliable. The current study was designed to genetically characterize the birds of prey belonging to two broad families; *Accipitridae* and *Falconidae*, through the analysis of mitochondrial *ND2* gene. The partial sequence of *ND2* gene was amplified and sequenced. The novel SNPs were found at various positions in different raptorial species. Phylogenetic analysis depict that there is more diversity among the members of family *Accipitridae* whereas the members of family *Falconidae* are more closely related. The sequence of *ND2* gene can serve as identification marker for other avian species which can lead to better conservation planning of endangered species of birds.

EVALUATION OF ANTIOXIDANT ACTIVITY OF TRACHYSPERMUM AMMI L. SPRAGUE

H. M. Tanveer, Z. Yousaf*, A. Aftab, Z. Razzaq, F. Khan, A. Younas, N. Riaz, A. A. Chahel,
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ABSTRACT

Phytochemicals are very good source of antioxidants. Natural antioxidants are more effective and they have no side effects of them. Due to the deficiency of antioxidants many diseases are caused e.g. skin diseases and internal diseases. The drugs although cure the problem but with a lot of side effects. Herbal treatment shall be used instead of drugs. Therefore present investigation was done to explore antioxidant potential of *Trachyspermum ammi* L. Sprague. Experimental design for this study was split Block RCBD (Randomized complete block design). The plant was extracted by the cold maceration method in both polar and non-polar solvents i.e. petroleum ether, methanol, distilled water and chloroform in a series of 30%, 50%, 70% and 100% v/v concentrations. Antioxidant evaluation was done through DPPH Radical Scavenging Assay and Total Phenolic Content (TPC) Assay. Among all the extracts of *T. ammi*, 30% petroleum ether conc. v/v i.e. 0.66 ± 0.02^d was nearest to the DPPH activity of the standard BHT. Hence, the concentration of 30% Petroleum ether extract was highly active antioxidant. 70% distilled water concentration i.e. 0.33 ± 0.01^d showed the least DPPH activity. While maximum percentage scavenging activity was showed by 100% chloroform extract i.e. 88 ± 1^a which was equal to the DPPH activity of α -tocopherol, 88%. While least activity was showed by 100% methanolic extract i.e. 24.8 ± 0.1^c . Whereas, highest TPC value was showed by 30% distilled water extract i.e. 156 ± 2^a and the least TPC value was showed by 70% petroleum ether i.e. 0.17 ± 1.15^b . The extracts showing the best results can be recommended as best antioxidant agents.

Keywords: Phytochemicals, Antioxidants, Polar solvent, Non-polar solvent, Cold maceration, Concentrations, Radical Scavenging, Total Phenolic Content

**GREEN BIOSYNTHESIS AND CHARACTERIZATION OF SILVER NANOPARTICLES
FROM CALLUS EXTRACT OF *RAPHANUS SATIVUS* L,**

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ABSTRACT

The present study was design to produce nanoparticles from callus of *Raphanus sativus* using different explant (leaf and node). This plant belongs to the family Brassicaceae and is used worldwide as a vegetable, animal fodder, and for various oil productions. Different Plant Growth Regulators were used (separate and combination) including 2,4-D and BAP. The physical and chemical factor were optimized best at pH 5.7, Temperature 25°C, photoperiod 16 hours and best concentration of sucrose 30g/L in solid medium. The best percentage of callogenesis (90%) was obtained with combination of 3.5mg/l 2,4 D and 3.5mg/l BAP. For making a comparison for *in vivo* and *in vitro* Silver nanoparticle, the leaves & callus of *Raphanus sativus* were used for their biosynthesis. Two solvents were used (Water and Ethanol). The best nanoparticles were obtained from water with AgNO₃ by the callus of *Raphanus sativus*. The characterization and evaluation of Prepared Nano particle were done by FTIR and UV Spectroscopy for confirmation. The UV-Vis spectroscopy results showed that the Absorption Spectra of Silver Nanoparticles from leaf and callus extracts had absorbance peak range of 300 nm and 600 nm respectively. The FTIR results of Silver Nano particle showed the presence of some important biomolecules in callus extracts that act as reducing and capping agent. This work is the first report on synthesis of silver nanoparticles from *Raphanus sativus* calli. This study may help to improve callogenesis from protocols and nanoparticles formation.

