

# Lignum Vitae





‘कनेक्शन के लिए **कतार नहीं**  
रिफील के लिए **इंतज़ार नहीं**’



आपकी सेवा में...  
रातदिन प्रतिदिन



अधिकृत वितरक:

वितरण केंद्र:

# EDITORIAL

ASHMITA CHATTERJEE

If you really think about it, all of us are just a smartly designed collection of atoms. In spite of our simplistic roots it seems magical how complex the human body is, every cell working in perfect symphony with the other, mysterious in infinite ways; mythical in so many other.

The Human body seems to be an over worked theme. Much of our existence, evolution and survival on planet Earth has been extensively chronicled, its labyrinth of tissues and organs explored countlessly. Brazilian lyricist and novelist Paulo Coelho had once said that “The act of discovering who we are will force us to accept that we can go further than we think”. One may be tempted to think that we have exhausted the body of all its surprises, that there is no further to go. But what we fail to realise that in spite of our efforts, much about the human body still remains tantalizingly inexplicable. It is a bottomless receptacle of knowledge, a forest we have only begun to explore.

It is disheartening that we don't feel the same awe towards it now as our ancestors did; and this is what the editorial team deems to change with the fourth installation of Lignum Vitae. We bring to you a plethora of unanswered questions and unconventional pieces, explore a gamut of unfamiliar phenomena and debunk the more uncommon misconceptions about the Human Body.

This year, Lignum Vitae or the 'Tree of Life' extends a branch into the uncharted waters of Myths, Mysteries and Magic encircling the Human Body. Join us in this journey as we look through the neglected yet, breath-taking pages of the body and wonder what still continues to evade us in this seemingly ordinary world.

Lignum Vitae, Latin for the 'tree of life' is incidentally the national tree of the Bahamas. Belonging to the genus *Guaiaecum*, the tree is considered to be 'holy wood' in many regions of the world. This tree is symbolic of the all-encompassing nature of Life Science as an avenue of study.

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# Your Genes and Your Environment

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Have you ever wondered, how much control do you really have over your own life in general, and your health in particular? Since a long time such questions have puzzled many. The new science of epigenetics which is gaining importance of late, is now offering some answers to these questions. Changing your “thoughts and belief” could be one of the simplest ways to change and have control over your health and life, according to some scientists.

“Epigenetics” refers to covalent modification of DNA, protein, or RNA, resulting in changes to the function and/or regulation of these molecules, without altering their primary sequences. In some cases, epigenetic modifications are stable and passed on to future generations, but in other instances they are dynamic and change in response to environmental stimuli.

Ever since the sequence of the human genome was known, the term “epigenetics” is increasingly being associated with the hope that we are more than just the sum of our genes. There is now proof, that the food we eat, the air we breathe, the lifestyle we lead or even the emotions we feel, has an influence not only over our genes but these changes are also passed on to the genes of our descendants. That means we pass on not only our

good and poor genes but also our good and poor life style choices to the future generations.

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### *What are the modifications that take place?*

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The epigenetic changes control whether a certain gene is transcribed and translated or not. The main factors that bring about the change are environmental like food, exercise, our emotions etc. The different modifications that take place are methylation of DNA bases, or changes in the histone proteins like acetylation, deacetylation, phosphorylation, sumoylation and expression of different types of micro RNAs. All these changes bring about an alteration in the gene expression patterns which are retained throughout our life (Heard and Martienssen, 2013).

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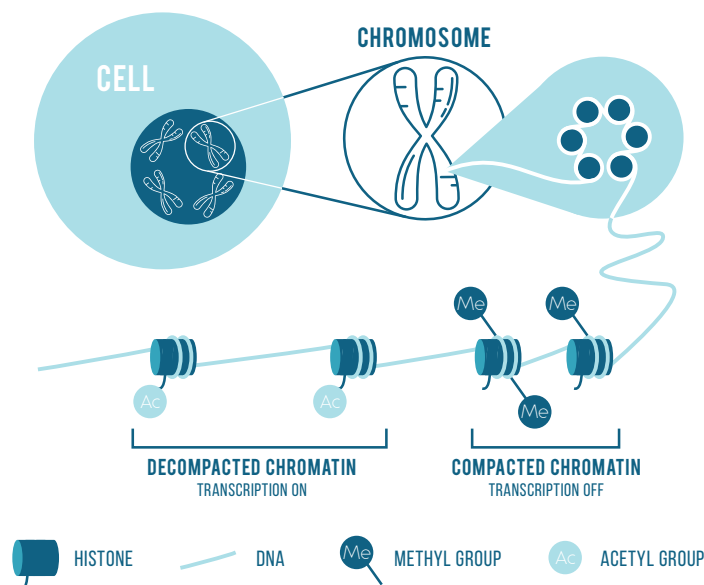
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### *You are what you eat*

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Our diet is one of the most important factors that bring about epigenetic changes. In a study done in the UK, it was found that junk food could actually slow down brain activity in children. According to the study





Some epigenetic modifications

conducted, children who eat fast food often are found to have poorer scores in tests for maths, science and reading when compared to children who are fed on a healthy diet. Researchers have suggested that a lack of iron – which is associated with fast food – leads to a slowing down of development of certain processes in the brain. In children who constantly feed on junk food epigenetic changes lead to such outcomes.

