

InfoSCIENCE

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... the science information



1970 to 2020 *Golden Jubilee*

Shri R.L.T. College of Science, Akola

Shri R.L.T. College of Science, Akola

Message ...



Shri Radhakisan Laxminarayan Toshniwal College of Science, Akola; established on 1st April 1970, today symbolizes commitment to the attainment of all-round educational excellence. Being the student of 1st batch of B.Sc. Part-I of this college and now the President of the Berar General Education Society, Akola, the “Golden Jubilee” of the college is therefore, an occasion of proud and joy for me.

Every milestone in the history of any institution is an occasion for looking back and forward. Looking back for all that has been achieved and looking forward to face the challenging task ahead. In the span of 50 years, the college has supported its students and staff by providing them all possible opportunities and the challenges. All these have enabled them to inculcate values of commitment and service together with a sharp intellect honed, knowledge and understanding. As I look ahead, I can visualize that the college will grow in pursuit of higher standards of teaching, learning and research. It will continue to serve a significant role in education and in the service of the country. I convey my felicitations and best wishes to all those of the present and the past who have contributed to the progress of the college in last 50 years.

On this occasion, I congratulate the editorial board of science magazine for its tireless efforts in bringing out this publication of 2nd issue of 1st volume of *infoSCIENCE*.

Dr. Rajkumar B. Heda

President

The Berar General Education Society, Akola

Message ...



On the occasion of “Golden Jubilee” of Shri Radhakisan Laxminarayan Toshniwal College of Science, Akola, I am happy and proud to greet you through this message. Shri R.L.T. College of Science, Akola run by the Berar General Education Society, Akola was established on 1st April 1970 with the aim of providing quality science education, on par with national and international standards.

The college, in its pursuit of excellence, persistently seeks and adopts innovative methods to improve the quality education. The benchmarks, the college set for itself in the field of teaching, learning and research, propel the 50 years of journey towards excellence. The dedicated, well experienced and learned teachers nurture the talents of the students. In 50 years, the college has become a leading educational institution in Maharashtra by its meritorious performance, academic excellence and research attitude. I take this opportunity to congratulate all the stakeholders who have contributed in many ways to the development of the college.

At this juncture, I congratulate the entire team of editorial board of science magazine for its dedicated work and sincere efforts that has resulted in the publication of 2nd issue of 1st volume of *infoSCIENCE*. I am sure that the *infoSCIENCE* will amply support the contribution of college in the field of teaching, learning and research.

Adv. Motisingh G. Mohta

Hon. Secretary

The Berar General Education Society, Akola

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Editorial ...

On the occasion of "Golden Jubilee"; 50 years of establishment of Shri Radhakisan Laxminarayan Toshniwal College of Science, Akola, we are extremely happy to publish the 2nd issue of 1st volume of science magazine... *infoSCIENCE* incorporated with different scientific and research articles in the field of science and technology.

We cordially thank our patrons, honorable executive members of the Berar General Education Society, Akola and principal, advisors, teaching, non-teaching staff members, students for their kind support towards this scientific project. We are also thankful to all the authors of articles published in this issue. Editors extend their best wishes to all the readers and contributors of *infoSCIENCE*.

Editors, *infoSCIENCE*



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Effect of *Moringa oleifera* Seed as Natural Coagulant for Purification and Treatment of Water

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The M. oleifera is an environment-friendly and found to be most suitable for the purification of the water. It acts as a natural anti-microbial agent against the microorganism present in drinking water. It also reduces the total hardness, turbidity, acidity, alkalinity and chlorides. *M. oleifera* seed powder can be used in the rural areas where no facilities are available for drinking water treatment. The aim of this study is to prepare natural coagulant by using *M. oleifera* seeds and to observe the coagulation activity of natural coagulants against microorganism present in water to assess the water quality on the basis of physical, chemical and bacterial parameters of water sample.

Water is elixir of life. It is polar, cohesive, adhesive surface tension polarity. It is the most abundant inorganic liquid in the world and occurs naturally anywhere on earth. Water is called universal solvent because most of the substances dissolved in water than in any other chemical. Water is a transparent, test less, odorless and nearly colorless and it covers 71% of the earth completely mostly in seas and oceans. Salt water is different from fresh water (Kulkarni, et al., 2016).

Wastes from industry serve as major sources for all water pollutants. Major industries like manufacturing, power generating, mining, construction and food processing have major role in water pollution. Agriculture wastes like pesticides contribute major role in water pollution. Pesticides are widely used in modern agriculture. They are present in surface and underground water bodies and increasing concentration of nitrates in ground water, leading to high nitrate level in underground drinking water sources, which can cause methemoglobinemia. Domestic wastes also serve a major role in water pollution. Many people dumped their garbage into streams, lakes, rivers, and seas. Most detergent and washing powders contain phosphate and other chemical which affect the health of all forms life in the water and human being also (Gambhir et al., 2012).

Water born diseases are caused by contaminated water which contain pathogenic micro-organisms. Many type of organism that may cause water born diseases are protozoa, bacteria, intestinal parasites, viruses. When the contaminated water is consumed by human being it causes ameobiosis, cholera, hepatitis, shigellosis, typhoid etc. In some cases water born diseases simply caused unpleasant symptoms and can be easily treated, however others have been found to be fatal (Henshaw, 2016).

People are using various method for water purification such as ultra violet light, water purifier, chlorination etc. But these methods are expensive and hence many people are not affording these methods. Therefore new methods for purification of water are required. The conventional method of water purification is the use of aluminum sulphate (alum). *M. oleifera* is the best natural coagulant that can replace aluminum sulphate, which widely used as around the world. Drumstick engross over India. When water is turbid we generally boil it. Natural coagulants were extracted from micro-organisms, animals or plants. One of this is *M. oleifera* seeds. Drumstick is one of the useable famous vegetable crops in India. Studies have revealed that the origin of drumstick is India, due to its medicinal uses it has reached to other

countries also. Scientifically, drumstick are called as *M. oleifera*, commonly known Saijan (Hindi), Shevga (Marathi), Murungai (Tamil), Muringnga (Malyalam) and Munagakaya (Telgu) in different Indian languages. Moringa is the genus in the family *moringaceae*. This genus comprises 13 species, all of which are trees that grows in tropical and subtropical climates. It is a native tree of the sub-Himalaya parts of the north-west India, Pakistan and Afghanistan. *Moringa oleifera* is called as multipurpose tree because its lives, pods and flowers are all packed with nutrients for both human and animals. Leaves of *Moringa oleifera* tree are eaten as green salads and used in vegetable curries. The seeds yields 38-40% valuable yellow oil called bin oil. The oil is clear, sweet and odorless. It doesn't spoil easily and hence used in manufacture of perfumes.



Figure : *M. oleifera* seed with seed coating



Figure : *M. oleifera* seed with seed coating

The coagulation mechanisms of the *M. oleifera* coagulant protein have been explained in different ways. It has been

described as adsorption, charge neutralization and inter-particle bridging. The *M. oleifera* coagulant proteins are small size therefore a bridging effect may not be considered as the likely coagulation mechanism. The seed may also act directly upon microorganism and result in growth inhibition antimicrobial peptides are through too act by disrupting the cell membrane or by inhibiting essential enzymes reported that *Moringa* seeds could inhibit the replication of bacteriophages (Mangale et al., 2012).

According to the World Health Organization's 2017 report, safe drinking water is the water that does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages. Safe drinking water is useful for all purposes like domestic and which includes hygiene. Preventive management is the preferred approach to drinking water safety and should take account of the characteristics of the drinking water supply from catchment and source to its use by consumers. The majority of consumers are objectionable that water should be tasteless and odorless.

Mangle, Chonesinal and Raut (2012) worked on *M. oleifera* seed as a natural absorbent and anti-microbial agent for ground water treatment. They studied deals with the suitability of the coagulation-flocculation process using *M. oleifera* seeds as natural absorbent and eco-friendly antimicrobial agent for purification of ground water for drinking purpose. In their study various doses of *M. oleifera* seed powder like 50, 100, 150 mg/lit were taken and checked for the efficiency doses on ground water. After treatment of water sample with *M. oleifera* seed powder were analyzed for different parameters like pH, turbidity, TDS, TS, hardness, chlorides, alkalinity, acidity, MPN and SPC. All parameters were reduced with

increase doses of *M. oleifera* seeds powder except alkalinity and pH.

Therefore this study is aimed at to prepare natural coagulant by using *M. oleifera* seeds and to observe the coagulation activity of natural coagulants against microorganism present in water to assess the water quality on the basis of physical, chemical and bacterial parameters of water sample.

For this study water sample was collected from borewell water in Akola and for preparation of natural coagulant fully matured seed were harvested. The wings and cat from seed are removed; fine powder was prepared and sieved. This powder was used as a coagulant followed by following procedure. The 2 gm seed powder was mixed in 100 ml distilled water to prepare stock solution of coagulant. Mixture was rapidly mixed for 45 min with 120-150 rpm. Then mixture was filtered using filter paper and allowed to settle for 2 hr. Filtered mixture was used for further process and water quality was checked for physico-chemical parameters as per the standard methods given in following table.

Table : Methods used for physico-chemical and biological study of water

| Physical Parameters | Method |
|----------------------|--------------|
| pH | pH meter |
| Turbidity | --- |
| TS | Evaporation |
| TDS | Evaporation |
| Colour | --- |
| Chemical Parameters | Method |
| Acidity | Titration |
| Alkalinity | Titration |
| Chloride | Titration |
| Hardness | Titration |
| Bacterial Parameters | Method |
| SPC/100 ml | Quantitative |
| MPN/100 ml | Quantitative |

Present work was carried out with treatment of *Moringa oleifera* seed

powder with borewell water samples in different concentration. During the analysis, it was observed that after treatment with *Moringa oleifera* seed powder pH was decreased at various doses coagulant as compared to before treated water sample. After treatment the range of pH is 7-7.5 and within the limit. As specified by WHO the recommended acceptable range of pH for drinking water is between 6.0 and 8.0. It is reported that the action of *Moringa oleifera* as a coagulant lies in the presence of water soluble cationic proteins in the seed. It is suggested that in water, the basic amino acids present in the protein of *Moringa oleifera* would accept proton form water resulting in the release of a hydroxyl group making the solution basic.

It was observed that the use of *M. oleifera* seed powder showed decrease in turbidity at 0.0589, 0.0092, 0.0115, 0.0276, and 0.0184 of bore well water with increasing the doses at 1, 2, 4, and 8 mg/l respectively. Due to this there was n improvement in the flock size and flock settled rapidly. The overdosing resulted in the saturation of the polymer bridge sites and caused destabilization of the destabilized particles due to insufficient number of particles to form more inter-particles bridges. The high positive charge and small size suggest that the main destabilization mechanism may could be adsorption and charge neutralization.

After the treatment of *M. oleifera* seed powder, the total solid and total dissolved solid were reduced from borewell water. The range of total solid and total dissolved solid within the limit of WHO standard. *M. oleifera* seed powder showed decrease in TS (2, 1, 1.33, 1.30) and TDS (0.66 1.33 0.33, 0.30) of borewell water with increase in doses of 1, 2, 4, 8 g/l respectively. *M. oleifera* is known to be a natural cationic polyelectrolyte and flocculent with a chemical composition of

basic polypeptide with molecular weights ranging from 6000 to 16000 Daltons, contain upto six amino acids of mainly glutamic acid, methionine and arginine. There is a no color change before treated and after treated water sample.

At various doses of *M. oleifera* it is observed that the acidity decreases (60, 48, 44, 32 g/l) in borewell water with increase

in doses of 1, 2, 4, 8 g/l respectively. Acidity found in the range between 20-60 g/l. because the seed of *M. oleifera* contain lower molecular weight water soluble proteins which carry positive charge. When seeds were crashed and added to water, protein produced positive charge acting like magnets and attracting predominately negatively charged particles.

Table : Parameters studied before and after treatment of borewell water with various doses of *Moringa oleifera* seed powder

| Parameters | Before treatment | After treatment of water sample at various doses of <i>Moringa</i> seed powder | | | | WHO/USPH Standards |
|-------------------|------------------|--|------------------|------------------|-----------------|--------------------|
| | 0 gm/l | 1 gm/l | 2 gm/l | 4 gm/l | 8 gm/l | 6.5-8.5 gm/l |
| pH | 7.5 | 7 | 7.2 | 7 | 7.3 | 5 |
| Turbidity (NTU) | 0.0589 | 0.0092 | 0.0115 | 0.0276 | 0.0184 | --- |
| TS (mg/l) | 7 | 2 | 1.33 | 1 | 1.5 | --- |
| TDS (mg/l) | 5 | 0.66 | 1.33 | 0.33 | 0.30 | 500 |
| Colour (mg/l) | Colourless | | | | | |
| Acidity (mg/l) | 100 | 60 | 48 | 44 | 32 | --- |
| Alkalinity (mg/l) | 3.8 | 3 | 2.4 | 2 | 0.9 | --- |
| Chloride (mg/l) | 133 | 25 | 19 | 13 | 7.9 | 250 |
| Hardness (mg/l) | 6.7 | 2.8 | 1.7 | 2.1 | 1.5 | 500 |
| SPC/100 ml | 35×10^3 | 25×10^3 | 17×10^3 | 11×10^3 | 9×10^3 | --- |
| MPN/100 ml | 1100 | 75 | 3 | 28 | 11 | ---l |

Hardness of before treatment water of borewell was observed to be 5.9 mg/l. It is observed that hardness of borewell water is decreased in value (2.8, 1.7, 2.1, 1.5) with the increasing doses of *M. oleifera* seed powder at 1, 2, 4, and 8 mg/l respectively. Hardness range was 2-3 gm/l and within the limit of WHO standards. As a polyelectrolyte, it may therefore be postulated that *M. oleifera* removes hardness in water through adsorption and inter-particle bridging.

SPC represents the standard plate count of bacteria. The water sample without natural coagulant shows highest count i.e. 277 cfu in 10^{-3} dilution, whereas plates with treated water sample 1, 2, 4, 8 g/l of coagulants shows 198, 103, 78, 30

cfu in 10^{-3} dilution respectively as shown in the figures.

MPN means total coliform which is calculated quantitatively. The presence of coliform indicates water is contaminated with fecal matter and unsafe drinking purpose due to coliform various water born diseases occur and therefore MPN must be nil for drinking water. After treatment MPN/100 ml coliform decreased as increased in concentration of *M. oleifera* seed powder as shown in figures. MPN of before treatment water of borewell was observed to be 1100/100 ml. After treatment the MPN is 75, 3, 28, 11/100 ml with increase in concentration at 1, 2, 4, 8 gm/l respectively as shown in the respective figures.