**PHYTOCHEMICAL ANALYSIS OF COMMERCIALY AVAILABLE VARIETIES OF
RAPHANUS SATIVUS L.**

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ABSTRACT

Red radish with peel contained comparatively more phytochemicals i.e. saponins, alkaloids, quinones, anthocyanins, sterols, flavonoids, glycosides, terpenoids, tannins and carbohydrates than red radish without peel and white radish (with and without peel). White radish with peel and without peel contained highest content of ascorbic acid 1.412g/100ml, while red radish with peel and without peel contained less amount of ascorbic acid i.e. 0.915g/100ml and 1.3737g g/100ml respectively. Titratable acidity was measured by acid base titration, red radish with peel contained highest amount of titratable acidity i.e. 0.4%, while white and red radish without peel had 0.2% acidity whereas white radish with peel was 0.1% acidic. Antioxidant activity was measured at 517nm with UV-visible spectrophotometer and it was measured by DPPH (full name) antioxidant radical scavenging assay. In white radish with peel the antioxidant absorbance value was 51%, in white radish without peel the absorbance value was 44%, in red radish with peel the absorbance value was 50% and in red radish without peel the absorbance value was 45%. Reducing sugars were estimated by Benedict's test. Large amount of sugars were present in red radish with peel and its amount ranged from 2 to 2.5% while white radish with peel contained moderate amount of sugars i.e. 1.5 to 2%. While white and red radish without peel contained low amount of sugars i.e. 0.1 to 0.5%. Red radish with peel had maximum amount of titratable acidity and white radish with peel had maximum antioxidant value which further enhanced its importance and nutritional value as fresh vegetable.

PAKISTAN'S ENERGY CRISIS: IN FACE OF GLOBAL ENVIRONMENTAL PLEDGES & NATIONAL COMMITMENTS

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ABSTRACT

In wake of recent international and national commitments, Pakistan is bound to shift its development on the sustainable trajectory. One of the common goals of the UNFCCC and Kyoto Protocol- Paris Agreement, Sustainable Development Goals (2030), Pakistan Vision-2025, Pak Energy Vision-2035, and National Power Policy (2013) is the achievement of a long-term, modern, efficient, reliable, affordable energy supply. This cannot be realized without considering the energy sector which is backbone of economy and unfortunately the major contributor to Pakistan's GHG emissions. Hence, this study reviewed the energy sector of Pakistan with the aim to explore its potential to achieve sustainable development. For this purpose, an extensive policy review was carried out to determine the underlying problems of the prevailing energy crisis. It was found that the global pledges have not only triggered socio-environmental consciousness but also vowed for reduction of carbon foot print through cleaner technologies, expansion of carbon markets and less fossil dependency. Although financial and technical support is provided through Global Environment Facility, Clean Development Mechanism, Green Climate Fund etc, however, these opportunities could not be fully utilized due to capacity issues. The China Pakistan Economic Corridor is also envisioned to bring energy-prosperity in the region. To realize its benefits, there is need to devise a rational integrated energy plan which must address all aspects of sustainability. Such energy system is indispensable in view of existing energy crisis and recent global initiatives that impose bigger challenge to Pakistan.

WATER AND ENERGY CRISIS IN PAKISTAN

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ABSTRACT

Humans have always fought for control over water in the past and its eventual scarcity in future is likely to start major conflicts and wars among nations. Availability of water is rapidly reducing with time. Neighboring countries like USA and Mexico demonstrated during the 1960's that mutual sharing of water can bring revolution in irrigated agriculture and boost their economies if sanity and perseverance prevails in the leaderships, but this did not happen in case of Pakistan and India. Pakistan in 1947 inherited with its creation major trans-boundary water issues which resulted in signing of Indus Water Treaty of 1960. An era of studies and construction of new waterways started with it and Pakistan was somehow successful in catering for its water needs at that time but with the rise in population and delay in construction of new water reservoirs after Mangla and Tarbela, a major water crisis coupled with energy is in the genesis. Hydropower is integrated with the water sector projects. Most of the large dams serve the multiple purposes of water storage as well as power generation. The planning and ranking of projects should therefore address both needs of the country. Report on land and water development in the Indus plain by white house, department of interior, USA (1964) Dr. Roger Revelle says, "We are convinced that within a generation West Pakistan's agriculture can undergo a revolution of the kind already occurring in Japan, the United States, and other advanced countries. A rate of increase can be established and maintained which will far outrun the growth of population and will so improve the economic condition". The potential can only be utilized to its maximum through an integrated approach towards water resources development. Pakistan should build at least one reservoir for storage of about 6 MAF every decade in the foreseeable future which will also enhance the agriculture yields in Pakistan which are quite lower than those achieved by some other countries. Present crop water requirements especially for wheat, sugarcane and rice are inappropriate. The potential can only be utilized to its maximum through an integrated approach towards water resources development. Pakistan should build at least one reservoir for storage of about 6 MAF every decade in the foreseeable future. The priority should be given to the construction of Diamer-Basha and Munda dams as well as Dasu hydropower project and make targeted efforts to build consensus on Kalabagh dam. Planning should start to build carry over reservoirs. Water conservation measures need to be adopted through the use of high efficiency irrigation systems. Using improved agricultural practices increase the rate of agricultural produce which should outrun the growth of population. Country-wide studies to define the specific crop water requirements of lands in various districts in the country should be carried out. Judicious use of groundwater should be ensured by urgently adopting strict regulation measures. Water conservation measures need to be adopted through the use of high efficiency irrigation systems. Using improved agricultural practices increase the rate of agricultural produce which should outrun the growth of population. Country-wide studies to define the specific crop water requirements of lands in various districts in the country should be carried out. Judicious use of groundwater should be ensured by urgently adopting strict regulation measures. Numerous reports on planning and development of water as well as energy resources are available which are never consulted at the time of planning. Now its time to act and practical approach should be adopted to curtail our water as well as energy situation prevalent in our country.