It has been identified that certain foods, such as cruciferous vegetables like broccoli, onions and garlic, turmeric, tomatoes, grapes etc. contain substances that act as histone inhibitors, allowing your tumour suppressor genes to activate and fight cancer. Regular consumption of such foods, results in naturally supporting your body's ability to fight tumours and remain healthy (Florea, 2014).

### *Exposure to heavy metals*

In a recent study, it was reported that the levels of lead in mother's neonatal blood has a significant influence on the DNA methylation profile of a child's neonatal whole blood. The study was carried out in 35 mother-infant pairs. Whole blood lead levels and DNA methylation levels were measured at over 450,000 loci from current blood and neonatal blood from both the mother and the child. It was found that mothers with high neonatal blood lead levels correlate with altered DNA methylation at 564 loci in their children's neonatal blood. These results suggest that exposure to lead during pregnancy affects the DNA methylation status of the foetal germ cells, which leads to altered DNA methylation in grandchildren's

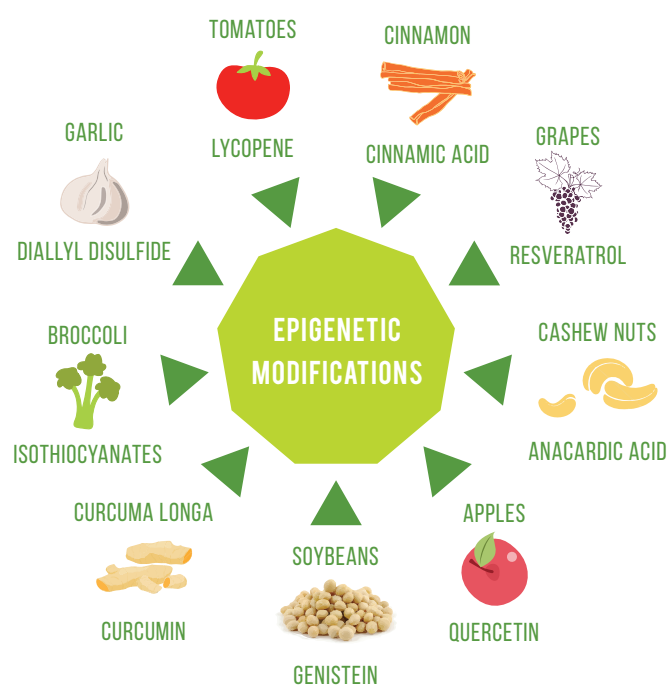
neonatal dried blood spots. This is the first demonstration that an environmental exposure in pregnant mothers has an epigenetic effect on the DNA methylation pattern of the grandchildren (Sen et al., 2015).

### *Exercise keeps you healthy*

We all know that a good morning walk, a brisk jog or activities like yoga or exercise keeps us healthy. Exercise provides many health benefits namely better cognition, cardiovascular and metabolic effects. This is because physical exercise brings about changes in the gene expression profile of skeletal muscle cells as a result of epigenetic changes. Molecular proof of this is in a recent study that showed that the levels of a trans-membrane protein called Irisin, increases in the plasma of humans with an increase in physical activity and results in enhanced metabolic functions (Jedrychowski et al., 2015)

So, what our grand moms and moms have been saying is true. We should pay attention to the food we eat and the lifestyle we lead. These have implications not only on our wellbeing but we will also pass this on to our grandchildren through the epigenetic modifications that take place.

So eat well, exercise well, sleep well and have good thoughts so, not only do you have a happy and healthy life and but also have happy and healthy grandchildren.



Food has an effect on your genes



# HANDEDNESS

MALLIKA TALWAR, SYBSC



Have you ever stopped to appreciate the design of a simple tool like a pair of scissors? If you look carefully at the handles of any common pair of scissors, you will realize that they are designed to suit a right handed user. A right hand grip causes the blades to press together more firmly to generate a sharper cut. Although, this may be news to most of us right-handers, ask any left-handed person and they will have a lot to tell you about the frustration that accompanies the use of not only a pair of scissors but also can openers, screws, guitars and even simple desks in most classrooms.

Most of us are well aware of the concept of handedness: the preferred use of the left or the right hand or one or the other depending on the task. The most commonly used marker for handedness is to see which hand is used for writing, based on which we may identify ourselves as left-handed, right-handed or ambidextrous. Approximately 70-90% of the world's population is right-handed. In reality however, measuring handedness is much more complex and the definitions to go by, remain vague and inconsistent. Bill Gates, for examples, is famously known to sign his cheques with his left hand but perform all other tasks with his right. Even more interesting is the case of ex-US president Gerald Ford, who supposedly, wrote left-handed while sitting and right-handed whilst standing up!

The complexity of this subject further deepens when we try to answer why most people are right handed and this remains one of the bigger mysteries of science. Although, several theories have been put forward to explain the reason for handedness among humans, none of them are conclusive on their own.

Throughout human history, we have seen a social bias towards right-handers. In fact, it is also thought that this bias itself has had some contribution to the increased number of right-handers. Very often, young children are encouraged and sometimes even forced to learn how to write with their right hands and in this way, the dominance of right-handers persist.

Perhaps the most common theory stems from brain

neurology. The human brain is divided into two hemispheres; the language and speech centers are most commonly found in the left hemisphere. It is theorized that fine motor skills such as those involving the use of hands, too, are found clustered with the language center. This makes the system more efficient as speech itself involves the use of many fine motor skills such as lip movements. Since the left hemisphere controls the right half of the body, most people turn out to be right-handed. However, this theory doesn't always hold true since more than half of the lefties in the world also have their language centers in the left hemisphere.