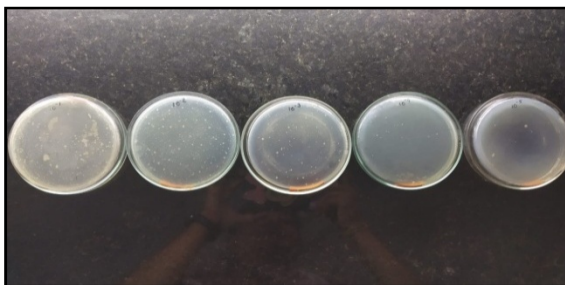


Figure : Result of SPC before addition of coagulant in borewell water sample



Figure : Result of MPN before addition of coagulant in borewell water sample

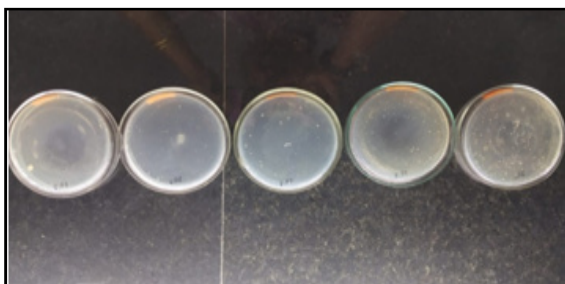


Figure : Result of SPC after addition of 1 gm/l coagulant in borewell water sample

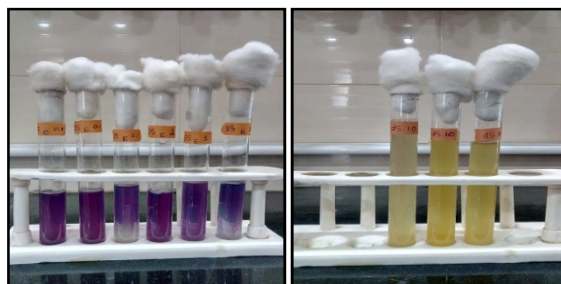


Figure : Result of MPN after addition of 1 gm/l coagulant in borewell water sample

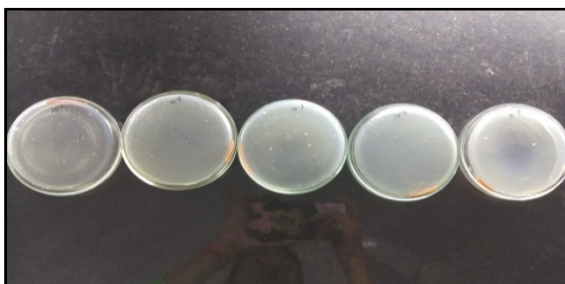


Figure : Result of SPC after addition of 2 gm/l coagulant in borewell water sample

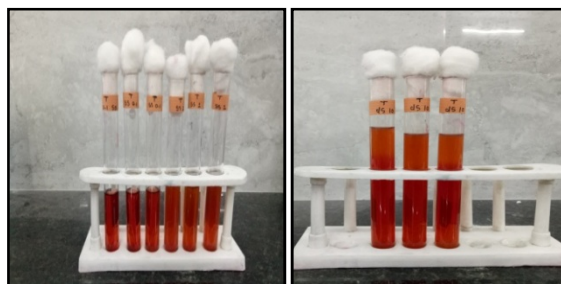


Figure : Result of MPN after addition of 2 gm/l coagulant in borewell water sample

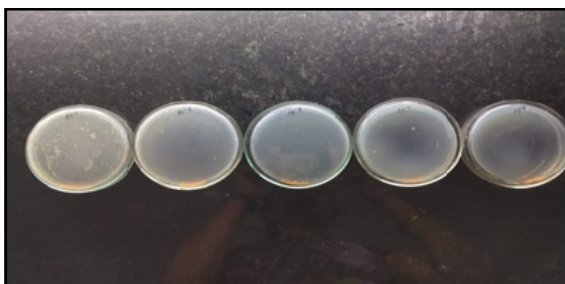


Figure : Result of SPC after addition of 4 gm/l coagulant in borewell water sample

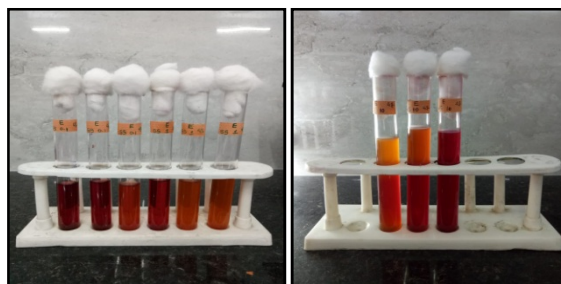


Figure : Result of MPN after addition of 4 gm/l coagulant in borewell water sample

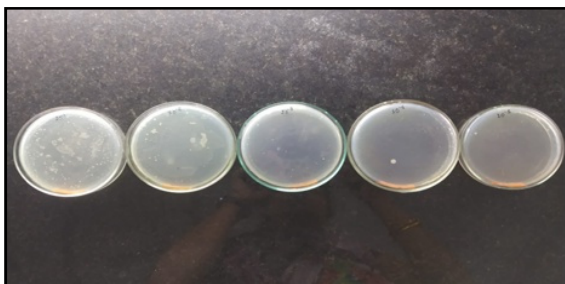


Figure : Result of SPC after addition of 8 gm/l coagulant in borewell water sample

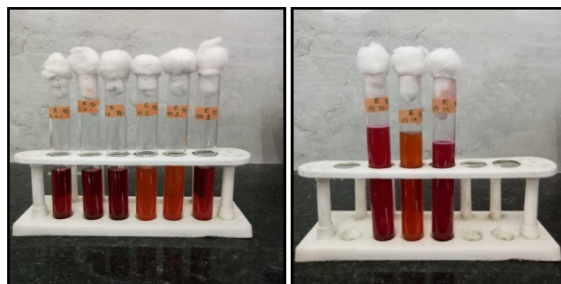


Figure : Result of MPN after addition of 8 gm/l coagulant in borewell water sample

Mangle (2012), carried out the experiment in which M. MPN was reduced after treatment of higher dose of 150 mg/l *M. oleifera*. *M. oleifera* seed act as natural coagulant, flocculent, absorbent for ground water treatment, it reduced total hardness, turbidity, alkalinity, chlorides. In present study *M. oleifera* act as a natural coagulant, flocculants absorbent for the treatment of bore well water. It reduced the total hardness, turbidity, alkalinity, chlorides, MPN and SPC after the treatment of higher doses of 8 gm/l of *M. oleifera*.

Prasad and Rao (2013), carried out the experiment in which various doses of *M. oleifera* seed powder like 50, 100, 150 mg/l taken and checked for the efficiency dose for water sample. The result obtained show that the *M. oleifera* powder contain some coagulating, properties and act as a flocculent absorbent at loading doses 150 mg/l for the treatment of drinking water. In present study, various dose of *M. oleifera* seed powder like 1, 2, 4, 8 gm/l were taken and checked for the efficiency dose for the borewell water. The result showed that the *M. oleifera* powder contain coagulating property at loading doses 8 gm/l.

Fahmi et al. (2011), carried out an experiment in which turbidity and hardness removal in hard water sources by using *M. oleifera*. They use 1, 30, 10 mg/l doses for removal of water turbidity and hardness. They use coagulating mechanism hence hardness and turbidity can be removed. In present study, the hardness and turbidity are reduced in bore well water by the coagulating mechanism using *M. oleifera* seed powder. Doses used to reduce water turbidity and hardness are 1, 2, 4, 8 gm/l.

Conclusion - The quality of water is of vital concern for mankind because it directly linked with human health. Bore well water

is used as a source of water which is considered suitable for drinking purpose. So it is very essential to check its parameters. *M. oleifera* seeds acts as a natural coagulant, flocculent, absorbent for the treatment of borewell water. *M. oleifera* is an environment-friendly and most suitable for the purification of the water it also act as a naturally occurring antimicrobial active agent against the microorganism which is present in drinking water and decrease the number of bacteria. The MPN test had show positive which indicate the fecal contamination and the water is not safe for drinking purpose. MPN is reduced after treatment of higher dose of 8 mg/l of *M. oleifera*. It also reduced the total hardness, turbidity, acidity, alkalinity, chloride.

M. oleifera seed is not giving toxic effect. It is eco-friendly and cheaper method of water treatment *M. oleifera* seed powder can be used in the rural areas where no facilities are available for drinking water treatment.

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Climate Change Disturbing Plant-Animal Relationship

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Higher mean temperatures as associated with climate change can have a severe impact on plants and animals by disrupting their mutually beneficial relationship. In relationship of many plants and their pollinators, it is seen that, there is mismatch in phenological synchrony of both, i.e. plants flowers earlier and pollinating insects' hatches later. In the worst case, this may cause the seed production of the plant to decrease and impair reproduction while requiring the bee to switch to other plants to forage on to compensate for the lack of food supply.

Scientists from the University of Wurzburg studied the impact of temperature on two solitary bee species that emerge in spring and on *Pulsatilla vulgaris*, one of the earliest flowering plants. The scientists were particularly interested in how different temperatures in winter and spring affect the hatching time of European orchard bee (*Osmia cornuta*) and of the red mason bee (*Osmia bicornis*) as well as the onset of flowering in the pasque flower.

The phenological synchrony of the two events, hatching and flowering, is crucial in the life of both plants and bee. But, the pasque flower (*Pulsatilla vulgaris*) is very sensitive to rising temperatures. As the temperature increases the pasque flower starts to flower earlier. The emergence of the solitary bee species lagged somewhat behind. This poses the risk that the first flowers of the pasque flower bloom in the absence of suitable pollinators. As a result, reduce viability and reproductive success could negatively affect the population size and even push a species to extinction in the long run. This temporal mismatch can also endanger the solitary bees due to the reduced availability of nectar and pollen.

Such mismatches due to climate change are also found in relationship of other plants and animals. For herbivorous insects, mismatch may be more prevalent as traditional host plant resources

decrease in availability and nutritional suitability. For example, the comma butterfly (*Polygonia c-album*) altered its host preference from *Humulus lupulus* to *Ulmus glabra*.



Figure : Pasque flower with bee pollinator

The effect of Climate change can also be seen in many other plant-animal relationships. So, we human, being the super species, it's our moral responsibility to concern about the climate change and help plants and animals to maintain their relationship.

Why Bees Matter ?

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This is the beginning of a difficult process of the protection of bees and other pollinators. We must do more than just talk, we should undertake concrete activities to increase care for bees and promote the development of beekeeping, everywhere. 'World Bee Day' presents an opportunity to recognize the role of beekeeping, bees and other pollinators in increasing food security, improving nutrition and fighting hunger as well as in providing key ecosystem services for agriculture.

Tiny miracle workers

Pollination is vital to life on our planet. Bees and other pollinators have thrived for millions of years, ensuring food security and nutrition, and maintaining biodiversity and vibrant ecosystems for plants, humans and the bees themselves. Pollinators are essential to the production of many of the micronutrient rich fruits, vegetables, nuts, seeds and oils we eat. In fact, close to 75 percent of the world's crops producing fruits and seeds for human consumption depend, at least in part, on pollinators for sustained production, yield and quality. The diversity of food available is largely owed to animal pollinators. But alarmingly, in a number of regions, pollination services are showing declining trends. In the past, this service was provided by nature at no apparent cost. As farm fields have become larger, agricultural practices have also changed, focussing on a narrower list of crops and increasing the use of pesticides. Mounting evidence points to these factors as causes to the potentially serious decline in populations of pollinators. The decline is likely to impact the production and costs of vitamin-rich crops like fruits and vegetables, leading to increasingly unbalanced diets and health problems, such as malnutrition and non-communicable diseases. Maintaining and increasing yields in horticultural crops under agricultural development is important to health, nutrition, food security and better incomes for

smallholder farmers. The process of securing effective pollinators to 'service' agricultural fields is proving difficult to engineer, and there is a renewed interest in helping nature provide pollination services through practices that support wild pollinators.



Pollination - Invisible to the eye but yielding great returns in agriculture

Pollination is the highest agricultural contributor to yields worldwide, contributing far beyond any other agricultural management practice. Thus, bees and other pollinators make important contributions to agriculture. Pollinators affect 35 percent of global agricultural land, supporting the production of 87 of the leading food crops worldwide. Plus, pollination-dependent crops are five times more valuable than those that do not need pollination. The volume of agricultural production dependent on pollinators has increased by 300 percent in the last 50 years. These figures reflect the importance that pollinators have in sustaining livelihoods across the planet. Several of the crops produced with pollination, cocoa and

coffee, to name two examples, provide income for farmers, in particular smallholder farmers and family farms, especially in developing countries. Bees can, in a sense, be considered as livestock. With the increasing commercial value of honey, bees are becoming a growing generator of income, livelihood strategy and means of food security for many small-scale producers and forest dwellers in many developing countries. Clearly, the benefits that bees and other small pollinators bring us go beyond human food. Thanks to these pollinators, farm animals have diverse forage sources and hence more flexibility to adapt to an increasingly changing climate. And we also have certain medicines, biofuels, fibres and construction materials. Some species also provide materials such as beeswax for candles and musical instruments. So embedded in our lives, bees and other pollinators have long inspired art, music and even sacred passages.



Figure : Eggs and larvae of bees



Figure : Drones and pupae of bees / adult bee

Threats to pollinators

Bees and other pollinators are under threat. Present species extinction rates are 100 to 1000 times higher than

normal due to human impacts. Insects will likely make up the bulk of future biodiversity loss with 40 percent of invertebrate pollinator species, particularly bees and butterflies, facing extinction. Changes in land use and landscape structure, intensive agricultural practices, monocultures and use of pesticides have led to large-scale losses, fragmentation and degradation of their habitats. Pests and diseases resulting from reduced resistance of bee colonies and from globalization, which facilitates the transmission of pests and diseases over long distances, pose a special threat. Furthermore, climate change also has a negative impact. Higher temperatures, droughts, floods, other extreme climate events and changes of flowering time hinder pollination largely by desynchronizing the demand (flowers in bloom) with the supply of service providers (abundant and diverse populations of pollinators).

Promoting pollinator conservation and management

FAO (Food and Agricultural Organization of United Nations) carries out various activities to encourage pollinator-friendly practices in agricultural management. It provides technical assistance to countries on issues ranging from queen breeding to artificial insemination to sustainable solutions for honey production and export marketing. The global action on pollination services for sustainable agriculture provides valuable information, helping farmers, farm advisors and land managers better understand the pollination needs of specific crops. It will include a global monitoring system that captures the diversity of domesticated honeybees, including data about products and services as well as the main threats and challenges that honeybees face. The International Pollinators Initiative 2.0, coordinated by FAO, promotes coordinated worldwide action to monitor pollinator

decline, identify practices and build capacity in the management of pollination services for sustainable agriculture and improve food security, nutrition and livelihoods.

Importance of celebrating world bee day

Observing 'World Bee Day' on 20 May each year will draw attention to the essential role bees and other pollinators play in keeping people and the planet healthy. It provides an opportunity for governments, organizations, civil society and concerned citizens everywhere to promote actions that will protect and enhance pollinators and their habitats, improve their abundance and diversity, and support the sustainable development of beekeeping. The date for this observance was chosen as it was the day *Anton Jansa*, a pioneer of modern apiculture, was born. *Jansa* came from a family of beekeepers in

Slovenia, where beekeeping is an important agricultural activity with a long-standing tradition. The proposal set forth by the Republic of Slovenia, the International Federation of Beekeepers' Associations and FAO, to celebrate 'World Bee Day' on 20 May each year met with approval by the United Nations General Assembly in 2017. 'World Bee Day' intends to shine a light on the importance of pollinators to improve the conditions for their survival so that bees and other pollinators may thrive.



Save Bees, Save Nature, Promote Bee Pollination

Impact of Water Scarcity on Education and Health

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For many people water never has been a big story in their lives. Why? Because they live in society that have sufficient water supply system. They turn on the tap and clean water flows, every day of the year. This makes it very difficult for people to appreciate how precious water is. Water is a life. All living things are depends on it. Besides this, it is used in moving waste, cleaning and sanitation, agriculture, construction and industries. Almost every human activity you can think of involves some use of water.

Water covers more than 70% of the earth's surface, so how can there ever be scarcity?

We are learning from childhood that Earth is the 'Blue Planet' having around 75% of the world's surface covered by water. But only 2.5% of the water is freshwater. From that small percentage of freshwater 30.1% of this is found in groundwater deep below in earth surface and remaining 68.6% of all available freshwater is stored in glaciers and polar caps. Finally leaves only 1.3% of the total freshwater on earth as surface water in sources like rivers, lakes and streams. But is it sufficient that living things rely on for their biological needs? Anthropogenic water consumption results in mean annual runoff decreases by about 5% or more in many river basins during control period (1971-2000).

But why should we care?

We should care because lots of factors that cause water scarcity are becoming more complex and uncontrollable. This means if we do nothing in terms of preserving and using it wisely, it is only a matter of time that all regions shall begin to experience water crisis. According to a report released by WWF (World Wildlife Fund), about 1.1 billion people face water shortage in the world. The report also indicates that 2.7 billion people experience the problem of water shortage in at least one month every year. This implies that the water scarcity

problem affects around 27% of the world population. With worldwide population increasing at a rate of 1.13% (80 billion people) every year, nation needs to take action to solve a problem which will only worsen.

Backlashes of water scarcity in education

An investment in a child's education is an investment in our future. However millions of families around the world don't have upfront resources to invest in two of the most critical resources for getting their kids to school safe water and toilet at home. When they don't have access to water at home, children are often responsible for collecting it for their families. Sharing the burden with their mothers, children around the globe spend 200 million hours each day collecting water. This takes time away from school. Likewise, poor sanitation keeps kids, especially girls, from being unable to go to school. Girls who lack access to safe water and sanitation at home or at school face significant challenges. Their safety and health are at risk when they have no choice but to defecate in the open. Menstruation poses another reason why girls in impoverished, water-insecure communities do not go to school. Access to water and sanitation changes this. Further on global scale for every year a girl stays in school, her income can increase by 15-25%. Of 104 million children absent from school, 65 million are girls. According to a study conducted in Tanzania, by reducing the

time it takes to collect water by a mere 15 minutes, communities can help increase girls classroom attendance by 12%. This is a concrete solution to help combat poverty, particularly because young, educated woman are less likely to get married against their will and has less probability to die because of a complicated birth. Furthermore, the probability that these young educated women give birth to healthy babies is much higher. As they know the value of education they more likely to send their children to schools. Finally, women who were able to attend school actively participate in a community's social, economic and political spheres. And these women earn higher salaries and are more productive. The number says: In case of women the life expectancy at birth increases by 10% by increasing the literacy rates by 10%. Providing quality water and education gives more opportunities, which have a positive impact on their families and communities.