POLYCYSTIC OVARIAN SYNDROME AN EMERGING HEALTH ISSUE IN RELATION TO PREVAILING ENVIRONMENT –A CROSS-SECTIONAL STUDY

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ABSTRACT

Polycystic ovarian syndrome (PCOS) is an emerging endocrinal disorder that affects the reproductive health of human females. PCOs is considered as a multifactorial disorder caused by both genetic and environmental factors. This study aimed to assess the role of environmental conditions such as; eating and behavioural patterns in the development of PCOS patients in Lahore District, Pakistan. This knowledge, attitude and practices study was based on questionnaire design to get information about PCOS from patients (n = 56), general physician (n = 25) and doctors (n = 100). Respondents of the survey, grouped into five classes and maximum patients belonged to age class ranging from 15-24 years. About 75% respondents were belonging to urban areas and its environment. More than 60% patients were consuming meat, plastic packed and junk food consumed more than thrice a week. Among the awareness level of the public, 25% have knowledge about the PCOS, whereas, 75 did not know about this syndrome. Most of the people feel hesitation in sharing and discussing their PCOS problem and onset of behavioural changes. General physician experiences about the PCOS patients, less than 25% patients consult them when they suffer from the syndrome at an early stage. This syndrome has generally occurred in those individuals having abnormal eating habits, sedentary lifestyle and environmental factors. The present study highlighted that poor dietary consumptions, environmental conditions and lifestyle play an important role in the spreading of PCOS. In Pakistan, there is a lack of awareness about the PCOS despite of its high prevalence. There is a dire need to create awareness about this syndrome and explore the impacts of modern chemicals and their management.

Keywords: Modern lifestyle, xenobiotic compounds endocrinal disrupters, pollution, awareness

EVALUATION OF GROUNDWATER RECHARGE CAPACITY THROUGH AN INVERT WELLS IN LAHORE CITY

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ABSTRACT

In Lahore city; due to rapid urbanization and high population growth rate, water demand has drastically increased for domestic, industrial and horticulture sectors. The water supply of the city is solely dependent on groundwater. The extensive extraction has resulted in the depletion of groundwater. The water-table depth varies from 17 to 42 m in the city. The water level in the city is decreasing at average rate of 0.92 m per annum (WASA Sources). Pakistan Council of Research in Water Resources (PCRWR) has installed an observation well in its office at Raiwind Road, Lahore and monitoring the water-table depth since 2004. Over the period of 12 years, water level has dropped about 9 m. The indiscriminate use of groundwater has resulted in groundwater depletion in many parts of the Pakistan, which accelerates the saline-water intrusion from the adjoining as well as from the underlying saline areas. In many parts of the world, rainwater is used to deal with water scarcity. Rainwater is an important source of recharging the groundwater aquifer. However, in Pakistan during rainy season huge amounts of fresh water is diverted into the drains where it mixes with the sewage. At many places, rainwater stays for considerable time and becomes a breeding ground for mosquitos resulting in outbreak of diseases. Recharge of aquifer through an inverted well is the most appropriate option of artificial recharge for industrial and urban areas, as it requires less space for whole system. PCRWR has installed six invert wells in Lahore city for groundwater recharge. Out of which, three boreholes were selected for this study to test the Recharge Capacity (RC) by putting water with water booster. It was obvious that the invert wells installed in rich aquifer with filter depth of 16 m accepted to downturn the water at average rate of 35 m³/hour. While Estimated Recharge Capacity (ERC) is nearly 70 m³/hour. This ERC is calculated from an equation $Q_r = 68 r \cdot h$ driven from Darcy law $Q_r = K 2\pi r h \frac{H}{L}$. Cumulative recharge of three wells was 1500 m³ from the total rainfall of 650 mm during the period of June 2017 to July 2018 with the catchment area of 5000 m². It is approaching that study will offer considerable aid in sustenance and managing of groundwater resources in Lahore city.