In comparison, the genetic theory is more widely accepted. Although some genetic basis behind handedness has been established, handedness is not inherited from parents in a simple way. It does not follow the simple dominant-recessive pattern of inheritance. In fact, even if both parents are left-handed there is only a 26% chance of the offspring also being left handed. While several theories are in place to explain the pattern of inheritance, the exact genes responsible for handedness have not yet been identified. However, some genes which are linked to higher odds of being left handed are known. Interestingly, variants of some of these genes have been linked to psychotic mental illnesses such as schizophrenia and even to certain language related disorders such as dyslexia. From an evolutionary perspective, scientists have found evidence of the occurrence of handedness amongst higher apes and even some prosimians. While previously, it was thought that handedness developed alongside another fascinating human achievement-speech, many scientists are now proposing that its evolutionary trigger might have been the increased need for motor co-ordination for tasks such as cracking nuts or digging out honey.

All in all, handedness is a complex and intriguing issue. The causes for handedness, whether they are social, biological, genetic or neurological or more likely a combination of all the above, are not fully understood and thus, have rendered handedness a fascinating and constantly developing area of research.



# WHY CAN'T WE TICKLE OURSELVES?

REANNE FRONTEIRO, SYBSC



I am a very ticklish person. A slight poke is enough to send me into hysterical laughter. I am sure everyone has been part of a tickle war at least once, in their lifetime, but have you ever wondered why it is almost impossible to elicit the same response when you try to tickle yourself? The answer to this question is intriguing, and pertains to an exciting topic in neuroscience.

The cerebellum, somatosensory cortex and anterior cingulate cortex are together responsible to process tickling. The cerebellum is a part of the hind brain which monitors movements. The somatosensory cortex is responsible for processing tactile stimuli i.e. touch, and is located in the parietal lobe of the cerebral cortex. The anterior cingulate cortex, located towards the front of the corpus callosum in the medial frontal lobe, processes emotions such as pleasure.

So how does tickling, a type of sensory stimulation, work? One of the functions that the cerebellum is capable of performing, is distinguishing between self-produced and externally produced stimuli. For example, your hand touching your leg is a self-produced stimulus, while an insect scurrying down your leg, is an externally produced stimulus. When you tickle yourself, the cerebellum determines the action to be self-produced, and can predict the sensations that it causes. Due to this prediction, the cerebellum now produces a secondary shadow signal that reduces or even inhibits the activity of the somatosensory and anterior cingulate cortex. In fact, fMRI imaging of the brain shows that there is an increased neuronal activity in this region when you are being tickled by someone else as opposed when you are tickling yourself. Which is why it is more 'tickly' and pleasant (unpleasant?) when you are

being tickled by someone else.

Now why, you may ask, does any of this matter! You see, tickling brings up many interesting concepts like the difference between the way the body responds to stimulus produced by itself and the stimulus produced by the environment. Simply put, it gives us insight into the neurological basis of 'self-awareness'. This is important, in view of all the sensory input that our body is constantly being bombarded with, we need to determine what is worth noting, and what can be ignored. It is a part of our survival instinct. I mean, imagine going into fight or flight mode every time your hand brushes against your leg! This concept can also be expanded and applied to explain other things, like why shoes don't feel uncomfortable but a cockroach under your foot does.

Another very interesting observation that comes out of this study, is that schizophrenics, unlike us, can actually tickle themselves! Scientists think this is possible because of neurological changes in their brain, due to which they cannot differentiate between self-produced and externally produced stimuli. So even though they are carrying out the action of tickling themselves, they attribute this action to an alien source, and the body naturally responds as it would if someone else really is tickling them. So further research in this area may help us better understand the disorder and perhaps help towards treating it.

Thus we see that the answer to the question of why we can't tickle ourselves, has far reaching consequences. Who knew right?! So the next time that you are in an impish mood, and are devising different methods to try and tickle yourself, know that you are conducting important research in the field of neuroscience!



# STRESS – DESTRESS : AVOID THE SHRINK !

NEHA JAIN, SYBSC

“

Stress level: extreme. It's like she was a jar with the lid screwed on too tight, and inside the jar were pickles, angry pickles, and they were fermenting, and about to explode.

”

**Fiona Wood**  
*(Plastic surgeon of British origin)*

The jar here is the brain and the angry pickles are our brain cells. Yea! That's what happens when we stress. Firstly, what is stress? Stress is a state of mental and emotional strain on the body. Or you may know it as that dead-line induced panic we all experience when we have procrastinated way too much on that assignment.

We often hear about how stress is bad for our health and our brain, and how it is not right to stress just before our exams as we might end up forgetting everything learnt. But the answer to the question “How exactly does stress affect the body and in particular the brain?” remains a mystery to many.

It is well known through published studies that constant stress causes hypertension and cardiovascular diseases; but, neuroscientists have now shown that it can also lead to permanent changes in the structure and functions of the brain.

We are all familiar with stressful situations like waiting for CIA results. The brain perceives this stress as ‘danger’ and acts; nerve signals are sent down the spinal cord to the adrenal glands to release more adrenaline to prepare the body for facing the ‘danger’; adrenaline increases the amount of sugar present in the blood resulting in increase in heart rate and blood pressure. Yes, all this happens when you wait for your results. And if this happens often, hypertension and cardiovascular diseases are inevitable, isn't it?