- **Facts**

- ✓ 31% of schools lack access to safe water and adequate sanitation globally (*JMP, 2015 Update and MDG Assessment*).
- ✓ 1 in 4 girls do not complete primary school (compared to 1 in 7 boys) (*UNICEF, Advancing WASH in Schools Monitoring, 2015*).
- ✓ 15% increase in female enrolment when provided with clean water (*UNICEF, Advancing WASH in Schools Monitoring, 2015*).
- ✓ By reducing the time it takes to collect water by a mere 15 minutes, communities can help increase girls classroom attendance by 12%.
- ✓ 570 M children lacking basic drinking water at their schools.

Backlashes of water scarcity in health

A lack of access to safe water or sanitation contributes to the spread of

water borne diseases and lots of infections, killing nearly 1 million people each year. It also affects the physical fitness of women and children who have no choice but to carry heavy pots from long distances. More risk for the pregnant women and their unborn babies. Around 2.3 billion people don't have a toilet and 844 million people lack access to safe water globally. Safe and clean drinking water is necessary to the development of a healthy child. It leads to decrease in water borne illness like typhoid and Diarrhoea. Diarrhoea is one of the top three leading causes of child death and this is often triggered from consuming unclean water. It is reported that 88% of diarrhoeal deaths are due to lack of access to sanitation facilities, together with inadequate availability of water for hygiene and unsafe drinking water. Further, every 2 minutes a child dies from a water-borne disease. Whether they are consuming contaminated water or suffering from dehydration due to diarrhoea, a lack of access to safe water is responsible. It is reported that, number of cholera cases for the decade 2000-2010 increased by 130%.

- **Facts**

- ✓ Unsafe water kills 200 children per hour.
- ✓ Today, a larger number of people own a mobile phone than those who have access to a toilet.
- ✓ People suffering from water related illness fill half of the world's hospital beds.
- ✓ Approximately 3.5 million people die each year due to inadequate water supply, sanitation and hygiene (*UN Water Quality Fact Sheet 2013*).
- ✓ 1 in 9 people worldwide do not have access to improved sources of drinking water (*UN Water Quality Fact Sheet 2013*).
- ✓ Over 8 out of 10 people who do not use an improved source of drinking water live in rural areas (*Joint Monitoring Programme (JMP), 2013*).

- ✓ Each year 1 million people killed by water, sanitation, hygiene related disease.

Possible solutions to combat water scarcity problem

Sometimes the magnitude of a problem can make one feel that there is nothing that can be done. But there is a lot you can do for water. There is a high chance that people reading this do not live in water deprived areas, and may think it is not their problem. Here's what you can do.

- ✓ Awareness among the masses for the preservation of natural water sources, as every year by year manmade pollution is destroying water sources by means of idol and durga immersion and remains of worship on large scale with hazardous material (POP).
- ✓ Waste water from industry strictly not allowed draining into the river or water bodies without treatment.
- ✓ Every independent home/flat and group housing colony must have rain water harvesting facility.
- ✓ Recycling of sewage water for non-drinking purposes.
- ✓ Be part of competitions, organizations,

societies that aim to preserve and defend natural resources including water.

- ✓ Keep the tap off when not in use. Minimize the flushing of toilets and bath times. In effect, anything that you can do to save water, do it.
- ✓ Look after to water leaking in public areas and colonies leads to save a loss of 2,26,800 litres of water per year.
- ✓ Join pressure groups that stop individuals, industries and governments from cutting down trees and doing other things that pollute water bodies and degrade the environment.

Globally, diarrhoea is leading cause of illness and death. It is reported that 88 per cent of diarrhoeal deaths are due to a lack of access to sanitation facilities, together with inadequate availability of water for hygiene and unsafe drinking water. It is reported that the number of cholera cases for the decade 2000-2010 increased by 130%. The risk from cholera will likely increase worldwide due to the growing populations living in peri-urban slums and refugee camps, as well as increasing numbers of people exposed to the impacts of humanitarian crises.

Free Economic Services by Spiders

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Spiders are found almost all conceivable habitats surviving. They play an important role as regulators of insect population in agro, forest and other terrestrial ecosystems. They are the best friends of farmers. Spiders follow the nature's rule of 'Live and let live'. The most important characteristic feature of spider is their ability to produce silken threads of various kinds. The spider silk is strong, natural, biodegradable, and antibacterial in nature. It is used to make a diverse range of items in industrial and medical field. This wonderful tiny arachnid gives many agricultural, ecological, medicinal services and adds beauty to nature.

Spiders are the arachnids having eight legs and eight eyes. Spider communities dominate the world's tropical, subtropical and almost all conceivable habitats surviving. Spiders may be found on the ground, in underground caves, on top of the mountain, near water's edge, under the water, under bark, under stones, under fallen logs, on grass leaves, in house etc. According to World Spider Catalog, Version 20.5, 48330 valid spider species from 4144 genera are known from the world.

Spiders are the best friends of farmers. They play an important role as regulators of insect population in variety of agro ecosystems. Generally lifespan of spider is about eight months which matches with agricultural rotation; this means they are meant for the crops. Number of spiders makes burrows in the soil and makes soil porous which helps in percolation of water in agricultural soil and increases water retention capacity of soil, e.g. breeding period of tarantula spider is in the month of May. It makes burrow inside soil after the month of June to create millions of holes in agricultural soil which makes it porous. Also, spiders feed on worms and small insects. Their fecal matter makes better pH of soil and improves fertility soil. In this way, spiders give free services to earth as soil builders.

Spiders follow the nature's rule of 'Live and let live'. They eat many insects

that bother humans, such as mosquitoes and cockroaches. Since, a single spider may eat many mosquitoes in one day; over the course of its lifetime a spider may prevent hundreds of mosquitoes from surviving to produce even more mosquitoes offspring. Similarly a spider in our house 'pays rent' by ridding the promises of many cockroaches and/or other insects.



Spiders are an important food source for birds, lizards, wasps and other animals. Birds like the cuckoo and the Galapagos mockingbird are highly insectivorous and may prey extensively on spiders. Adult female of Nephila spider may be a good source of palatable protein in the area where protein sources are scarce. The most important characteristic feature of spider is their ability to produce silken threads of various kinds. Spider silk is important to bird species for building nest.

Spiders also make their contributions to human welfare. Spider venom is now being scanned for the development of pesticides. The spider silk is natural, biodegradable and can be produced pollution free. This biomaterial is used to make a diverse range of items like bullet-proof clothing, parachutes chords, surgical threads, artificial tendons,

biodegradable bottles, strings of musical instruments etc. Spiders are at the top of food web of small invertebrates. This food web is the subset of food web of top carnivore like tiger. Hence, if spiders are conserved by protecting their natural habitat, tigers will be automatically conserved.

Evolution of Free and Open Source Software

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Even though free and open-source software (FOSS) is widely used, much of the computer science research and community has yet to fully recognize its potential to change the world of research and development of software-intensive systems across disciplines. Free and open-source software development (FOSSD) is emerging as an alternative approach for how to develop large software systems.

Free and open-source software (FOSS) is software that can be classified as both free software and open-source software i.e. anyone is freely licensed to use, copy, study and change the software in any way and the source code is openly shared so that people are encouraged to voluntarily improve the design of the software. This is in contrast to proprietary software, where the software is under restrictive copyright licensing and the source code is usually hidden from the users. FOSS maintains the software user's civil liberty rights. Other benefits of using FOSS can include decreased software costs, increased security and stability (especially in regard to malware), protecting privacy, education and giving users more control over their own hardware. Free and open-source operating systems such as Linux and descendants of BSD are widely utilized today, powering millions of servers, desktops, smartphones e.g. android and other devices. Free software licenses and open-source licenses are used by many software packages. The free software and open-source software movement are online social movements behind widespread production and adoption of FOSS.

The top five reasons to choose open-source software are lower cost, security, no vendor 'lock in', better quality and transparency.

FOSS benefits over proprietary software

- **Personal control, customizability and freedom** - Users of FOSS benefit to make unrestricted use of and to study, copy,

modify and redistribute such software with or without modification. If they would like to change the functionality of software.

- **Privacy and security** - Manufacturers of proprietary, closed-source software are sometimes pressured to building in backdoors or other covert, undesired features into their software. Instead of having to trust software vendors, users of FOSS can inspect and verify the source code themselves and can put trust on a community of volunteers and users. As proprietary code is typically hidden from public view, only the vendors themselves and hackers may be aware of any vulnerability in them while FOSS involves as many people as possible for exposing bugs quickly.

- **Low costs or no costs** - FOSS is often free of charge although donations are often encouraged. This also allows users to better test and compares software.

- **Quality, collaboration and efficiency** - FOSS allows for better collaboration among various parties and individuals with the goal of developing the most efficient software for its users or use-cases while proprietary software is typically meant to generate profits. Furthermore, in many cases more organizations and individuals contribute to such projects than to proprietary software.

Drawbacks compared to the proprietary software

- **Security and user-support** - According to Lanus's law the more people who can see and test a set of code, the more likely

any flaws will be caught and fixed quickly. However, this does not guarantee a high level of participation. Having a grouping of full time professionals behind a commercial product can in some cases be superior to the FOSS. Furthermore, publicized source code might make it easier for the hackers to find vulnerabilities in it and write exploits. This however assumes that such malicious hackers are more effective than white hat hackers which responsibly disclose or help fix the vulnerabilities, that no code leaks or ex-filtration occur and that reverse engineering of proprietary code is hindrance of significance for malicious hackers.

- **Hardware and software compatibility** - Sometimes, FOSS is not compatible with proprietary hardware or specific software. This is often due to manufacturers obstructing FOSS such as by not disclosing interfaces or other specifications needed for members of the FOSS movement to write drivers for their hardware - for instance as they wish customers to run only their own proprietary software or as they might benefit from partnerships.
- **Bugs and missing features** - While FOSS can be superior to proprietary equivalents in terms of software features and stability, in many cases FOSS has more unfixed bugs and missing features when compared to similar commercial software. This varies per case and usually depends on the level of interest and participation in a FOSS project. Furthermore, unlike with typical commercial software missing features and bug fixes can be implemented by any party that has the relevant motivation, time and skill to do so.
- **Less guarantees of development** - There is often less certainty in FOSS projects gaining the required resources/participation for continued development than commercial software backed by companies. However companies also often abolish projects for being unprofitable and often large

companies rely on and hence co-develop open source software.

- **Missing applications** - As the FOSS operating system distributions of Linux has a lower market share of end users there are also fewer applications available.

FOSS examples in different field

There are plenty more quality open-source software exists. Here only mention few subject wise introductory samples. Most of these programs are cross-platform, meaning they can be installed on MS Windows, Mac OS X and Linux.

- **Computer Science**
 - ✓ **Linux and Ubuntu BOSS Linux** - Free operating system, almost neutral to virus attacks and no hassles for licensing issues.
 - ✓ **Firefox Web Browser** - To browse the internet safely.
 - ✓ **Drupal** - It is a free and open-source content management system (CMS) written in PHP and distributed.
 - ✓ **Joomla** - Under general public license (GNU). Useful for website building and web applications, to use content management system for building websites, webpages.
 - ✓ **PHP and MySQL** - It is a package for developing the interactive websites and establishing back-end connectivity with a database. Famous websites using PHP include Facebook, Google and Wikipedia.
 - ✓ **LaTeX and XFig LaTeX** - These are the typesetting softwares for preparing the reports, letters and presentations, especially useful for persons engaged in writing/publishing documents from science/arts/commerce fields. Xfig is a free and open-source vector graphics editor. In **Xfig** figures may be drawn using objects such as circles, boxes, lines, spline curves, text etc.
 - ✓ **LibreOffice Suite** - Trains in the basic computer usage skills like word processing, spreadsheet and presentation using the LibreOffice components Writer, Calc and Impress. One can also learn other useful components like Draw, Math and Base.

✓ **Moodle Learning Management System** - Moodle LMS is one of the most popular LMS used globally by educational institutes.

✓ **KTtouch** - Typing tutor. Teaches how to type using an online interactive keyboard. Useful for learning typing at your own pace. Gradually increase your typing speed and accuracy.

✓ **TuxTyping** - Typing application especially for children start typing, practice lessons, play a typing game and set a language for typing.

✓ **GIMP** - Raster graphics editor aimed at image retouching/editing.

✓ **Darktable** - Digital image workflow management and RAW photo processing.

✓ **digiKam** - Integrated photography toolkit including editing capabilities.

Samba - Bridges gaps between Linux/ Unix and Windows.

- **Antivirus**

✓ **ClamAV, ClamWin, Gateway Anti-Virus, Lynis.**

- **Programming Languages**

✓ **Scilab** - Mathematical and scientific calculation software, open-source substitute for MATLAB. Very useful for all science and engineering students in academics particularly.

✓ **PERL** - Practical extraction and reporting language commonly known as PERL is a high level, general purpose and dynamic programming language.

✓ **Python** - Numerical computational software for science and engineering education. Used in 3D animation and gaming industry, artificial intelligence, YouTube, NASA, CERN, Yahoo and so on.

✓ **Ruby** - Useful to learn the industry level programming.

✓ **Java** - Programming language.

- **Mathematics**

✓ **ASCEND** - It is a free, open-source mathematical modeling system.

✓ **GeoGebra** - Interactive geometry, Algebra and Calculus application. Very useful to teach, learn and abstract

geometry concepts for UG/PG students as well as research scholars.

✓ **Axiom, Reduce, GAP, GiNaC** - Computer algebra system.

- **Chemistry**

✓ **ASCEND** - Main uses have been in the field of chemical process modeling with its novel modeling language conventions and powerful solver. Useful for UG/PG chemical engineering and chemistry students.

✓ **CellDesigner** - It is a process diagram editor for drawing gene regulatory and biochemical networks. It is used for user-friendly visualization, modeling and simulation of genetic regulatory networks, protein networks and metabolic networks.

✓ **ChemCollective Virtual Labs** - It is a simulation of a chemistry laboratory. It allows students to explore and reinforce fundamental concepts, select various standard reagents (aqueous) and use them as they use in a real laboratory.

✓ **DWSIM** - It is an open-source CAPE-OPEN compliant chemical process simulator. It allows us to conduct experiments and analyze data using advanced models and operations.

✓ **GChemPaint** - Allows you to draw and display 2D chemical structures. Very useful to teach and learn abstract chemistry concepts.

✓ **Jmol Application** - Learn how to create 3D chemical crystal and bio-molecule structures. Very useful to teach and learn abstract chemistry concepts.

✓ **UCSF Chimera** - UCSF Chimera is a program for interactive visualization and analysis of molecular structures and related data. Using Chimera one can generate high quality images, animations.

✓ **Chemistry Dev. Kit, JOELib, OpenBabel**

- **Bio-Informatics**

✓ **Avogadro** - It is a free and open source, advanced molecule editor and visualizer designed for cross-platform use in computational chemistry, bioinformatics, etc. It offers flexible high quality rendering.

✓ **Biopython** - It is a collection of Python tools for computational biology and bioinformatics. Biopython contains the modules and classes to represent protein sequences, nucleic acid sequences and sequence annotations.

- **Electronics / Physics**

✓ **ExpEYES** - It stands for Experiments for Young Engineers and Scientists. It is used to perform basic physics and electronics experiments.

✓ **Oscad now eSIM** - Open-source EDA tool for circuit design, simulation, analysis and PCB design. It is an integrated tool built using open source software such as KiCad, Ngspice and Scilab.

- ✓ **Nanotechnology**

✓ **Ninithi** - Visualize and analyze carbon allotropes such as carbon nanotube, fullerene and graphene nano-ribbons.

- ✓ **Quantum chemistry**

✓ **CP2K** - Atomic and molecular simulation of solid-state, liquid, molecular and biological systems.

- ✓ **Electronic design automation (EDA), Fritzing, KiCad**

- **Engineering**

✓ **Blender** - Open source equivalent to Maya and 3DMax. Useful to create 3D animation for architecture and animation students.

✓ **OpenFOAM** - Useful for mechanical, civil, chemical engineering.

✓ **OpenModelica** - It is an open-source modelling and simulation environment intended for industrial/academic usage.

✓ **QCAD** - It is a free, open-source application for computer aided drafting (CAD) in two dimensions (2D).

✓ **FreeCAD** - Parametric 3D CAD modeler with a focus on mechanical engineering, BIM and product design.

✓ **LibreCAD** - 2D CAD software using AutoCAD like interface and file format.

- **Library**

✓ **Koha Library Management System** - Koha is useful for library science students

and a library staff who wishes to create a Koha library for their institute.

✓ **Integrated Library Management Software Evergreen** - It is developed for the Georgia Public Library Service's PINES catalog.