Key Words: Recharge wells, Recharge capacity, Drawdown, Urban runoff, Rainfall.

STAPH AND E. COLI ARE THE MAJOR PATHOGENS OF MASTITIS IN BUFFALOS

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ABSTRACT

Buffaloes play important role in the economy of country through milk production. Mastitis is a main barrier in the milk production in dairy sector of Pakistan. The aim of this study was to identify the number of cases of mastitis in study area, optimization of PCR for immediate detection of main bacterial pathogens of mastitis, comparison of efficacy of culture method and Polymerase chain reaction. We also aimed to conclude the efficacy of different antibiotic against isolated bacteria and studied the gross and histopathological lesions. For this purpose 100 udder parenchyma tissue sample of slaughtered buffaloes were collected at Lahore abattoir on the basis of sign and symptoms of clinical mastitis. The microbiological analysis, culture method showed staphylococcus aureus as a major pathogen (24%), followed by E. coli (21%) and mixed infection (9%). Cultural identification of major pathogen was confirmed by PCR. Histopathological results in the current study showed epithelial degeneration and necrosis, exudation, proliferation of connective tissue, fragmented alveoli, hyperemia, congestion, atrophied alveoli, infiltration of neutrophil and fibrosis. Antimicrobial sensitivity test showed major pathogens were highly sensitive to cefoperazone with sulbactam (90%) and amikacin (42%), but were highly resistant to erythromycin and penicillin (100%). It concludes S. aureus and E. coli are major cause of mastitis and are responsible for various histopathological changes. The major pathogens showed variable rate of sensitivity to different antibiotics disc. These findings help to understand the pathological significance of mastitis, prevention of drug resistance, control and treatment of mastitis.

Keywords: Buffaloes, mastitis, isolation, molecular identification, histopathology, antimicrobial sensitivity

FEASIBILITY STUDY FOR A HYBRID MICRO-CHP SYSTEM UTILIZING BIOMASS GASIFICATION AND AN EVACUATED TUBE COLLECTOR WITH PARABOLIC CONCENTRATORS FOR OFF-GRID COMMUNITIES IN PAKISTAN

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ABSTRACT

This study investigates the financial feasibility of a hybrid micro scaled combined heat and power system. The hybrid system comprises of a solar thermal module in the form an evacuated tube collector with parabolic concentrators and a combustion module in the form of a biomass gasifier. This hybrid setup has been developed for off-grid areas in Pakistan as an answer to all their energy needs. The system offers both electrical and heat outputs since it offers cogeneration. The electrical load is extracted from a gas generator and the heating load is extracted as hot water. RetScreen4 has been used to evaluate payback period for the system. The analysis encompasses payback simulations for a variety of financial parameters such as inflation rate, biomass fuel cost, initial costs and O&M costs. This characterization hopes to shed light on the changes in the feasibility of the system if during its lifespan there is a change in the financial setting of the end user.

Keywords: Hybrid system, combined heat and power, payback period, RetScreen4

**ELECTRICITY CONSUMPTION MODELLING IN INDUSTRIAL AND COMMERCIAL
SECTOR OF ISLAMABAD AND RAWALPINDI**

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ABSTRACT

Electricity has been the major issue in Pakistan for last 2 decades and the industrial and commercial sectors have suffered the most from all the energy conundrum. The primary purpose of this study is to understand the nature of electricity consumption modelling in the industrial as well as commercial sector of Islamabad and Rawalpindi. This study will emphasize the electricity modeling of industrial sector of Islamabad and Rawalpindi using Long range energy alternative planning (LEAP). LEAP is an effective tool that is used for modelling over the long span of time. Electricity consumption demand is observed and multiple scenarios have been discussed over the span of 30 years and the result of these scenarios led us to formulate a strategy towards the effective energy policy. These scenarios compelled us to understand the future concerns that could help formulate policies for sustainable development in industrial and commercial sector of Islamabad and Rawalpindi.