There is more to it than this. The brain is white (myelin

and glial cells), and grey (neuron cell bodies). Myelin is a fatty white substance covering the axons of nerve cells by forming a sheath known as the myelin sheath. This is vital for transmission of signals along neurons. Proper ratio of white to grey matter is essential for an efficient brain.

Now, chronic stress resulting in higher levels of cortisol—a steroid hormone released from the adrenal cortex, has been proven to produce more myelin-producing cells than neuron cells. This has been established through experimentation with rats. In the experiment, when the brains of rats were subjected to acute stress, they were observed to produce more oligodendrocytes—cells responsible for myelin cell production, than astrocytes—star-shaped cells whose functions vary from comprising the blood brain barrier to providing nervous tissue with metabolic support. Hence the increase in myelin results in signals getting transmitted less efficiently, thereby making the brain less productive.

Chronic stress leads to depression and anxiety later in one's life. Connectivity and dimensions of the amygdala— anterior portion of the hippocampus is responsible for emotional behavior and motivation. This connectivity is impacted by increased stress levels.

Cortisol is also responsible for maintaining the connectivity between the amygdala and hippocampus, which keep the system in a “fight or flight” mode. This is vital for the immune system of the body. But increase in cortisol levels inhibits this connectivity by changing the



stem cells present. This in turn impacts memory; negative feedbacks like depression and anxiety, and post-traumatic disorders may later be experienced in life.

Does stress actually decrease the size of the brain, or is it just a myth?

Stress does indeed decrease brain size. Chronic stress is responsible for the change in the volume and dimensions of the brain, and can also disrupt the process of acquiring knowledge and impede emotional functions. This occurs due to changes in genes responsible for synaptic connections, which leads to the formation of fewer connections.

Now for the good news! This change in the brain need

not be permanent. The brain, as mentioned by many neuroscientists, is called the “plastic organ” of the body and is known to undergo continuous changes throughout your life. So, even if you have stressed a lot in the past it’s not too late. Several methods exist to reduce stress and save your brain from decay. Diverting your mind from stressful thoughts by engaging oneself socially, regular exercise, having a healthy diet and proper sleep, have been known to be effective.

So, yes. Cutting down on fast food like Mc Donald’s and catching that extra hour of sleep instead of watching your favorite TV show might just save your brain!

## BUSTING MYTHS

### Eating mangoes leads to acne - TRUE

Acne is caused due to an abundance of sebaceous glands present on the skin, making it oily and resulting in the formation of blackheads, whiteheads, pimples etc. Hormones such as insulin also tend to affect acne patterns. An increase of insulin caused by high glycemic load (sugary foods) leads to increased acne.

Thus sweet foods such as mango do result in acne.



### Humans use only 10% of their brain - FALSE

The study of Einstein’s brain has created an urban legend far from the truth. While the brain has many unsolved mysteries, we have still mapped the functions of large portions of our brain. As of now no part of the brain has been found that doesn’t correspond to some function. If we did not use 90% of our brain, majority of our neural pathways would degenerate.



### Higher your IQ, the more you dream - TRUE

Those with a higher IQ are capable of activating larger parts of their brains leading to an increase in dreams.



### Peeing on a jelly-fish bite is the best cure - FALSE

Despite what the “Friends” episode suggests, instead of neutralizing the pain the process leads to aggravation and an increase in pain as the jellyfish stinging cells are activated by fresh water. Urine is fresh water!





# A winter's tale: COMMON COLD



AMRITA KALATHIL, SYBSC

**D**o you always get yelled at by your mother when you don't wear your jacket out during the winter or if you wash your hair right before you sleep? Does it always end with the same sentence you've heard a million times, "You'll catch a cold!"? Well, this statement should seem illogical to you because a cold is caused by a virus; a rhinovirus to be specific and so is the flu (influenza virus), not due to a temperature related phenomenon. The confusion is understandable; it is because of the common word 'cold'. Yes, the poorly made pun was intended!

However, there's more to the confusion than just a word. This also has to do with the resemblance in your body's defence mechanisms against the cold and against a cold. The mucus in your nose and throat dry up due to the chilly air with less moisture, making you sneeze and cough to keep the germs out, similar to what happens due to inflammation when you're down with a cold. You shiver when you're sick just as you do when you 'feel cold', which can be explained simply. Body heat is produced by movement, thus as temperatures fall around you, your body induces vibrations that help preserve the 'normal' 37°C. When attacked by a virus, substances called interleukins are released by your immune system; that signal the hypothalamus to shift the thermostat, resulting in a fever. Therefore, according to your body, "it is cold" and hence any action which would increase the store of heat is commenced. So there you go, another old myth debunked.

But a cold is more contagious in the winter due to increased transmission, as people tend to stay indoors in close contact with each other. Poor ventilation and low humidity results in the virus remaining on dust and water particles for extended periods of time. Low humidity results in higher transmission because smaller moisture droplets remain suspended in the surrounding air longer

as compared to heavier ones that fall easily, resulting in an increase in the inhalation of germs that inhabit these. Recent study shows that shifting of genes occurs seasonally, i.e. certain genes are expressed to a greater extent in one season as compared to another. Certain genes expressed in winter increase inflammatory responses and some expressed during summer suppress the same. So it's possible that even if you fall sick almost equally in the various seasons, it more often in winter time. Keeping warm may therefore be a necessary precaution.