✓ **Koha** - SQL Based library management.

✓ **NewGenLib, OpenBiblio, PMB**

✓ **refbase** - It is web based institutional repository/reference management software.

- **Educational Suites**

✓ **ATutor** - Web based learning content management system (LCMS).

✓ **Chamilo** - Web based e-learning and content management system.

✓ **Claroline** - Collaborative learning management system.

✓ **DoceboLMS** - SAAS/cloud platform for learning.

✓ **eFront** - Icon based learning management system.

✓ **FlightPath** - Academic advising software for universities.

✓ **GCompris** - Educational entertainment, aimed at children aged 2-10.

✓ **Gnural** - Brainwave entertainment software.

✓ **H5P** - Framework for creating and sharing interactive HTML5 content.

✓ **IUP Portfolio** - Educational platform for Swedish schools.

✓ **ILIAS** - Web based learning management system (LMS).

✓ **Moodle** - Free and open-source learning management system.

✓ **OLAT** - Web based learning content management system.

✓ **Omeka** - Content management system for online digital collections.

✓ **openSIS** - Web based student information and school management system.

✓ **Sakai Project** - Web based learning management system.

✓ **SWAD** - Web based learning management system.

✓ **Tux Paint** - Painting application for 3-12 year old children.

✓ **UberStudent** - Linux based operating system/software suite for academic studies.

Conclusion - Open-source software which is a computer software program designed and deployed with its source code made available and licensed with a free license in which the copyright holder provides the rights to an anonymous entity for any purpose. Free and open-source software development (FOSSD) is emerging as an

alternative approach for how to develop large software systems. FOSSD offer new types and new kinds of practices, processes and organizational forms to discover, observe, analyze, model and simulate. This article presents pros and cons of free and open-source software as well as some samples of FOSS in different fields.

Plant Water Uptake in Drying Soils

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The fundamental mechanism of water flow in plants has been described for many years. Briefly, the diffusion of vapour through stomata leads to the evaporation of water from the surface of inner leaf tissues and an increase of tension in the xylem that propagates to each root segment following the cohesion-tension principle (in this context, a root segment can be seen as a portion of root with uniform hydraulic properties). Where this tension is higher than the surrounding soil, it induces an inflow of water from the rhizosphere, following paths of low soil hydraulic resistance. How far plants are able to sustain their leaf water demand is therefore largely dependent on the hydraulic properties of soil-root system.

Coincidence between root foraging and soil resources distribution

The importance of root placement for water extraction depends on the ability of the soil to redistribute its water to sustain the uptake of water that occurs in the rhizospheric compartment of the soil. In soils with high water conductivity throughout the season, fast soil water redistribution from the bulk soil to the rhizosphere limits the role of root foraging as long as the root system conductance is large enough. In drying soils, however, the smaller hydraulic conductivity of the soil reduces soil water redistribution and the soil volume from which individual root segments are able to obtain their water narrows down accordingly. In such conditions, even transient, the placement of roots and its correlation to distribution of soil water sets an upper limit to the amount of water that can be extracted.

In transient or cyclic drought environments, the reserve of soil water can be temporarily restricted to deeper layers because water uptake (and evaporation) occurs preferentially in the topsoil, where the root length density (cumulated root length per unit soil volume) is the highest and the path to extract water the lowest. This situation is most pronounced under terminal drought, as the soil water reserve is not refilled over the growing season and is gradually restricted to deeper soil layers. Increasing the root system depth and

tailoring deep water extraction was therefore proposed as a key element of a root system ideotype adapted to water-limited environments (Comas et al., 2013). Considering construction and maintenance costs of root systems, the ideotype should preferably have few and long laterals, evenly distributed along the depth axis. The rationale is that few long laterals have a small weight on the carbon budget and allow the exploration of a larger soil volume. Aerenchyma is also considered as a feature reducing the root construction cost, in favour of deep root extension, also advocate for a greater root length density at depth and reduced density in the topsoil to favor deep soil water extraction.

Root system depth appears to be amenable to conventional breeding and has been shown to be under control of, at least, four different quantitative trait loci in rice (*Oryza sativa*) (Courtois et al., 2013) and one major constitutive quantitative trait loci in maize (*Zea mays*). In addition, several traits that should contribute to a deep root phenotype have been proposed or identified. Increasing the diameter of the main roots is thought to be linked with a greater growth potential and a greater ability to explore hard soil (Bengough et al., 2011). In rice, the gene *DEEPER ROOTING1* has been shown to steepen the root insertion angle and increase the rooting depth, conferring improved drought resistance. In groundnut (*Arachis*

hypogaea), *DEHYDRATION RESPONSE ELEMENT B1A* has been shown to increase drought resistance by promoting root development in deep soil layers. Additionally, increasing the proportion of aerenchyma in main root axes reduces the metabolic cost of root exploration. The manipulation of root branching in different layers, which is part of the deep root ideotype, is expected to be more difficult to achieve for practical observation constraints. While considering those traits, it should be reminded that deep rooting could be obtained differently in tap-rooted species compared with monocot root systems with continued production of gravitropic adventitious root axes.

The identification of root ideotypes is further complicated by the fact that root growth and development are strongly influenced by the soil environment. Root architecture remodeling in response to a wide range of nutrient deficiencies has been recently described and partly elucidated in *Arabidopsis* (*Arabidopsis thaliana*). Changes in root architecture in response to phosphate starvation occur under the control of *Oryza sativa MYB2 phosphate-responsive gene1* in rice and *AtSIZ1* in *Arabidopsis*. Interestingly, alternative adaptations to the same adverse conditions exist among different genotypes, as illustrated by altered primary or lateral root growth conferring resistance to K starvation. Local environmental conditions also contribute to root architecture remodeling. Individual roots are able to reorient toward water (hydrotropism) under the control of *MIZUKUSSEI1* and *GNOM* in *Arabidopsis*. Similarly, *PIN-FORMED2* activity influences the capacity of individual roots to escape high-salinity patches (halotropism) (Alsina et al., 2011). This plasticity of root development should not be overlooked in drought resistance studies given the role of water in nutrient uptake.

The benefit of deep root systems in drought-prone environments has been demonstrated experimentally in rice, wheat (*Triticum aestivum*), maize, legumes, grapes (*Vitis vinifera*) or trees. However, other results seem to indicate that deep root systems are not always linked to an increase in yield. Experiments with chickpea (*Cicer arietinum*) and wheat indicate that drought tolerance, especially in terminal drought conditions, can be linked to a conservative use of water throughout the season rather than deep rooting. In such cases, plants tailored for improved root length density at depth are likely to use too much water early in the season and reduce the reserve of water in the profile during grain filling. A similar behavior has been reproduced using modeling tools. As suggested recently, benefits of any root-related trait could be highly dependent on the drought scenario (Genotype × Environment interactions) (Burton et al., 2013).

Root system hydraulic architecture

Although all root segments are somehow connected to the plant stem, the negative water potential that develops at their surface as a result of the xylem tension is not necessarily uniform. Individual root segments are not equally conductive to water, both radially and axially, and the paths that link them to the shoot base are unique. On the one side, from the root surface to the xylem vessels, water flows radially, following paths of lowest hydraulic resistance using apoplastic, symplastic, and cell-to-cell pathways. This radial water inflow into the root, described as a composite transport, can be characterized at the root segment level by a radial hydraulic conductance, which has been shown to be variable between species (Bramley et al., 2009) and even ecotypes. On the other side, the axial flow along the xylem is characterized by the axial conductance of successive root

segments. Complete hydraulic structure of the root system, comprising its topology and the size and hydraulic properties of its constituting segments, forms its root hydraulic architecture. Under uniform soil water distribution, it has been shown that the hydraulic architecture allows for predicting the expected contribution of every root segment to the water uptake, recently referred to as the standard uptake fractions distribution (Couvreur et al., 2012).

The tissular organization of root segments is a long-term determinant of their radial conductivity (Figure). This includes the number and anatomy of cell layers between the root surface and the xylem and the presence of hydrophobic Casparian strips that occur typically at the endodermis and exodermis. The formation of hydrophobic structures has been shown to be influenced by the growing medium and is triggered by drought conditions. As the tissular organization is established permanently, this implies that the radial conductivity reflects the root segment history (its development, in relation with its environment). Beyond these structural features, the root radial conductivity is also controlled on a shorter term by the regulation of water channels, or aquaporins (Cochard et al., 2007). Presence of functional aquaporins in cell membranes highly facilitates the passive flow of water and has been shown to contribute to 20% to 80% of the radial water inflow into the root (Maurel and Chrispeels, 2001) (Javot et al., 2003), although this contribution varies between species (Bramley et al., 2009, 2010). Aquaporin regulation is achieved through their expression intensity or subcellular localization or through the gating of aquaporin pore (gating) (Boursiac et al., 2008). In maize, aquaporins have been shown to be preferentially localized in the endodermis and exodermis.

As for the radial conductance, both permanent and transient features affect

the axial conductance of individual root segments. Structural features include the number, size, degree of interconnection, and decorations of xylem vessels. The number and size of xylem vessels increase during the maturation of root segments and decrease with branching order in cereals. The xylem diameter reflects the root segment history. For example, it tends to be lower in shallow roots than in deep roots for woody plants growing in environments subject to drought or freezing conditions. The anatomy of xylem vessels also displays a large variability in *Zea* spp. (Burton et al., 2013), rice, legumes or coniferous. Transient modifications of the axial conductance occur as a result of xylem vessel embolism, or cavitation, following the nucleation and rapid expansion of gas bubbles under high tension. Because embolized vessels are not hydraulically conductive, the flow of water through the root segment is restricted to remaining, noncavitated vessels. Different

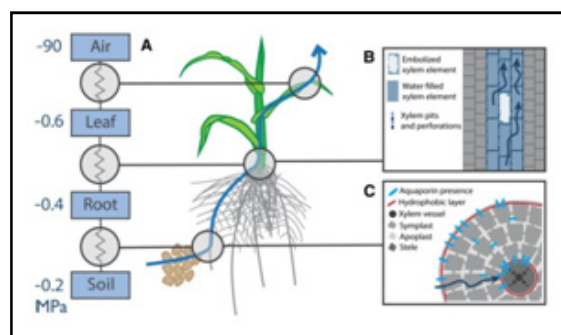


Figure : Water flow in the plant.

A : Water flow in the plant is a passive process driven by water potential differences and regulated by hydraulic conductivities between the compartments of the system (soil-root-shoot-atmosphere).

B : Axial water flow is influenced by the anatomy of the xylem pipes (size, number, and presence of pits) and the occurrence of cavitation events (embolism of xylem elements).

C : Radial water flow is influenced, in the long term, by the radial anatomy of the root, such as the number of cell layers and the presence of hydrophobic layers (endodermis and exodermis). In short, the radial flow is influenced by the expression and localization of aquaporins.

species are not equally susceptible to cavitation or even cultivars, but not always. Susceptibility to cavitation has been linked to the large xylem vessels, anatomy of walls, and pits (Cochard, 2010) (Christman et al., 2012). It has to be noted that xylem vessel cavitation is a reversible event, although the exact mechanisms underlying the refilling processes are not yet fully known. It is often considered that the axial conductance does not limit water flow in the root system by virtue of the large conductivity of xylem vessels. However, recent experimental evidence has revealed the negative effect of cavitation on the plant water status.

Novel root hydraulic architectures are being proposed to improve drought tolerance, advocate for greater axial and radial conductivities in deep roots to increase the uptake and transport capacity of water from deep soil layers. In conditions of scarce deep water, (Comas et al. 2013) recommend decreasing the axial conductance to save water for the end of the crop cycle. More generally, the importance of the ratio between axial and radial conductivities has also been stressed from modeling studies. Large values of this ratio should lead toward a uniform distribution of the uptake throughout the entire root system, while low values would favor preferential uptake in the topsoil. Experimental evidence that manipulation of root hydraulic architecture can improve the water status of plants under water deficit remains scanty. Designing a root hydraulic architecture to improve drought tolerance is thus likely to be specific to the species and genotype, climatic scenario, soil hydraulic properties, and management practices (Couvreur et al., 2012).

Modeling can help explain the dynamics of root water uptake

Despite the fact that water uptake follows simple rules of passive flow driven by water potential gradients and following

paths of lowest resistance, and despite our knowledge of the main paths and factors affecting their conductivities, our understanding of water uptake at the plant and seasonal scale remains limited by the difficulties in integrating those interacting paths and factors, at the appropriate scales and in a spatial and temporal framework. Many of those factors have been evoked in the above sections, but many others have been deliberately set aside, such as the feedback effect of water uptake on root growth via its effects on, e.g. assimilation and soil mechanical impedance. Because direct experimental observations are necessarily capturing limited aspects of water uptake, systems approaches gained much interest in the last decade.

Using the model R-SWMS illustrated the negative impact of local conductivity drops around roots in drying soils on the water uptake process. The importance of the ratio between axial and radial root conductivities and of the soil type was also highlighted. On the soil side, the model can be instrumental to investigate the influence of the root water uptake on water flow and nutrient transport in the surrounding soil. Recently, it was used to assess the impact of salinity on the plant transpiration reduction. To streamline the adoption of these tools by the plant science community, (Couvreur et al., 2012) proposed a simplified version of R-SWMS that can be used at the crop level but still relies on a precise parameterization of root hydraulic architecture. This simplified model has also been shown to simulate behaviors such as compensatory uptake and hydraulic lift from hydraulic principles.

Methods to investigate root water uptake dynamics

The development of measurement techniques and observation methods has been instrumental in many recent advances of our understanding of root water uptake

dynamics. While traditional methods to investigate either plant or soil properties are mainly used at the plant scale, new techniques have empowered a more detailed approach of the system, down to the centimeter scale.

Several two and three dimensional observation methods have been developed that enable better characterization of root system architecture. Pouches dipping in nutrient solution are becoming increasingly popular to screen early stages of root systems development in two dimensions. Recently, a scanning technique has been proposed for digitizing entire root systems of plants grown in rhizoboxes. The two-dimensional restriction of pouches and rhizotrons was recently released by stereo imaging of root systems grown in tubes filled with gellan gum (Clark et al., 2011). Lastly, x-ray computed tomography or magnetic resonance imaging, widely used in medical sciences, is now entering the plant research domain. These allow the three-dimensional noninvasive monitoring of root growth in realistic soil cores and in the future, should provide many details on the precise soil conditions around individual root segments, including soil water content.

The quantification of root hydraulic properties remains certainly one of the biggest challenges. Techniques suitable for global measurements have been established for many years. The pressure chamber is widely used and estimates the conductance from the measurement of the water flow induced by a known pressure differential. Other techniques estimate the conductance of individual root segments, yet remain extremely time consuming (e.g. pressure clamp) and pressure probe. Part of the challenge lies in the plasticity of root hydraulic properties as function of segment type and age and environmental conditions and in the variability between measurement methods (Bramley et al., 2007).

Oppositely, an array of techniques is available to monitor soil water content in one, two and even three dimensions. This includes time domain reflectometry, electrical resistance tomography or more recently, ground penetrating radar. The spatial resolution of these techniques ranges in the decimeter scale and is appropriate to study the distribution of water in rows or interrows. Recently, two techniques have been successfully tested for the observation of water flow down to the centimeter level. Light transmission imaging can be used to finely map changes in soil water content in transparent rhizotrons (Cassiani et al., 2006). Unfortunately, the technique is restricted to a specific type of substrate (white sand) and does not estimate water uptake by individual roots due to the unknown redistribution of the water in the substrate.

More recently, the use of neutron radiography that is not bound to any specific type of substrate has been used to investigate water movement and determine water uptake sites in lupin (*Lupinus albus*) root systems. Using D₂O injection in combination with a convection-diffusion model, water uptake by individual segments could be quantified in complete root system. This technical evolution is therefore promising new insights on water dynamics at smaller scales, while systems analysis frameworks will help to integrate this information (Beff et al., 2013).

Conclusion - The determinants of water flow through the soil-root system are well known and have been largely studied individually. However, their integration at the plant and canopy scales and over a whole crop cycle remains very limited. The spatial and temporal heterogeneity of the soil, the interactions between the soil and the root at multiple scales, and the need to combine very different disciplines makes this integration particularly difficult. With the development of functional-structural

soil-plant models, root systems biology is bringing novel analytical tools to turn a vast amount of data into biological questions crossing scales and disciplines. We believe that new root system ideotypes could emerge from a more comprehensive and quantitative consideration of the many determinants of water flow during a whole crop cycle and in the framework of a cost benefit analysis at the system level.