Keywords: LEAP, Energy modelling, Electricity consumption, sector based analysis

MINIMIZATION OF ENERGY CRISIS BY INTRODUCING RANGE EXTENDER IN ELECTRIC VEHICLES – EVALUATION OF BATTERY PACK SIZING AND ENGINE OPTIMIZATION

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ABSTRACT

Fossil fuel consumption has been increased rapidly from last couple of decades. It is increasing import of crude oil and air pollution. Pakistan facing energy crisis due to high utilization of burning fuel on national level which has gained prime attention for industries as well as consumers. Individual user is facing fuel cost management issues as fuel prices getting increased. Leaving us behind with an option to think of electric vehicles. Pakistan has been started to import hybrid vehicles on big scale but it is not enough to support everyone's needs. A kind of electric vehicle I known as Range Extended Electric Vehicles (REEV) which works with an on board charging device to increase the driving range. The most commonly used range extenders are internal combustion (IC) engines, fuel-cells, and micro gas turbines (MGT). Range extenders based on micro gas turbine (MGT) technology are being promoted in electric vehicles (EV) in order to reduce the battery size and extend the driving range. MGT offers higher power density, fuel flexibility, lower weight and good efficiency (with recuperation) compared to conventional reciprocating engines. MGT facilitates a relatively smaller battery pack, which ultimately can reduce the capital and maintenance cost of electric vehicles. Despite its advantages, MGT incurs small-scale design issues related to component performance, heat transfer between hot and cold sections and manufacturing limitations. In this paper, the design of an MGT has been studied simultaneously with the battery bank size and charging time analogy with an aim to evaluate their conjoint operation. In addition, the influence of MGT small-scale effects on battery pack recharging has been presented. For the study, Gas Turbine Simulation Program (GSP) has been extensively used together with detailed battery pack calculations. Comparison between sizing of the battery and MGT design is a critical outcome of this research.

Keywords: micro gas turbine (MGT), electric vehicles, on-board charging device, driving range, range extender, Gas Turbine Simulation (GSP).

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Prof. Dr. Niaz Ahmad Akhtar, Vice Chancellor, University of the Punjab, Lahore and Prof. Dr. Sajid Rashid Ahmad, Principal CEES, Lahore are receiving General President, Dr. Muhammad Arshad, Pakistan Association for the Advancement of Science and Prof. Dr. Muhammad Saleem Chaudhary, the General Secretary, Pakistan Association for the Advancement of Science.



Dr. Muhammad Azam Kasi, Prof. Dr. Niaz Ahmad Akhtar, The Chief Guest Engr. Chaudhry Ijaz Ahmad, Dr. Muhammad Arshad, Prof. Dr. Sajid Rashid Ahmad are standing in respect of the National Anthem.



The participants standing in respect of the National Anthem during the Inaugural ceremony.



Dr. Muhammad Arshad The General President, of the Association presenting his Presidential Address.



A View of the Eminent Scientists participating in the 38th all Pakistan Science Conference.



The host Prof. Dr. Niaz Ahmad Akhtar, Vice Chancellor, University of the Punjab is presenting his welcome address to the participants.



Prof. Dr. Muhammad Saleem Chaudhary, the General Secretary conferring a report regarding activities of the Association.



The Chief Guest, Engr. Chaudhry Ijaz Ahmad And Prof Dr. Sajid Rashid Ahmad, Principal, CEES, Lahore are presenting a Souvenir to Prof. Dr. Muhammad Saleem Chaudhary, the General Secretary Pakistan Association for the Advancement of Science.



The Chief Guest, Engr. Chaudhry Ijaz Ahmad is receiving a Souvenir from Prof. Dr. Muhammad Saleem Chaudhary, the General Secretary, Pakistan Association for the Advancement of Science.



The Honorable Chief Guest presenting the Souvenir to Prof. Dr. Sajid Rashid Ahmad, Principal, CEES, University of the Punjab, Lahore.



The Honorable chief guest Main Khalid Mehmood, the Provincial Minister for Disaster Management, is receiving a Souvenir from Prof. Dr. Sajid Rashid Ahmad, Principal, CEES, University of the Punjab, Lahore.



The Honorable Chief Guest presenting the Souvenir to Prof. Dr. Shahid Munir, the Vice Chancellor, University of Engineering and Technology, Jhang.



The honorable Chief Guest Engr. Chaudhry Ijaz Ahmad, Additional General Secretary, PTI, Pakistan is presenting his thought provoking address to the participants.



Prof. Dr. Sajid Rashid Ahmad, Principal, CEES, Lahore presenting a vote of thanks to the participants of the Conference.