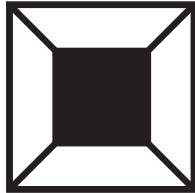
But hang onto your hats a little longer! Although we consider one occurrence parallel to the other for the wrong reasons, they might just have a strong correlation. One of the few theories explaining this correlation, involves the phenomenon of vasoconstriction. In winter blood vessel diameters reduce to ensure heat is distributed to components of the body that need it and away from those that do not. This disallows WBCs from entering the blood vessel and gaining access to pathogens.

It has also been found that cells assume apoptosis and produce anti-viral signals (interferons) to a greater degree in warmer conditions, which show better recognition and communication. Production of cortisol, a steroid that suppresses the immune system is also induced by temperature related stress in the winter as the body tries to conserve heat. Viruses replicate to a greater extent during cooler seasons, as increased cooler regions of the body facilitates this. Another relevant point to note, is the nature of the viral membrane at different temperatures, which also affects transmission and replication.

Though the debate remains unsolved and we are back to square one, we do know you are susceptible to catch that pesky cold during the winter. So layer up those clothes, keep warm and listen to Mother!



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# ON THE EVOLUTION OF RELIGION

JANAKRAJ BHATTRAI, TYBSC

Mystery, myth and magic spring out of a core central theme that surrounds humans through their evolution; religion. A belief of the existence of an extraordinary, powerful entity that governs all that surrounds.

This belief has majorly been attributed to a human form but has also extended to a multitude of other entities. Some of the most interesting ones include aischolatriy (worship of dirt), arborolatriy (worship of trees), autolatriy (self-worship), aynolatriy (dog worship), necrolatriy (worship of the dead) and so on. The beauty of religion is that it has evolved in mass as well in isolation in almost all niches of

humankind. From big cities to isolated tribes, there exists an undisturbed, involved belief in such a power.

We occasionally come across debates on the existence of God that are accompanied by contrasting opinions. Let us not get into the debate but using a logical, unbiased approach try to reason with the same. Often it has been a limitation of our understanding and we perceive the solutions to lie on extreme edges of “yes and no”, and both separate from each other. It must be noted that phenomena in nature are seldom quantised but never compartmentalised. Essentially, it means that the answer may not be merely a YES or a NO, there are numerous

possibilities with combinations of yes and no; a gradient from the yes extreme to the no extreme.

Scientifically, we certainly cannot accept a force that is supernatural. However, there are many events that cannot be explained because of our limited knowledge, but some claims can be certainly disproved with the amount of knowledge we have.

On the other hand we must also realise that religion has been associated with humans throughout evolution for tens of thousands of years. Something that has played a very important role in our evolution and has been a belief of many great minds in the past as well as present, and cannot be just considered for naught.

Rather than an external control, religion seems to be an internal control that has made us do good and prevented us from doing bad. In evolutionary terms, good deeds are a set of actions that have given us an evolutionary benefit and bad have resulted in the opposite.

To understand this better, let us go to a time and a place where it all began- The Savannas, the birthplace of humankind. Let us consider two tribes living there in the prehistoric times (we'll call them tribe A and tribe B). Tribe A is a theist tribe i.e. they believe in an existence of a supernatural entity that rewards them when they do good and punishes them for bad. Tribe B is an atheist tribe. In tribe A, individuals help each other and work for the welfare of the tribe, fearing the unpleasant consequences of 'bad' and in the hopes of being rewarded for 'good'. As an outcome, they prosper as a society. Tribe B on the other hand is uncontrolled. There, the strongest and smartest will dominate over the others and kill the

ones they wish to eliminate. As an outcome, this tribe will be confined to limited number of families and a very small genetic diversity. If now we consider an occurrence of an undesired natural calamity or disease, the atheist tribe will be wiped off because of their limited number and diversity. Hence the theist tribe will create the next generation and so on. This explains the wide spread occurrence of religion. Therefore, the genes which said "God exists" gave an evolutionary benefit over the other.

Religion has acted as an internal law that has helped us evolve as a global society like none other. In recent times along with increased cognitive abilities and understanding, the development of external law and legislature has taken away from the dependence on an internal law. Upon understanding the nature of truth, we are trusted with the responsibility to now handle the well-being of our species. With realisation comes responsibility.

It must be noted that the article is based on the evolution of religion and not on its origin and it does not claim that religion is only reason for the development of human societies. Development of such multi-layered characteristics requires a number of factors amongst which religion could be a major one.

The motive of this article is not to answer the question of religion. It is to urge individuals to think of such matters with a logical and a reasonable approach and not get caught up by the dogma that surrounds us. Our perception is limited to our knowledge. Let us not get entangled in it but step out, accept new ideas and think wide.

Image Source: [www.weavinggrace.com](http://www.weavinggrace.com)

## BUSTING MYTHS

**Your heart beat mimics the music you listen to - TRUE**

Depending on the type of music you listen to, the tempo of your heart beat increases or decreases and the patterns vary. This knowledge can be used to decrease the effects of hypertension.



**Sleeping less than 7 hours reduces life expectancy - TRUE**

Sleep is essential for the normal functioning of our body. When we sleep our body rejuvenates as it grows, repairs itself, consolidates memories etc. Lack of sleep may even lead to many mental disorders.