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Pollen Allergy

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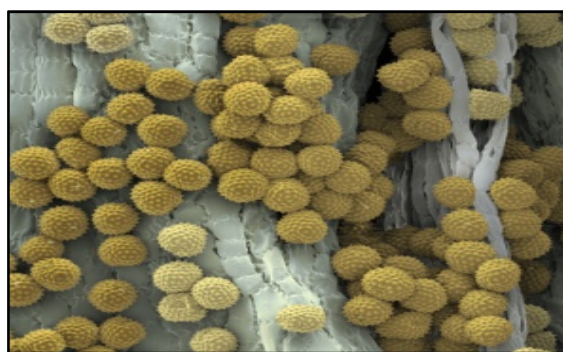
Pollen is a very fine powder produced by trees, flowers, grasses, and weeds to fertilize other plants of the same species. Many people have an adverse immune response when they breathe in pollen. The immune system normally defends the body against harmful invaders such as viruses and bacteria to ward off illnesses. In people with pollen allergies, the immune system mistakenly identifies the harmless pollen as a dangerous intruder. It begins to produce chemicals to fight against the pollen. This is known as an allergic reaction, and the specific type of pollen that causes it is known as an allergen.

Pollen is one of the most common triggers of seasonal allergies. Many people know pollen allergy as “hay fever”. Experts usually refer to pollen allergy as “seasonal allergic rhinitis”. Each spring, summer and fall, plants release tiny pollen grains to fertilize other plants of the same species. Most of the pollens that cause allergic reactions come from trees, weeds and grasses. These plants make small, light and dry pollen grains that travel by the wind. Grasses are the most common cause of allergy. Ragweed is a main cause of weed allergies. Other common sources of weed pollen include sagebrush, pigweed, lamb’s quarters and tumbleweed. Certain species of trees, including birch, cedar and oak, also produce highly allergenic pollen. Plants fertilized by insects, like roses and some flowering trees, like cherry and pear trees; usually do not cause allergic rhinitis.

People with pollen allergies only have symptoms when the pollens they are allergic to are in the air. Symptoms include; runny nose and mucus production, sneezing, itchy nose, eyes, ears and mouth, stuffy nose (nasal congestion), red and watery eyes, swelling around the eye.

Doctor can usually diagnose a pollen allergy. However, they may refer you to an allergist for allergy testing to confirm the diagnosis. An allergist is someone who specializes in diagnosing and treating allergies. The allergist will first ask you about your medical history and your symptoms, including when they started

and how long they have persisted. Make sure to tell them if the symptoms are always present or get better or worse at certain times of the year. The allergist will then perform a skin prick test to determine the specific allergen that’s causing your symptoms. During the procedure, the allergist will prick different areas of the skin and insert a small amount of various types of allergens. If you are allergic to any of the substances, you will develop redness, swelling and itchiness at the site within 15-20 minutes. You might also see a raised, round area that looks like hives.



Home remedies and preventative steps that a person can take to reduce their allergy symptoms. Examples include; keeping the windows closed when pollen counts are high, changing clothes each time after coming inside from the outdoors to limit pollen exposure, taking a bath or shower each night before going to bed to rid the skin and hair of pollen buildup, washing bedding in hot, soapy water at least once per week. Many home remedies for allergies are available but research has not yet proven that they are effective.

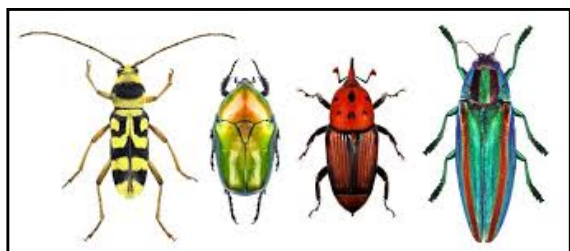
Insect World - Diversity of Beetles

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Beetles are a group of insects that form the order Coleoptera, in the superorder Endopterygota, class insecta. The name of the taxonomic order Coleoptera comes from the Greek *koleopteros*, given to the group by Aristotle for their elytra, hardened shield-like forewings, from koleos, sheath and pteron, wing. The English name beetle comes from the old English word bitela, little biter, related to bitan (to bite).

The body of the beetle is comprised of three sections all coated in the hard outer shell, which are the head, the thorax and the abdomen of the beetle. Beetles also have antennae which are used to understand the surroundings of the beetle and are made of about 10 segments. Their front pair of wings is hardened into wing cases, elytra, distinguishing them from most other insects. The Coleoptera, with about 400,000 species, is the largest of all orders, constituting almost 40% of described insects and 25% of all known animal life-forms; however, scientists estimate the real number is between 4 million and 8 million beetle species. The largest of all families the Curculionidae (weevils) with some 83,000 member species, belongs to this order.



Beetles found in almost every habitat except the sea and the polar region. They interact with their ecosystems in several ways. Beetles often feed on plants and fungi. They break down animal and plant debris and eat other invertebrates also. Some bigger species of beetle have been known to eat small birds and even small species of mammal. Other species of beetle feed of the dust from wood and therefore enjoy burrowing

themselves into trees. Recently, the Asian long-horned beetle has been found in number of North American states with the beetle having quickly gained a name for itself as an agricultural pest. The Asian long-horned beetle is a type of bark boring beetle which means that they dig themselves into wood. Some species are serious agricultural pests, such as the Colorado potato beetle, while others such as Coccinellidae (ladybirds or ladybugs) eat aphids, scale insects, thrips and other plant-sucking insects that damage crops.



Due to their small size and wide, diverse range, beetles are prey to numerous species of animal from other insects to reptiles, birds, fish and mammals. The exact predators of the beetle however are largely dependent on the size and species of the beetle and the area in which the beetle inhabits.

Beetles are believed to play a vital role in whichever ecosystem they inhabit mainly as they consume the debris from plants and animals including fallen petals and animal dung. All animals that ingest decomposing material are working wonders for the soil as they are consuming a large proportion of the compounds that

would otherwise be absorbed into the soil, such as carbon dioxide and nitrogen.

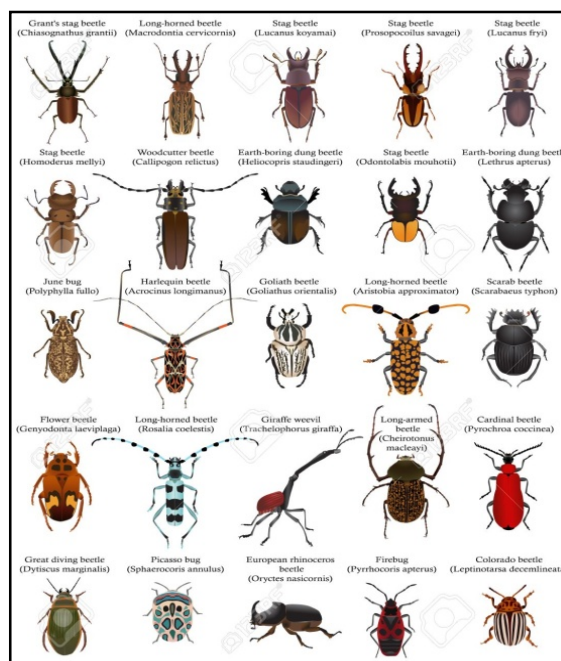
Beetles typically have a particularly hard exoskeleton including the elytra, though some such as the Rove beetles have very short elytra while Blister beetles have softer elytra. The general anatomy of a beetle is quite uniform and typical of insects, although there are several examples of novelty, such as adaptations in water beetles which trap air bubbles under the elytra for use while diving.

Beetles are Endopterygotes, which means that they undergo complete metamorphosis, with a series of conspicuous and relatively abrupt changes in body structure between hatching and becoming adult after a relatively immobile pupal stage. Some, such as Stag beetles, have a marked sexual dimorphism, the males possessing enormously enlarged mandibles which they use to fight other males. Many beetles are aposematic, with bright colours and patterns warning of their toxicity, while others are harmless Batesian mimics of such insects. Many beetles, including those that live in sandy places, have effective camouflage.



Beetles are prominent in human culture, from the **sacred scarabs** of ancient Egypt to beetle wing art in Europe. In South Asian countries they are used as pets or fighting insects for entertainment and gambling. Many beetle groups are brightly and attractively coloured making them objects of collection and decorative displays. Over 300 species of Beetles are

used as food, mostly as larvae. Widely consumed species include mealworms and rhinoceros beetle larvae. However, the major impact of beetles on human life is as agricultural, forestry, and horticultural pests. Serious pests include the boll weevil of cotton, the Colorado potato beetle, the coconut hispine beetle, and the mountain pine beetle. Most beetles, however, do not cause economic damage and many such as the Lady and Dung beetles are beneficial by helping to control insect pests.



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Carbon Nanotubes and its Applications

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The structure of a carbon nanotube is formed by a layer of carbon atoms that are bonded together in a hexagonal mesh. This one-atom-thick layer of carbon is called graphene and it is wrapped in the shape of a cylinder and bonded together to form a carbon nanotube. Carbon nanotubes are discovered in 1991 by Sumio Iijima. Nanotubes are categorized as single-walled nanotubes (SWNTs) and multi-walled nanotubes (MWNTs). CNTs are well-suited for applications requiring high strength, durability, electrical conductivity, thermal conductivity and lightweight properties compared to conventional materials.

The amazing and versatile carbon

Chemical basis for life with an atomic number of 6, carbon is the 4th most abundant element in the universe by mass after hydrogen, helium and oxygen. It forms more compounds than any other elements, with almost 10 million pure organic compounds. Abundance, together with the unique diversity of organic compounds and their unusual polymer forming ability at the temperatures commonly encountered on earth makes the element, the chemical basis of all known life.

The structure of a carbon nanotube is formed by a layer of carbon atoms that are bonded together in a hexagonal (honeycomb) mesh. This one-atom-thick layer of carbon is called graphene and it is wrapped in the shape of a cylinder and bonded together to form a carbon nanotube. Carbon Nanotubes are long, thin cylinders of carbon discovered in 1991 by Sumio Iijima. These are large macromolecules that are unique frothier size, shape and remarkable physical properties. They can be thought of as a sheet of graphite (a hexagonal lattice of carbon) rolled into a cylinder. These intriguing structures have sparked much excitement in recent years and a large amount of research has been dedicated to their understanding. Currently, the physical properties are still being discovered and disputed. Nanotubes are members of the fullerene structural family. Their name is

derived from their long, hollow structure with the walls formed by one atom thick sheets of carbon called graphene. These sheets are rolled at specific and discrete (chiral) angles and the combination of the rolling angle and radius decides the nanotube properties; for example, whether the individual nanotube shell is a metal or semiconductor. Nanotubes are categorized as single-walled nanotubes (SWNTs) and multi-walled nanotubes (MWNTs). Individual nanotubes naturally align themselves into ropes held together by Vander Waals forces, more specifically, the pi-stacking.

These cylindrical carbon molecules have unusual properties, which are valuable for nanotechnology, electronics, optics and other fields of materials science and technology. Owing to the material's exceptional strength and stiffness, nanotubes have been constructed with length to diameter ratio of upto 132,000,000 : 1, significantly larger than for any other material. In addition, owing to their extraordinary thermal conductivity, mechanical and electrical properties, carbon nanotubes find applications as additives to various structural materials. For instance, nanotubes form a tiny portion of the material(s) in some (primarily carbon fiber) baseball bats, golf clubs, car parts or damascus steel. Applied quantum chemistry, specifically orbital hybridization best describes chemical bonding in nanotubes. The chemical bonding of

nanotubes involves entirely sp^2 hybrid carbon atoms. These bonds, which are similar to those of graphite and stronger than those found in alkanes and diamond which employ sp^3 hybrid carbon atoms, provide nanotubes with their unique strength.

Single-walled carbon nanotube structure

Single-walled carbon nanotubes can be formed in three different designs, armchair, chiral and zigzag. The design depends on the way the graphene is wrapped into a cylinder. For example, imagine rolling a sheet of paper from its corner, which can be considered one design and a different design can be formed by rolling the paper from its edge. A single-walled nanotubes structure is represented by a pair of indices (n, m) called the chiral vector.

Multi-walled carbon nanotube structure

There are two structural models of multi-walled nanotubes. In the Russian doll model, a carbon nanotube contains another nanotube inside it (the inner nanotube has a smaller diameter than the outer nanotube). In the Parchment model, a single graphene sheet is rolled around itself multiple times, resembling a rolled up scroll of paper. Multi-walled carbon nanotubes have similar properties to single-walled nanotubes, yet the outer walls on multi-walled nanotubes can protect the inner carbon nanotubes from chemical interactions with outside materials. Multi-walled nanotubes also have a higher tensile strength than the single-walled nanotubes.

Applications

CNTs are well-suited for any application requiring high strength, durability, electrical conductivity, thermal conductivity and lightweight properties compared to conventional materials. Currently, CNTs are mainly used as additives to synthetics. CNTs are

commercially available as a powder, i.e. in a highly tangled-up and agglomerated form. For CNTs to unfold their particular properties they need to be untangled and spread evenly in the substrate. Another requirement is that CNTs need to be chemically bonded with the substrate, e.g. a plastic material. For that purpose, CNTs are functionalized, i.e. their surface is chemically adapted for optimal incorporation into different materials and for the specific application in question. Carbon nanotubes can also be spun into fibers, which not only promise interesting possibilities for specialty textiles but may also help realize a particularly utopian project. Some important applications of CNTs are given below.

• Materials

The carbon nanotube enabled nanocomposites have received much attention as a highly attractive alternative to conventional composite materials due to their mechanical, electrical, thermal, barrier and chemical properties such as electrical conductivity, increased tensile strength, improved heat deflection temperature or flame retardancy. These materials promise to offer increased wear resistance and breaking strength, antistatic properties as well as weight reduction. It has been estimated that advanced CNT composites could reduce the weight of aircraft and spacecraft by up to 30%. These composite materials already find use in -

- ✓ Sporting goods (bicycle frames, tennis rackets, hockey sticks, golf clubs and balls, skis, kayaks; sports arrows)
- ✓ Yachting (masts, hulls and other parts of sailboats)
- ✓ Textiles (antistatic and electrically conducting textiles ('smart textiles'); bullet-proof vests, water-resistant and flame-retardant textiles)
- ✓ Automotive, aeronautics and space (light-weight, high-strength composites).
- ✓ Industrial engineering (e.g. coating of

wind-turbine rotor blades, industrial robot arms).

- **Catalysis**

What makes carbon nanotubes so attractive for catalysis is their exceptionally high surface area combined with the ability to attach essentially any chemical species to their sidewalls. Already, CNTs have been used as catalysts in many relevant chemical processes; however, controlling their catalytic activity is not easy. Initially, carbon nanotubes have been combined with molecules via strong covalent bonds that lead to very stable compounds. Such connection, however, implies a change in the structure of the nanotube and therefore in its properties. It would be analogous to nailing an advertisement to a post using a thumbtack: the union is strong, but it leaves a hole in both the advertisement and the post. Weak non-covalent forces have also been used, which keep the structure of the nanotubes intact, but typically yield kinetically unstable compounds. The comparison in this case would be to tape the advert to the post. Neither the advertisement nor the post is damaged, but the union is much weaker.

- **Transistors**

Despite the rise of graphene and other two-dimensional (2D) materials, semiconducting single-walled carbon nanotubes are still regarded as strong candidates for the next generation of high-performance, ultra-scaled and thin-film transistors as well as for opto-electronic devices to replace silicon electronics.

- **Sensors**

Many studies have shown that although CNTs are robust and inert structures, their electrical properties are extremely sensitive to the effects of charge transfer and chemical doping by various molecules. Most sensors based on CNTs are field effect transistors (FET) and widely used to detect greenhouse gases in

environmental applications. The CNTs functionalization is important for making them selective to the target analyte. Different types of sensors are based on molecular recognition interactions between functionalism CNT and target analytes. For instance, researchers have developed flexible hydrogen sensors using single-walled carbon nanotubes decorated with palladium nanoparticles.

- **Nano inks**

Ink formulations based on CNT dispersions are attractive for printed electronics applications like transparent electrodes, RFID tags, thin-film transistors, light-emitting devices and solar cells.

- **Electrodes**

Carbon nanotubes have been widely used as electrodes for chemical and biological sensing applications and many other electrochemical studies. With their unique one-dimensional molecular geometry of a large surface area coupled with their excellent electrical properties, CNTs have become important materials for molecular engineering of electrode surfaces where development of the electrochemical devices with region-specific electron-transfer capabilities is of paramount importance.

- **Displays**

Given their high electrical conductivity and incredible sharpness of their tip (smaller the tips' curvature radius, more concentrated the electric field, the higher field emission), CNT's are considered the most promising material for field emitters and a practical example are CNTs as electron emitters for field emission displays (FED). FED technology makes possible a new class of large area, high resolution, low cost flat panel displays. However, FED manufacturing requires CNT to be grown in precise sizes and densities. Height, diameter and tip sharpness affect voltage while density affects current.