# HOMOSEXUALITY

DHRYATA KAMDAR, FYBSC



Research has always been perceived as limited to the scientific community but little do we know that it can affect the attitude and the thought process of people on certain issues. For example, how it is helping people all around the world get more comfortable with the reality of homosexuality.

This generation understands that there are many types of sexual orientation. Many seem to have no issue in accepting homosexuality; but we have seen throughout history that this was thought to be a sin. But the fear of punishment can't change a man's sexual orientation. We have been brought up in a society that is increasingly accepting of this community. This wasn't the case in the 1980s where almost all of England was against this group of people. Now four in five of the British approve of this community.

Research since the 1920s has shown that being gay may have a genetic or biological basis. The publication of the findings of a Research conducted by a group of scientists in the Psychological Medicine in 2014 gave substantial evidence on the contribution of genes to the sexual orientation of a man. They provided a comprehensive study by conducting a genome wide linkage scan of 409 independent homosexual brothers and found two areas of linkage gene at chromosome 8 and Xq28 (X chromosome). Previous studies supported their claim that genes did play a role in the sexual orientation of a person. Epigenetic Theories on Homosexuality showed how genes not only

affected homosexuality but also its heritable factor. Many other studies show how the prenatal conditions and hormones, female fertility, number of male offspring and even brain structure can be factors that determine the sexual orientation of man. Although they are yet to provide concrete evidence, they did confirm that there indeed is a biological root.

Yes, environmental factors do play a role but it is a combination of both these factors and not one. And hence it is widely believed in the scientific world that being gay is not a lifestyle choice. It is a fundamental part of the person.

This conclusion has affected the way people look at homosexuality. We can see how the attitudes of people have changed towards gay men and lesbian women. I personally feel that this conclusion played a major role because knowing that someone might not personally choose to go against their religion or their understanding, but it is just a variation of human sexuality that they innately have, may help them accept it more easily. In fact a survey in Sweden, Philippines and The United States of America showed that when people were told that homosexuality might have a biological basis, more than half of the correspondents had a positive attitude towards the idea of gay men.

The field that we are in can have a profound effect on the community. Biology has the incredible power not just to tell us how we think but also to change what we think.



**DID YOU  
KNOW ?**

The heart has its own electrical impulse, it can continue to beat even when separated from the body.

# Once a cheater always a cheater?

ANANYA AGNIHOTRI, SYBSC

**Note:** The views and ideas presented in the article are of the author's and are based on current research on the subject. However, science is ever changing and evolving. Each day we discover something new which may or may not disprove our previously drawn conclusions. Readers are advised, to proceed at their own discretion.

As monogamous beings, we take our relationships very seriously- any upturning of this social order causes us unending pain and misery – but we cheat all the same. Some say that it cannot be helped and call themselves “commitment phobes”, or say they didn't mean to do it but that it happened anyway. Maybe there is more truth in these excuses than we would like to believe. A series of studies, not aimed at condoning such behavior, but merely examining it, has revealed that ‘cheating’ or ‘extra pair mating’ for some people maybe genetically controlled.

Humans are among the 3% of mammals that are monogamous by nature. Evolutionarily, monogamy has been advantageous- one partner provides food and protection, while the other raises the young. However, there are countless instances of inconstancy in relationships, and according to the studies in question, a particular gene having two variants, or alleles, may control this behavior. This gene codes for dopamine receptors. Dopamine is commonly known as the “happy hormone”, and is released after pleasurable activities such as cuddling, exercise and sexual intercourse. It has been found that 50% of people with the “long allele” of this gene had strayed from their partners, compared to the 22% with the “short allele” variant of this gene. People with the “long allele” were also most likely to be involved in unhealthy addictions such as smoking and drinking.

Vasopressin, a hormone associated with maintaining osmotic balance in the body, is also responsible for unfaithful behavior. Levels of this hormone, just like the “cuddle hormone” Oxytocin, can affect trust, empathy

and one's ability to interact in a social setting.

Directly injecting the pleasure centers of a polygamous Montane Vole's brain with vasopressin has shown to increase the likelihood of monogamous behavior. Furthermore, low vasopressin levels in people with autism, has been found to affect their ability to understand and perform appropriate social behavior. A study in 2014 involving over seven thousand Finnish twins revealed that “cheating” women showed an alteration for the gene that codes for vasopressin receptors, further reinforcing that low levels of vasopressin could result in unfaithfulness.

Of course, there are other social factors which result in cheating- money topping the lists. Men who earn more than their spouses by a huge margin, seem to end up being more unfaithful. On the other hand, “stay at home” fathers also show a higher tendency to cheat on their wives. Only when there is parity in the incomes of both partners, are the chances of straying minimized.

Failure of a previous relationship, unhappiness stemming from a current one, and of course, the evergreen “I was too drunk” are all responsible for infidelity, that have been found to affect heterosexual relationships. Whether they apply to same sex relationships, cannot be said with conviction, as they haven't been studied as extensively.

We are complex beings and unlike other mammals, our actions are at times governed by more than just biological and evolutionary needs. Apart from helping us understand why lasting in a monogamous, committed relationship is difficult for some, these studies sure do add substance to the adage, “Once a cheater, always a cheater”.

# SAVANT SYNDROME: THE PUZZLING ANOMALY OF GENIUS

JIGYASA DAYAL, FYBSC



KIM PEEK



LESLIE LEMKE

Who hasn't wished to wake up one day and find oneself to have become a genius? Well, albeit the rare thirty two cases, it is possible. This unusual condition, now known as the Savant syndrome, was originally described by John Langdon Down (the man who described Down's syndrome) as the 'idiot savant' syndrome which literally translates as 'knowledgeable idiot' in French. But why such an oxymoron to describe the condition? Savants are characteristically people possessing lower than average IQ, mental disabilities and the inability to perform very routine tasks like talking, eating, getting dressed, but who show rather contrasting spectacular abilities which earn them the description: 'island of genius'.

While most savants usually have severe congenital neurological disorders and autism spectrum disorder, some acquire this condition later in life after serious brain injuries or disease. On the global registry there are 319 known savants, of which only 32 have acquired Savant syndrome. At least half of all savants are autistic. Savant skills usually occur in one or more of these five areas: art, music, calendar calculation, mathematics, and spatial. The most common savant skill is calendar calculation, in which a person can name the day on any given date of any year accurately. Another common skill is super memory.

The cause of this malady is still unknown, but scientists have found that damage to the left anterior temporal lobe is a common seed of savant syndrome. One of

the theories about the syndrome is 'paradoxical functional facilitation' as described by Kapur (1996) which states that

due to damage to the left hemisphere, the right hemisphere compensates, which results in enhanced functioning of the right hemisphere. The right hemisphere, among other functions is devoted to spatio-visual development.

It is confirmed that they can intercept low level information which is normally available only at the sub conscious level. Another theory is that these individuals possess hypersensitivity which results in them grasping the most minute of details. Many cases of 'eidetic' or 'photographic' memory have been observed. Another anomaly seen with this condition is that the male savants outnumber the female savants 6:1. A probable theory is that high levels of testosterone in the embryonic stage tends to slow down the development of the left hemisphere resulting in compensation by the right hemisphere (Geschwind & Galaburda, 1987).

A few savant cases have been described below. It must be noted that Savant syndrome is not classified as a mental disorder and the word 'idiot' has been dropped from the original name as these individuals show certain remarkable abilities.





DANIEL TAMMET

## KIM PEEK

Kim was born with severe brain damage. The doctor had advised his father to put him in a mental institution and forget about him. Although he had low a IQ, and struggled with everyday tasks, he had extraordinary reading skills and memory, and had memorized over 12,000 books. It took him 3 seconds to read through 2 pages and the best part was that he could recall all the facts and trivia he had read. He was the inspiration for the 1988 movie 'Rain Man'. Along with this he could superbly perform calendar calculation.

## LESLIE LEMKE

He was born with severe birth defects which resulted in doctors removing his eyes. He was put up for adoption by his mother, and was adopted at 6 months of age by Mary Lemke, a nurse. He couldn't stand up till he was 12 and couldn't walk until he was 15. When he turned 16, Mary found him in the middle of the night playing Tchaikovsky's Piano Concerto No. 1 flawlessly in spite of having no classical music training. He had only heard it once on TV. Leslie can play any piece of music by listening to it just once. He has performed many concerts around the world.

## ORLANDO SERRELL

He is a rare case of acquired savant syndrome. He was born normal but when he was 10 years old he was hit on the head while playing baseball. After getting injured he continued playing and from that day onwards he has shown savant skills. He performs impeccable calendar calculations and he can remember the weather on any day post the day of the accident!



ORLANDO SERRELL



JEDEDIAH BUXTON

## DANIEL TAMMET

Often dubbed as the brain man, Daniel appears to be normal but in fact is a mathematical and lingual savant, having acquired his savant skills after a bout of epilepsy at the age of four. He has successfully recited the value of Pi to 22,514 decimal places from memory. He suffers from a rare condition called synesthesia which results in mixed up senses, for example seeing sounds and associating colors to smells. For example Pi to him appears to be a rolling landscape full of different shapes and colors. He is also a polyglot, comfortable with conversing in up to 11 languages. An Icelandic TV channel challenged him to learn a language in a week and to no surprise he did and also conversed with the TV presenter in Icelandic.

## JEDEDIAH BUXTON

He was the earliest known savant; he was born in 1707 in England. He was a superhuman calculator. He could not write, and had no knowledge of science or history and yet was able to calculate the area of his village by simply walking around it once. When examined by the Royal Society in 1754 his mathematical brain was able to calculate numbers up to 39 figures.

Is savant syndrome a way of the brain compensating for its severely damaged aspects, or is it a condition which helps those affected unlock the otherwise untapped regions of our brain? Is it just a superior memory retrieval mechanism, or merely a positive side effect?

Perhaps there is a savant in all of us who got lost over the years of evolution or perhaps it truly is a miracle.



# KEEP DREAMING, BUDDY!

JUDITH EVANGELINE, SYBSC

Elias Howe's idea for a mechanized sewing machine had a problem, he couldn't figure out where the eye of the needle should be placed. One night, he dreamed of being attacked by warriors with spears, which had holes at their tips. The dream provided him with the answer- a needle with a hole at the tip as its eye. Other great discoveries in history have also been the result of a dream, like Kekule's resonating structure for Benzene.