- **Buckypapers**

Buckypapers could find numerous applications, as one of the most thermally conductive materials known, buckypaper could lead to the development of more efficient heat sinks for chips; a more energy-efficient and lighter background illumination material for displays; a protective material for electronic circuits from electromagnetic interference due to its unusually high current-carrying capacity; or switchable surfaces.

- **Optoelectronic / photonic applications**

While individual nanotubes generate discrete fine peaks in optical absorption and emission, macroscopic structures consisting of many CNTs gathered together also demonstrate interesting optical behaviour, e.g. a millimeter-long bundle of aligned MWCNTs emits polarized incandescent light by electrical current heating and SWCNT bundles are giving high brightness emission at lower voltage compared to conventional tungsten filaments.

- **Nanomedicine and biotechnology**

Carbon nanomaterials such as nanotubes or graphene not only are widely researched for their potential uses in industrial applications, they also are of great interest to biomedical engineers working on nanotechnology applications. There is considerable interest in using CNTs for various biomedical applications. The physical properties of CNTs, such as mechanical strength, electrical conductivity and optical properties could be of great value for creating advanced biomaterials. Carbon nanotubes can also be chemically modified to present specific moieties (e.g. functional groups, molecules and polymers) to impart properties suited for biological applications such as increased solubility and biocompatibility, enhanced material compatibility and cellular responsiveness. Nitrogen-doped carbon nanotubes for instance have been

developed for drug delivery applications. However, the issue of cytotoxicity of CNTs is an area that has already attracted much research interest and has not resulted in a definitive answer yet. Given the inconclusive state of these nanotoxicology studies researchers say that more systematic biological evaluations of CNTs having various chemical and physical properties are warranted in order to determine their precise pharmacokinetics, cytotoxicity and optimal dosages.

- **Filtration**

High-flow membranes are an important part of future energy-efficient water purification. Already, researchers have demonstrated efficient water transport in carbon nanotubes with openings of less than one nanometer. When embedded in fatty membranes, the nanotubes squeeze entering water molecules into a single file chain, which leads to very fast transport. The flow was 10 times faster than in wider carbon nanotubes and 6 times faster than in the best biological membrane, a protein called aquaporin. Carbon nanotubes also have been used to demonstrate protective textiles with ultra breathable membranes. These membranes provide rates of water vapour transport that surpass those of commercial breathable fabrics like Gore-Tex, even though the CNT pores are only a few nanometers wide. Crucially, they also provide protection from biological agents due to their very small pore size, less than 5 nanometers wide. Biological threats like bacteria or viruses are much larger and typically more than 10-nm in size. In order to make these membranes also protect from chemical agents, who are much smaller in size, researchers modified the CNT surfaces with chemical-threat-responsive functional groups. These functional groups will sense and block the threat like gatekeepers on the pore.

Stevia Leaf Powder - Promising Alternative and Healthier Natural Sweetener to Substitute Sugar in Ice Cream

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One of the promising alternatives and healthier sweeteners to substitute sugar in ice cream is the use of stevia leaf powder as it is known to have no calorie content. Stevia leaf powder is a natural sweetener which has a potential to substitute sugar in ice cream production. With increase in proportion of stevia leaf powder, ice cream viscosity increases whereas overrun value decreases. The time of ice cream melting becomes longer with increase in proportion of stevia leaf powder. Replacement of sugar with stevia leaf powder decreases the caloric value and increases in the antioxidant activity of ice cream.

Ice cream is one of the many other dairy products which are favourable by consumers because of its sweet taste and high nutritional value which can be easily assimilated in the body. The utilization of alternative sweetener to substitute sugar in ice cream production is become more popular as consumers' awareness of healthy food has been increasing. However, the utilization of alternative sweetener should consider common problems occurred in ice cream production, such as its viscosity, overrun, melting time and also consumers' preferences on healthy product. Therefore, the utilization of alternative sweetener should be able to improve ice cream quality while also provides additional benefit for consumers' health.

Stevia leaf powder is a natural sweetener which has a potential to substitute sugar in ice cream production. Stevia leaf powder (*Stevia rebaudiana*) contains 5-10% *stevioside* and is 10-15 times sweeter than sucrose. These stevia leaf powder characteristics thus provide a sweet taste, while also safer for diabetic consumers, consumers with dental caries and obesity. Moreover, stevia leaf powder also known to contains phenol compound as much as 2.5% (on dry basis) which showed IC_{50} inhibition at 50% of DPPH radical at $11.04 \mu g^2$. This showed that the utilization of stevia leaf powder as

sugar substitution on ice cream production could also give an antioxidant property to the ice cream by the availability of phenol compound from the leaf powder. Phenol, as an antioxidant, would complement the lack of electrons in free radical, inhibiting the chain reaction of free radical formation from continuous oxidation process in the body when consumed.



Preparation of ice cream - The materials required for ice cream production are raw milk, skim milk, non-dairy creamer, sugar, stevia leaf powder and emulsifier. The ice cream is prepared by firstly pasteurizing the fresh milk at $65^{\circ}C$ for 15 minutes, then adding the skim milk (5.5%), non-dairy creamer (5.5%), emulsifier (2.5%), sugar (15-20%) and stevia leaf powder (0.1-0.6%). The mixture is then homogenized with a mixer for 15 minutes. The next step is aging the homogenized mixture in the refrigerator at $4^{\circ}C$ for 4 hours, followed by freezing in an ice cream maker. The produced ice cream is then placed in the freezer for 24 hours.

Viscosity - Ice cream viscosity increases with increase in proportion of stevia leaf powder. It is due to the fiber content of stevia leaf powder. The fiber content in stevia leaf powder increases the total solid content of the ice cream which results in more viscosity in the ice cream.

Overrun - Ice cream overrun is the condition where ice cream volume is increases due to the trapped air in the ice cream dough during agitation and freezing process. The ice cream formulated with stevia leaf powder show decrease in overrun value following the increase of stevia leaf powder proportion.

Melting rate - The ice cream melting rate is the time for the ice cream to melt completely at room temperature. The fat content in stevia leaf powder increases fat content in ice cream and affect the rate of melting the ice cream. The time of ice cream melting becomes longer with increase in proportion of stevia leaf powder. Use of stevia leaf powder affects the strength of ice cream body. More stevia leaf powder form a thicker and sturdier ice cream structure, therefore slows down the melting process.

Sugar content - The lower percentage of sugar in the ice cream with stevia leaf powder substitution is regarding that the used sugar was mainly sucrose, wherein sucrose the total dissolved solids is basically the total sugar content in a material. The existing sweetening agents in

stevia leaf powder are glycosides consisted in stevioside, rebaudioside and dulkoside. All of which are bound to carbohydrates such as rhamnosa, fructose, glucose, xylose and arabinose. Sucrose content in sugar is very high, up to 99.8%, while sugar levels in the stevia leaf powder is around 74.6 g per 100 g stevia leaf powder, in which 1 tsp sugar sweetness level equivalent to 1/8 stevia leaf powder, so that 1 g of sugar is equivalent to 0.125 g of stevia leaf powder.

Total Calories - Replacement of sugar with stevia leaf powder as a sweetener by itself reduces the caloric value of the product. The number of calories content in sucrose is 3.94 kcal/g while in the stevia leaf powder is 2.7 kcal/g.

Antioxidant activity - The content of antioxidant compounds such as flavonoids and phenols present in stevia leaf powder increases the content of antioxidant compounds in ice cream and affect the antioxidant activity of ice cream. So there is increase in the antioxidant activity of ice cream with the increase in proportion of stevia leaf powder.

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Mathematical Model of Security System Based on Human Speech Recognition and Body Recognition

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Technology is the fastest growing field now-a-days. In this vast field one must need security system which uses electronics gadgets and this security system must be growing and updating simultaneously with technology. This growth in electronic transactions results in a raise of demand for fast and accurate user identification and authentication system. Total security system may solve this problem since number of parameters like face, speech, fingerprint, palm print etc. are undeniably connected to its owner. It is also verify quantitative data like e-cards, password and login-ID etc. of human being. This is the review of the security system based on speech recognition and body recognition of human kind through mathematical model. It can compare the recorded speech and body expressions with original speech and body expressions which are stored in a central or local database to give perfect identification.

Technology is growing up day by day in the present era. The rapid growth in the use of internet applications and the great concern for security require reliable and automatic personal identification. In this vast field one must need security system which uses electronics gadgets/devices and this security system must be grown up and updated simultaneously with technology. This growth in electronic transactions results in a raise of demand for fast and accurate user identification and authentication system. Total security system may solve this problem since number of parameters like face, speech, fingerprint, palm print etc. are undeniably connected to its owner and it is also verify quantitative data like e-cards, password and login-ID etc. of human being. This is the review of the security system based on speech recognition and body recognition of human kind through mathematical model. Speech recognition, which can be classified into identification and verification, is the process of automatically recognizing who is speaking on the basis of individual information included in speech waves. Speech verification is the process of accepting or rejecting the identity claim of a speaker. Most applications in which a speech is used as the key to confirm the identity of a speaker are classified as

speaker verification. But sometimes speech has the problem of not being able to identify human with sore throat. Such problems can be solved with body recognition. In body recognition, digital video cameras connected to computers have come into wide use recently. Body recognition has to be able to perform the basic two tasks i.e. to detect and track people and person recognition. Today there are a number of computer techniques that can be used in automatic visual surveillance systems, face detection and face recognition have been thoroughly studied over the last 10 years in computer field. While recent face detection systems are able to deal with large pose variations, face recognition systems are limited to identifying persons in frontal and near-frontal views only. Recently, learning-based techniques and template matching have been applied to detecting people. The periodicity of gait allows to detect walking people in image sequences. Gait has also been used for person recognition in image sequences. There are number of challenges for human body detection and identification like the invariance against pose changes, changes in illumination and the selection of image features which allow to reliable identify human body. In this review there is discussion on speech

recognition and body recognition for security purpose with Gaussian Mixture Models (GMM) and body recognition Model.

Speech recognition

Speech recognition technique makes it possible to use the speaker's speech to verify their identity and control access to services such as voice dialing, banking by telephone, database access services, information services, voice mail, telephone shopping, security control for confidential information areas, and remote access to computers. Speech recognition is generally used as a human e-machine interface for other software. A speech recognition system performs three primary tasks i.e. pre-processing - converts the spoken input into a form the recognizer can process, recognition - identifies what has been said and communication - sends the recognized input to the software/hardware systems that need it. Speech recognition is the translation of spoken words into text. There are two types of speech recognition one is text dependent and other text independent and different methods likes HMMs, GMMs, SVMs and NNs may be used for it. The HMM (Hidden Markov Models) is usually for text dependent speaker recognition since there is textual context. As a special case of HMM, GMM are used for doing text independent voice recognition.

Body Recognition

Images of full-body persons are represented by color based and shape based features. The system consists of two modules one is image pre-processing and other is human body/pose recognition. Overview of the human body recognition is shows in figure. First of all, human image is capture from the camera and forwarded to the pre-processing module, where human body and its feature, extract from the background. In recognition module, human body is recognized with the human identity and pose of human.

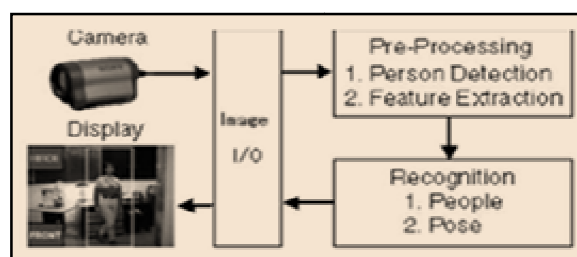


Figure : The system overview of human body recognition

Applications

The present era of information and technology is quickly revolutionizing the way of transactions and security plays an essential role in technology. For example, access codes for banks accounts and computer systems often use PIN's for identification and security clearances. When credit and ATM cards are lost or stolen, an unauthorized user can often come up with the correct personal codes. In this case total security system may solve this problem, since the total security system works with qualitative data and quantitative data of human and identifies human characteristics like face, speech, fingerprint, palm print, body etc. are undeniably connected to its owner. This system is highly beneficial for bank, military, crime branch etc. As described above GMM and SVM used for voice recognition and human body recognition respectively and so both recognition techniques are most useful in total security system. The total security system is the system which verifies quantitative data like e-cards, login-ID and password as well as qualitative data like face, voice, body, iris of human. The advantages of using a GMM as the likelihood function are that it is computationally inexpensive, is based on a well-understood statistical model. It is insensitive for text-independent tasks of the voice from the database. Let have probability density function (PDF) where the parameters have unknown values. When are the observed sample values and is regarded as a function of, which is called likelihood function. The maximum the

likelihood estimates are those values of the s that maximize the likelihood function, so that when the s are replaced with s , which gives maximum likelihood estimation output. Thus, electronic device identifies highest likelihood value from the collection of training data, which data is generated by the GMM. To ensure a good dynamic range and better discrimination capability, log of the likelihood is computed. At the verification stage, the process is very similar to the identification process described above, with the exception that instead of computing the log likelihood for all the voices in the database. Input voice is compared with the database. If the input voice gives a better log likelihood, the input voice (speaker) is verified and otherwise rejected. The comparison is done using the log likelihood ratio (LLR) test. When the logarithm of the likelihood ratio is used, the statistic is known as a log

likelihood ratio statistic. In body recognition, the system recorded human expression and pose during whole one day. From the video recording, system captures different poses (left, right, front, back) and expression of the one person and prepares the training data with normalizing color, features and expressions. Now whenever next time person is passing through the system, the pose and expressions are captured. The system first recognizes the person and then selects the proper multiclass classifier (SVMs), to determine the pose of the person. The system returns the pose identification rates and human expression identification rates of the input person. If it matches from the training data then person is verified otherwise rejected. For both tasks, person identifications and pose estimation the best results are obtained with normalized color features as well as SVM classifiers.

Black Hole - Revealing the Secrets of Universe

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Black hole is a region in space time having strong gravitational acceleration; so strong that not even matter particles but also electromagnetic radiations like light cannot escape from it. According to Einstein's general theory of relativity highly dense compact mass can deform space-time to form black hole. The curve which bound this region is known as event horizon. Event horizon is the place from where nothing can escape, not even light. The four types of black holes are primordial, stellar, super massive and miniature black holes.

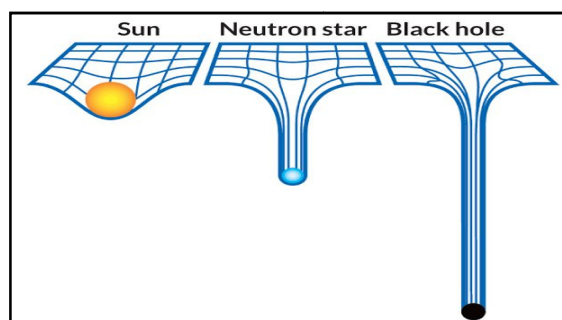
The existence of black hole was predicted by astronomical pioneer and English clergyman John Michell in a letter published in November, 1784. Along with Michell, Mr. Laplace also put some theories regarding existence of black hole. In 1915, Albert Einstein developed his general theory of relativity in which he had put some solutions and equations of space-time. After the few months later of this theory Karl Schwarzschild found a solution to the Einstein field equations, which describes the gravitational field of a point mass and spherical mass. What was this point mass and spherical mass found over the space-time graph of universe predicted by Albert Einstein? This point mass or spherical mass is nothing but implies towards the existence of the black holes, the area or place where space-time graphs bends or the space-time lines bends towards it. But it was not clear at that time and all scientists were trying to define it.



What is black hole ?

It is a region in space time having strong gravitational acceleration; so strong that not even matter particles but also electromagnetic radiations like light cannot

escape from it. According to Einstein's general theory of relativity highly dense compact mass can deform space-time to form black hole. The curve which bound this region is known as event horizon. In simple words it can be called as boundary. Event horizon is the place from where nothing can escape, not even light. In the centre of the black hole there is gravitational singularity i.e. one dimensional point where huge mass is concentrated in comparatively small space, where density and gravity are infinite and space time curves are too infinite. Alternately we can say that the space where black hole is located in the universe, there must be huge curvature in space-time. The more mass you place in smaller volume more will the gravitational pull. Now here question arise that, how such dense giant (Black holes) things are formed?



Formation of black hole

The mother of such hefty and feary thing is nothing but the stars itself. Stars are just like our sun but bigger than sun in size and shape. Stars are the astronomical objects consisting of luminous spheroid of

plasma together. Stars shine because of thermonuclear reaction or fusion. When the fuel of stars gets completely used, the gravitational pull from the centre of stars increases which is continuously prevented by thermonuclear fusion; this gravitational pull leads to the total collapse of star matter into its centre due to its own gravity. Now, after this collapse depending upon the size of stars and mass of stars, white dwarf, neutron stars and black holes are formed. Small or medium sized stars are usually converted into dwarf while comparatively big stars are converted into neutron stars or pulsars and massive, big, giant stars are converted into black holes after the collapse.

Types and location of black hole

The four types of black holes are as follows -

- **Primordial black holes** - These types of black holes are formed soon after the Big Bang in the early beginning of the universe. These are highly inhomogeneous and have high density.
- **Stellar black holes** - When massive stars run out of their nuclear fuel, an unstable situation is developed. If the central core of a star is massive enough i.e. 10 times more massive than our sun, then gravity takes upper hand and it gets ultimately collapsed. In this way stellar black holes are formed.
- **Super massive black holes** - Due to the speed of gas jets and position of star cluster, it is found that the centre of every galaxy consists of black holes. These black holes might be the result of the collapse of a dense cluster of stars.
- **Miniature black holes** - Theory suggests that miniature black holes too, form in the early beginning of the universe along with primordial black holes but scientists do not find any evidence of their existence. According to theory the event horizon of the miniature black holes are small as like atomic particles they are too small.

Astronomers cannot see black holes because they are invisible and very dense

objects from which not only particles but also light cannot escape, so how do they know these objects exist? They can infer the presence of a black hole from its interaction with a companion star. The strong gravitational pull of the black hole can tear off matter from its companion in large streams. The stream of star matter heats up as it circles closer and closer to the point of no return. Astronomers can see these accretion disks from the motion and the heat; they can infer the presence of a black hole.

Hypothesis and phenomenon regarding black holes

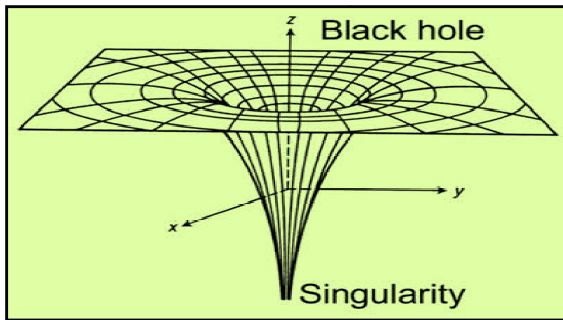
It is thought that on the event horizon time gets slowed i.e. time gets dilated. Time dilation is nothing but the difference in time of two places in the universe one of which is slower than the other. In Einstein's general theory of relativity it is proved that time is not absolute at every place in the universe; not only the universe but also on the earth it is relative to event, place and mass. It is observed that places where more mass is concentrated, there will be more density which implies to the more gravitational force and if more gravitational force, the rate of time is slow i.e. areas or places which have more gravitational pull will have more time dilation. Consider the formula as follows.

$$t = \frac{t_0}{\sqrt{1 - v^2 / c^2}}$$

Where, 't' is the time for moving frame of reference and t₀ is the proper time interval. In case of a black hole's velocity, it is nearly or absolutely equal to the speed of light so as light cannot escape from it hence the denominator will become zero, 't' will become infinite which implies that at the event horizon time is infinitely dilated which implies infinitely experiencing gravity pull which implies to an infinite amount of mass.

Second hypothesis was, if any object falls into the black hole then it might be forwarded to another dimension or

universe, which proved wrong after study it is found that, if any object fall into the black hole then mass of the object is added to total mass of the black hole which means the object, mass will became inseparable part of that event horizon and centre of black hole which ultimately follows law of singularity of our known physics law.

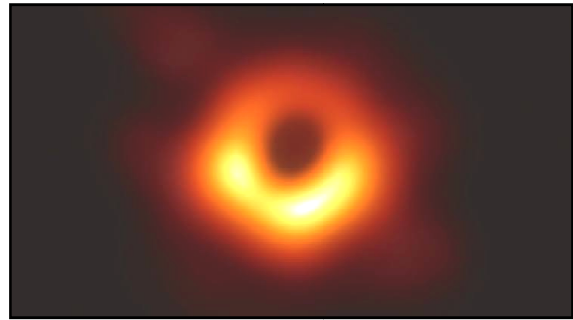


In 1970, the famous scientist Stephen Hawking proposed that all black holes leak mass or radiate mass in form of Ghostly quantum particle that escape over time. This radiation is known as Hawking radiation. Eventually Hawking radiation causes black holes to evaporate altogether leaving a single unique vacuum. Some consider that these vacuum may contains information from which blacks holes are formed, but some scientist differ on this topic and they leaking mass they may lose information of those material from which they are formed.

Recent activities

In figure the super massive black hole at the core of supergiant elliptical

galaxy Messier 87, with mass use 7 billion times the sun's as depicted in 1st image released. This is the 1st real image of black hole on 10 April 2019. In above image crescent shaped emission ring and central shadow is visible, which is gravitational magnified views of black holes taken by event horizon telescope. The main capture is event horizon of that black hole.



As per observations of scientist, it is known to us that in the centre of each galaxy in universe the black hole is present, which continuously engulfing the matter in our galaxy milky. Way our black hole is present in Sagittarius A* position i.e. present in Sagittarius constellation at A* position.



Bioinformatics in Drug Discovery

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Bioinformatics provides strategies and algorithms to predict new drug targets and to store and controls available drug targets information. The drug discovery involves different phases from target identification to preclinical development. Bioinformatics is the sum of computational approaches to analyse, manage and store biological data. It involves the analysis of biological information using computer and statistical techniques. It is the science of developing and utilizing computer database and algorithms to accelerate and enhance biological research.

Bioinformatics plays an important role in the design of new drug compounds. Rational Drug Design (RDD) is a process used in the biopharmaceutical industry to discover and develop new drug compounds. RDD uses a variety of computational methods to identify novel compounds, design compounds for selectivity, efficiency, safety and develop compounds into clinical trials candidate.

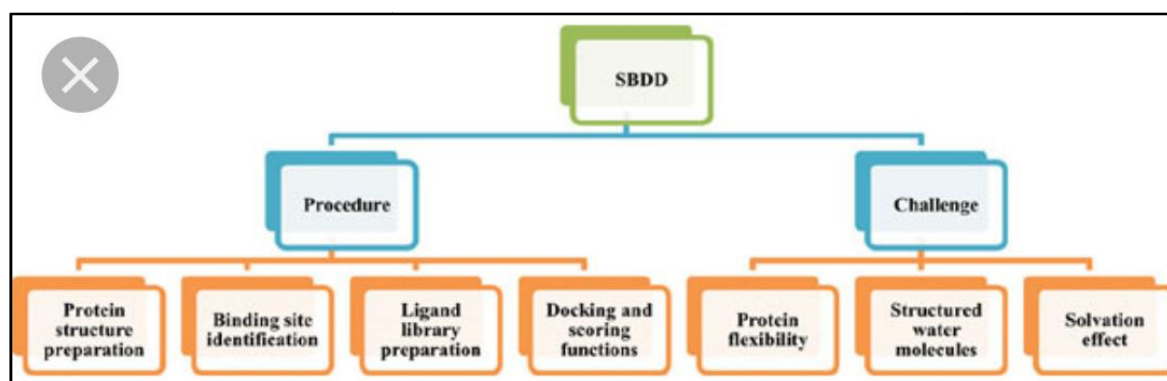
Drug Discovery is a step by step process by which new candidate drug are discovered. Bioinformatics deal with the exponential growth and development in primary and secondary databases like nucleic acid sequence, protein sequence and structures.

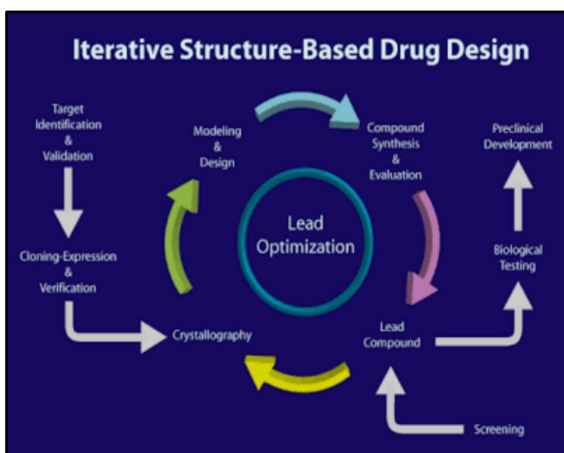


Structures based drug design (SBDD)

Structural Based Drug Design (SBDD) is one of several methods in the rational drug design toolbox. Drug targets

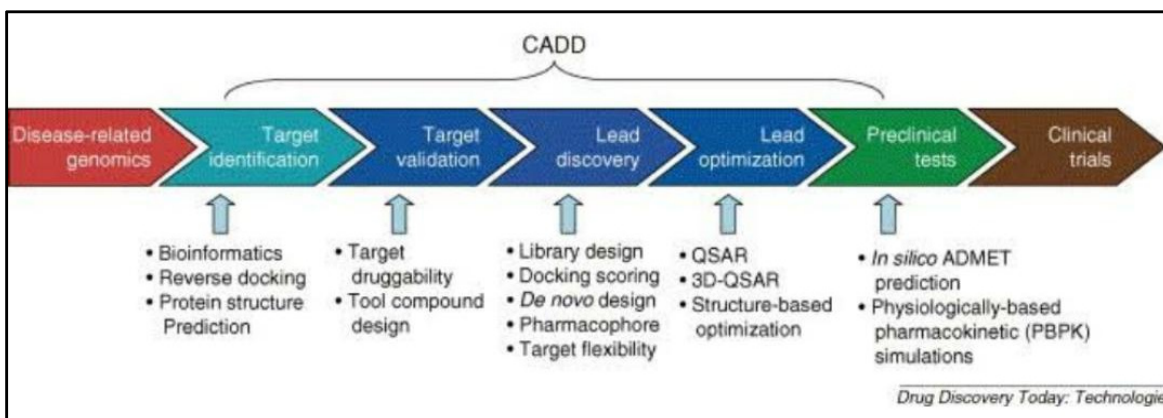
are typically key molecules involves in a specific metabolic or cell signalling pathways that are believed to be related to a particular disease states. SBDD uses the 3D geometrical shapes or structure of protein to assist in the development of new drug compounds. SBDD methods have been used in designing drug for a well known cancer related to protein complex. Two protein targets that have been studied extensively in cancer research are P53 and MDM2. These two proteins from a single P53-MDM2 complex as part of a cell signalling pathways that regulates cell division mutated form of P53-MDM2 results in various forms of tumours and cancer. The beauty of the SBDD methods is the extremely high level of detail that it reveals about how drug compounds and their protein targets interact. Docking ligand is one of the key benefits of SBDD method is the exceptional capability it provides for docking putative drug compounds (ligand) in an active site of targets protein in o process called molecular dynamics. SBDD allow research to dock ligand into protein active site.





Computer aided drug design (CADD)

Recent technique in bioinformatics in drug discovery including CADD is a method to stimulate drug receptor interaction. CADD methods are heavily dependent on bioinformatics application, tools and database. In vHTS protein targets are screened against database of small molecule compound to see which molecule bind strongly to targets. Zinc is a good example of vHTS compound library sequence analysis.



Drug design based on bioinformatics tools

The process of designing a new drug using bioinformatics tools has opened a new research area. However computational techniques assist one in searching drug targets and in designing drug silico. There are following paths to design drug

- **Identify targets disease** - It is important to know about disease and existing or traditional remedies. Bioinformatics method has been developed to virtually screen the target for compounds that bind and inhibit protein.

- **Study interesting compounds** - It is necessary to identify the lead compound that has some activities against disease.
- **Detect the molecule bases for disease** - If it is known that a drug must bind to a particular spot on a particular protein or nucleotide then a drug can be tailor made to bind the site.
- **Refinement of compounds** - Once you got number of lead compound have been found computational and laboratory techniques have been successfully in refining the molecules structure to get great drug activity and low side effects.
- **Quantitative structure activity relationship (QSAR)** - This computational techniques should be used to detect the functional groups in your compound in order to refine your drug.
- **Solubility of molecules** - To check whether the targets molecules in water soluble or readily soluble in fatty tissue will affect what part of body becomes concentrated in.

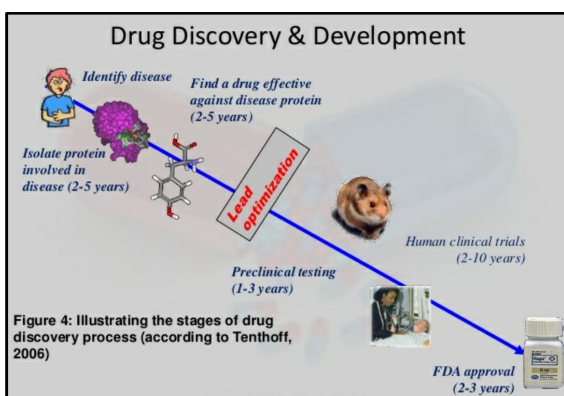
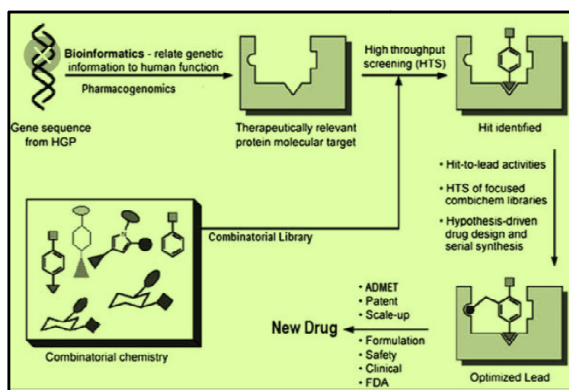


Figure 4: Illustrating the stages of drug discovery process (according to Tenthoff, 2006)



• **Drug testing** - Once a drug has been shown to be effective by an initial assay techniques, much more testing must be

done before it is given to patients. Animal testing is the primary type of testing at this stage.

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Biological Degradation of Plastic

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Being a frequently deliberate release pollutant, plastic is a major cause of environmental pollution. Researchers explore many physical and chemical methods for degradation of plastics. Microbial enzymes are one of the most eco-friendly tools used for the biodegradation of plastics. The low cost and low technology treatments capable of reducing and even eliminating plastics are developed by researchers. In activity of biodegradation most of the enzymes are found in fungi and bacteria. This review focuses on induced biodegradation rate of plastic by fungal and bacterial species. The microbial species produce enzymes along with surface active compounds called bio-surfactants, which enhance the degradation process.

Plastic is one of the abundant synthetic polymers. The accumulation of plastic is responsible for hazardous and long lasting detrimental change in environment. Plastic is polymer which consists of carbon, hydrogen, silicon, oxygen, chloride and nitrogen. Source of extraction of basic components used are oil coal and natural gas etc. It is widely used in our day to day life because of its stable and durable characteristics.

Polyethylene, polyethylene terephthalate (PET), polybutylene terephthalate (PBT), nylons, polystyrene (PS), polyvinyl chloride (PVC) and polyurethane (PUR) are widely used plastics. Polyethylene is of various types like LDPE (low density polyethylene), MDPE (medium density polyethylene) and HDPE (high density polyethylene). Due to lack of efficient methods for safe disposal these synthetic polymers are accumulating in the environment.

Biological degradation is a phenomenon of biological transformation of natural polymer (lignin, cellulose) and synthetic polymers (polyethylene, polystyrene). Microorganisms degrade the polymers by using it as a substrate for their growth.

Degradation varies from one microorganism to another as they possess different characteristics. Various factors which are responsible for biodegradation

are types of polymer, mainly the type of treatment and characteristics of organism. Types of enzymes which are produced for biodegradation are intracellular and extracellular. Enzymes are represented by character of microorganism. The substrate is initially accumulated by cellular membrane of microbe which is further degraded by cellular enzymes. Among this, high density polymers are not easily degraded due to their insolubility. Small units like monomer and oligomer are easily degraded as they are soluble. Insolubility is not suitable for the degradation of plastics by microbial flora.

Now a day's bio-plastics are used to save environment as it is easily degradable and reduce accumulation of pollutants. It is produced either from biomass and renewable sources or from fossil materials. Some petroleum base plastics are also used like polycaprolactone (PCL), starch blends etc. which easily degrade by microbes.

Polyethylene is a synthetic polymer having high hydrophobic level. It is widely used as packing material for milk and food products, plastic bags, water bottles etc. which is a main cause of environmental problems.

Polyurethanes (PU) represent the most common class of polymers which is specially used in medical, industrial and automotive fields. It is also have wide application in production of fibres,

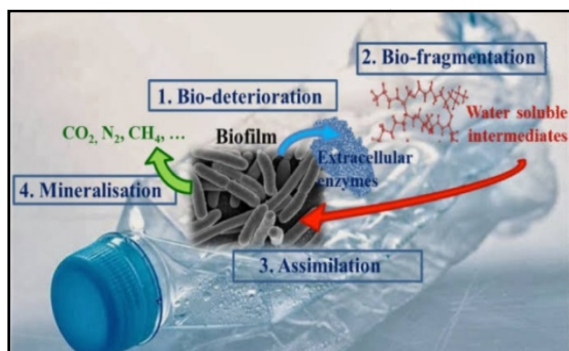
synthetic skins, adhesives, elastomers, paints, furniture, coatings, constructional material and padding's etc. This polymer is consists of series of urethane linkages.

Plastic degrading microorganisms

Buried polyester, polyurethane in soil shows the growth of both bacteria and fungi. In degradation process of plastic, fungal species are found more as compared to bacterial species. Genera of bacteria identified for biodegradation of polyester in in-vitro process are *Pseudomonas*, *Bacillus* and *Comamonas*. A thermophilic bacterium called *Brevibacillus borstelensis* strain isolated from soil degrade branches of low density polyethylene by utilizing carbon source and reducing its molecular weight by 30% when incubated with polyethylene film.

Geomyces pannorum is the predominant fungi consisting of 22-100% of the polymer PUR degrading fungi. The biodegradation activity is also found with *Aspergillus niger*, in which visible signs of deterioration occur quite slowly after about 30 days.

Biodegradation rate of plastic can be increased by improving the hydrophilic level or by reducing the length of polymer chain. Improvement is done by the oxidation which is to be accessible by microbial growth. Biodegradability of plastic polymer can be checked by measuring the changes macroscopically or observing microbial growth after exposure to the enzymatic environment but mostly by CO₂ evolution.



Mechanism of enzymatic biodegradation

The most eco-friendly and safer plastic waste treatment is microbial enzymatic degradation. Polyethylene is degraded by intracellular and extracellular depolymerises found in fungi and bacteria. Firstly, enzyme gets attached to polyethylene substrate and then catalyzes it by hydrolic cleavage. Complex polymer disintegrates into short chains as monomer, dimer and oligomer, which pass through the bacterial membrane and act as a sole source of carbon and energy. These processes are referred as depolymerisation and mineralization, in which CO₂, H₂O and CH₄ are produced as end product. The mechanism of enzymatic biodegradation is further explained as flow chart.

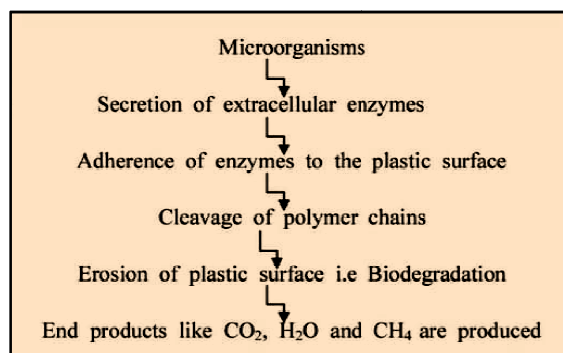


Figure : Mechanism of the enzymatic biodegradation of plastic

Enzyme varies with plastics

Amount of various enzymes produced by the micro-organisms vary with species, even between strains of the same species. A main characteristic of enzyme is their specificity, as enzymes are very specific in their action on substrate. Some strains capable of degrading the polyethylene are *Brevibacillus spp.*, *Bacillus spp.* where proteases are responsible for degradation. Serine hydrolase, esterase and lipase enzymes found in *Pseudomonas*. Lipase degrades 53% of polyester type polyurethane films after 24 hour reaction.

Significance - Biodegradation process is very eco-friendly. The growth of microbes optimized by controlling temperature,

incubation time, humidity and substrate by polyethylene, polyurethane, which are consumed as an energy source. It helps in the production of large amount of enzyme. It is the safest method to handle hazardous waste like plastic.

| Source | Enzyme | Microorganisms | Plastic act as substrate |
|-------------|----------------------|--------------------------------------|-------------------------------------|
| Fungal | Glucosidases | <i>Aspergillus flavus</i> | Polycaprolactone(PCL) |
| | Unknown | <i>Penicillium funiculosum</i> | Polyhydroxybutyrate(PHB) |
| | Cutinase | <i>Aspergillus oryzae</i> | Polybutylene succinate(PBS) |
| | Catalase, Protease | <i>Aspergillus niger</i> | PCL |
| | Unknown | <i>Streptomyces</i> | PHB, PCL |
| | Urease | <i>Trichoderma sp.</i> | Polyurethane |
| | Cutinase | <i>Fusarium</i> | PCL |
| | Unknown | <i>Amycolaptosis sp.</i> | Polylactic Acid(PLA) |
| | Serine hydrolase | <i>Pestalotiopsis microspora</i> | Polyurethane |
| | Manganese peroxidase | <i>Phanerochaete chrysosporium</i> | Polyethylene |
| Bacterial 1 | Lipase | <i>Rhizopus delemar</i> | PCL |
| | Unknown | <i>Firmicutes</i> | PHB, PCL, and PBS |
| | Unknown | <i>Protobacteria</i> | PHB, PCL, and PBS |
| | Lipase | <i>Penicillium, Rhizopus arrizus</i> | Polyethylene Adipate(PEA), PBS, PCL |
| | Serine hydrolase | <i>Pseudomonas stutzeri</i> | Polyhydroxyalkanoate(PHA) |

Conclusion - In natural condition, within three months of incubation period, *Pseudomonas fluorescence* affect the initial weight of polyethylene up to 70.10% and *Bacillus subtilis* affect upto 62.17%. But in laboratory, with optimized conditions *Bacillus subtilis* affect initial weight of the polyethylene upto 78.95%. Plastic is degraded due to microbial enzyme activity, but it varies in natural and artificial conditions due to different environmental conditions.



Recent Cancer Remedies

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Cancer is one of the commonest causes of patient death in the clinic and it is a complex disease occurring in organs and also in organ systems or both in the body. The poor diagnoses, therapies and prediction of the disease could be mainly due to the variation of durations, locations, sensitivity and resistance against drugs, cell differentiation and origin, and understanding of pathogenesis. With increasing evidence that the interaction and network between genes and proteins play an important role in study of cancer molecular mechanisms, it is necessary and important to introduce a new concept of systems clinical medicine into cancer research, to combine systems biology, clinical science, omics-based technology, bioinformatics and computational science to improve diagnosis, therapies and prognosis of diseases. Cancer bioinformatics is a critical and important part of the system.

New bioinformatics techniques

DNA microarray technology has revolutionized the process for discovering the relationships between gene expression and disease patterns. The use of microarrays (DNA microarray is a collection of microscopic DNA spot attached to a solid surface) set has resulted in the generation of vast quantities of data with the need for high-throughput computational techniques for analysis. Traditional methods of analysis such as clustering have revealed highly informative information for hypothesis generation but have generally been limited to single experimental runs focused on a specific cancer type. Newer techniques have sought to move beyond the single chip analysis and look for higher level patterns that are evident only across multiple, disparate microarray experiments.

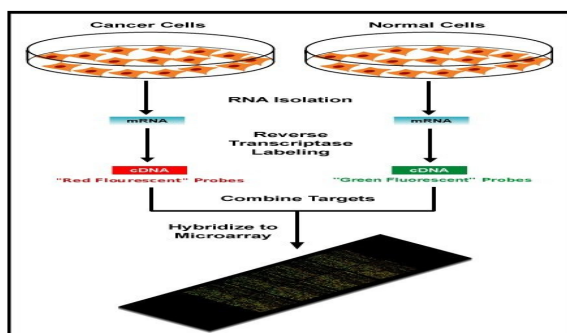


Figure : DNA microarray

The development of systems to analyze individual genome data is an ongoing activity in many groups and

institutions, with diverse implementations tailored to their bioinformatics and clinical units. In future, this type of pipeline will allow oncology units at hospitals to offer treatment for individual cancer patients based on the comparison of their normal and cancer genomic compositions with those of successfully treated patients. However, this will require the exhaustive analysis of genomic data within an analytical platform that covers the range of topics described here. Such genomic information has to be considered as an addition to the rest of the physiological and medical data, essential for medical diagnosis.

Methodologies of cancer bioinformatics

Cancer bioinformatics is one of multiple ways to concentrate bioinformatics methods in cancer, according to the specificity of disease metabolisms, signaling, communication, and proliferations. Clinical bioinformatics, an emerging science combining clinical informatics, bioinformatics, medical informatics, information technology, mathematics, and omics science together, can be considered to be one of critical elements addressing clinical relevant challenges in early diagnosis, efficient therapies, and predictive prognosis of patients with cancer. There is a need to develop cancer bioinformatics specific methodologies or introduce new and advanced bioinformatics tools to answer

the specific question of cancer. It may be a non-relative question or a future expectation how experts in cancer bioinformatics can help clinicians to establish the potential picture of gene or protein interactions and mechanisms correlated with tumor-associated shapes,

densities, or locations. A commentary by von der Heyde and Beissbarth in the thematic series on cancer bioinformatics in BMC medicine discusses the recent insights into mechanisms of cetuximab resistance in head and neck cancers resulting from novel analysis of the EGFR pathway.

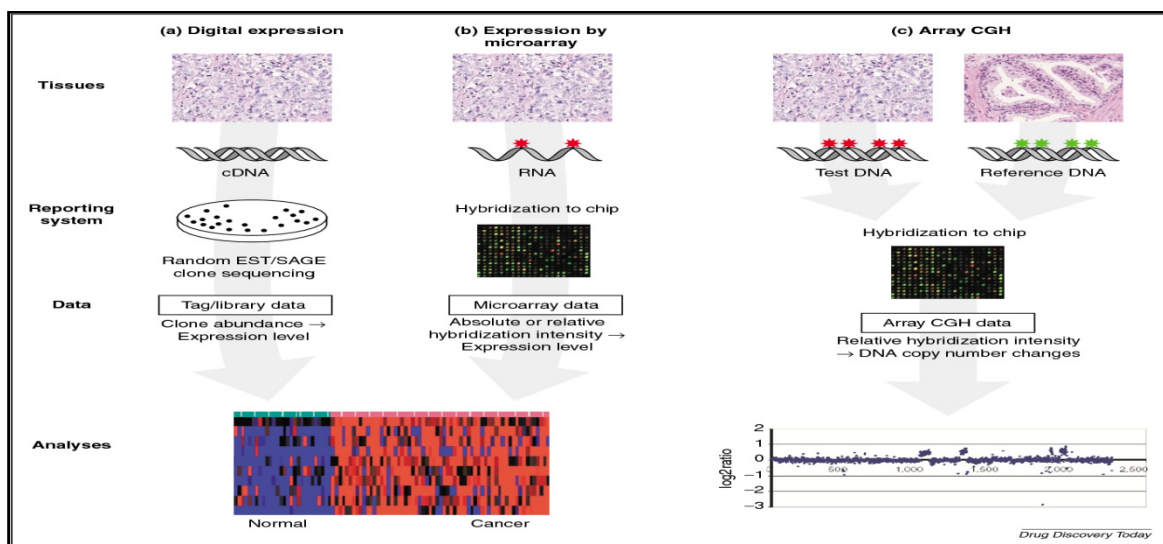


Figure : Methodologies of cancer treatment in cancer bioinformatics

Conclusion - Cancer bioinformatics as an emerging strategy, which is one of the most critical and useful approaches to systems clinical medicine for clinical research and applications and improve the outcomes of patients with cancer. The thematic series on cancer bioinformatics provides a unique and outstanding platform and opportunity for scientists to integrate omics science, bioinformatics tools and data, clinical research, disease-specific biomarkers, dynamic networks, with precision medicine, together fighting

cancer and improving the life quality of patients with cancer.

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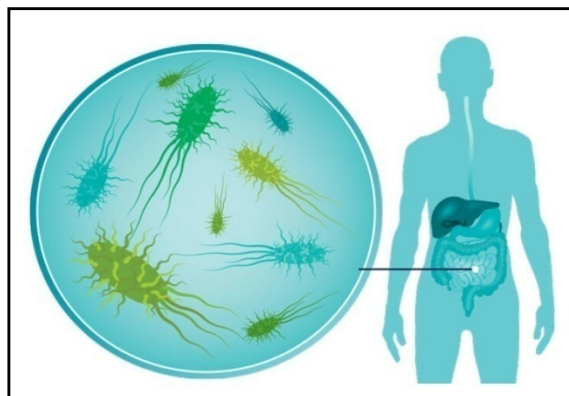
Conversion of Type-A Blood into Universal Donor Type-O Blood with the Help of Bacterial Enzymes

Ms. Shruti J. Rathi

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Scientist Elizabeth Pennisi and some chemical biologists at the University of British Columbia (UBC) in Vancouver etc. found a way to use a pair of enzymes from a human gut bacterium to convert type-A blood into type-O blood. They found that a group of bacterial enzymes found in a human gut efficiently removes sugars from the gut wall lining. These enzymes are found to be more effective at removing antigens from type-A blood.

People typically have one of four blood types-A, B, AB and O, defined by unusual sugar molecules on the surfaces of their red blood cells. If a person with type-A blood and receive type-B blood or vice versa, these molecules, called blood antigen can cause the immune system to mount a deadly attack on the red blood cells. But the type-O blood lacks these blood antigens making it possible to transfuse those blood cells to anyone.

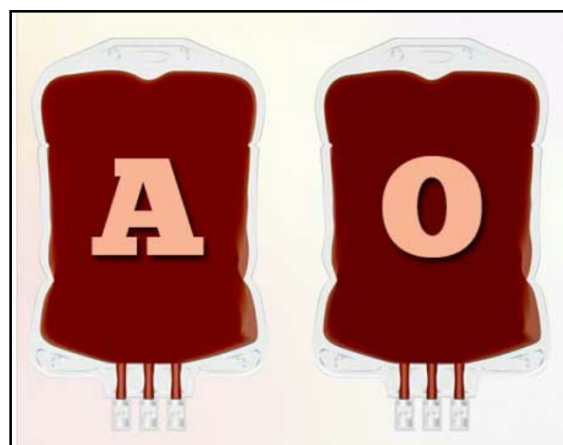


Recently in 'Nature Microbiology', a research paper presents the viable way to convert type-A blood into type-O blood using enzymes that from the gut bacterium *Flavonifractor plautii*. When these enzymes are added to type-A blood, molecules on its surface that define it as type-A becomes unattached, turning it into universal type-O blood. But on other hand type-O '-ve' is a very rare blood group and also it has no antigen, so it won't be flagged.

Conversion of blood of type-A into type-O

Making it a universally safe option for blood transfusion, scientist Elizabeth

Pennisi and some chemical biologists at the University of British Columbia (UBC) in Vancouver etc. decided to look for a better one among human gut bacteria. They found a way to use a pair of enzymes from a human gut bacterium to convert type-A blood into type-O blood.



Scientists found that the sugar are present (found) on the human digestive tract are quite similar to the ones found on blood cells and a group of bacterial enzymes found in the gut efficiently removes sugars from the gut wall lining. Researchers tested to see, if these enzymes could remove the sugars from type-A blood. After that, the gut bacteria enzymes are added to a unit type-A blood, which could get rid of the offending sugars, they found.

The findings are very promising in terms of their practical utility. They also found that the enzymes are more effective at removing antigens from type-A blood than previously tested enzymes.

This method is proved successful in clinical testing and is able to be applied to many other blood types that exist. This technique could save thousands of lives.

In the United States, type-A blood makes up just under one-third of supply,

meaning the availability of 'Universal' donor of blood could almost double.

Until, do you know your blood group

... If not, find out!

Donating blood is a simple and quick way to save a life

50 Golden years Shri R.L.T. College of Science, Akola



Shri R.L.T. College of Science, Akola, was established on 1st April 1970 and since then always keeps itself busy to develop the students through teaching, learning, research and extension in the field of science and technology. The college dedicates itself to the cause of science education and propagation of scientific temper among the students with social commitment and national integration.

A “Golden Jubilee” is an appropriate occasion for the college to take review of what it has been done and achieved during last 50 years. A journey of 50 years is a long period and it's a momentous occasion for the college to pause to recall the struggles and efforts of visionary donor 'Late Shri Radhakisanji Laxminarayan Toshniwal', along with former and present office bearers and life members of the Berar General Education Society, Akola which has contributed in many ways to the growth of the college.

Today, the recognition of the college as one of the leading educational institutions stems largely from the dedication, devotion, discipline and cooperative efforts of all the former and present principals, teaching, non-teaching and supportive staff members. I take this opportunity to extend sincere thanks to all of them, whose relentless efforts make the college as one of the best educational institutions in Maharashtra.

Dr. Vijay D. Nanoty

Principal

Shri R.L.T. College of Science, Akola

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