However the greatest problem lies in defining dreams and deciding how they can be useful, when we don't even remember most of them. Dreams occur during our REM cycle, we dream about four to six times during the night, throughout which we are in a state of paralysis. Sigmund Freud was one of the early trend setters in developing dream theories. According to Freud, dreams are a representation of the unconscious desires, and many psychologists have concurred that dreams are a significant part of our daily lives.

However, neurological research has shown that areas of the limbic system which are involved in emotions, sensations and memories; and also the amygdala along with the hippocampus send neural signals which the brain synthesizes and interprets as dreams. This theory called the Activation-Synthesis hypothesis, leads us to believe that dreams have no significant meaning but are merely signals being translated at the end of the day. It can also be considered as a recounting of the day's memories, as shown in the movie, *Inside Out*. Although some researchers still argue that a dream is a biologically evolved defense mechanism. According to this, threat simulation theory, dreams help us resolve problems subconsciously, fight our

fears and demons rationally and make us think logically and constructively when we encounter obstacles during the day. Therefore when faced with the same problem in the near future we subconsciously tackle it with a new approach.

What most people don't realize is that we can recall dreams, as research has shown that the brain uses the same path when recalling and amassing memories. We remember fragments of our dreams when we awake from our REM sleep, and dream therapists say that an additional effort such as writing down the dream immediately, is essential in remembering the dream in its entirety before it is lost from our memory. Some people can realize that they are dreaming and continue dreaming, an ability known as lucid dreaming, and can even help steer the outcome of the dream towards a particular direction. Psychologically speaking this helps with confronting difficult problems.

Dr. Stephen LeBerge says that people with the skill to lucid dream, can set a mental alarm to wake up at a specified time without an alarm clock. Ever wonder why during college days you wake up five minutes before the alarm rings but don't do so during the holidays? Now you know the answer. Lucid dreaming can be used to tame nightmares and give dreams a happy ending. However, honing this skill can be some tricky business, but rest assured that you will sleep peacefully knowing, you can control your dreams. So keep dreaming, and you may find the answers to life's problems or even dream up the next greatest invention! Because you know it's all in your head- I mean, in your hands!

**DID YOU  
KNOW?**

Humans are bioluminescent and glow in the dark. The light that we emit is 1,000 times weaker than our human eyes are able to pick up.



# Jamie

AKSHA CHOWDHARY, SYBSC

*A fictional illustration of the latest research on studies made by Susuma Tonewaga and team at Picower Institute of Learning, MIT. Taken from Science Reporter.*

Jamie's femur and fibula were working at twice the rate of her cerebral neurons. With her amygdala pouring chemicals of confusion and anxiety, she bumped into a gurney which maneuvered its way into the Operation theatre. She could not remember why she had landed up in the hospital. All she could recollect was that she had a disease: a disease which made her forget, a disease which would not let her remember new things. But Dr. Tonegawa said that her disease could be cured. Not only that, but also her recovery would revolutionize the therapy for the disease. She just couldn't remember how! What was this disease after all? Alzheimer? Allmizher? Alzeihem?...

On the other hand, the physician and scientist, Dr. Tonegawa was determined to cure Jamie. He was reminiscing his years of research on the subject as he walked towards his intellectual abode. As soon as he entered his lab, he slouched over the table and reread his scientific basis: 'During the learning process, neurons in the brain are able to reinforce their mutual connections so as to fix lasting memories. These neurons in the brain are called memory engrams.' In order to study this he needed to label the neurons and observe them under the microscope to tell which neurons were a part of the memory engram. He then turned over to his hypothesis, which read: 'A memory is always hidden in the brain and never lost. A signal or a cue like sight, smell or a sound can be used to retrieve a hidden memory. In this particular experiment, the signal used is the laser light. This technique is known as optogenetics, where the hippocampus region of the brain is stimulated by laser light.' He was instantly reassured of his protocol.


He turned around to see his diligent team working on the caged souls of white fur. These mice were labeled such that their neurons produced red-fluorescence labelled proteins during the formation of a memory. The team also inserted a gene that made the neurons flash up when lit by blue laser light. "It is time," he thought. His requirements

were ready and his theory was rational. He took a shot of his whisky, to untie the knots in his stomach and started the experiment.

The idea of the experiment was to induce a memory in the mice, manipulate it and try to retrieve the original memory. The doctor released the mice into a small cubicle which contained an electric chamber. As soon as the mice entered the chamber they received a mild electric shock. This created a memory of 'fear' in their brain. Their neurons were then studied under the microscope. RED! The doctor brightened up when he observed the labeled memory engram of 'fear' in the mice turn red. "Congratulations Fellas! The first step is successful," exclaimed the doctor with a wide grin. After a light round of cheering, the team once again became serious. It was time to manipulate the temporal lobe of the innocent creatures. A handful of mice were then administered a drug that prevented the neurons from forming strong connections and enabled the mice to forget any link between the chamber and shock. The mice were now in a state of amnesia in which their 'fear' neurons were deactivated. The team then used blue laser light in the red indicators of the memory engram, in a hope to reactivate the 'fear' neurons. Some clutched their arms, a few others bit their nails and Tonegawa just held his breath in the anticipation of a hopefully positive result. Everyone peered into the cubicle to trace the movement of the mice. After forty-five minutes of rigorous monitoring, the room burst into giggles, cheers and expressions of alleviation. Not a single mouse had moved into the electric chamber. Their memories had been retrieved. Laser light was a potential cure for Alzheimer's disease.

Amidst the applause and merriment, Dr. Susuma Tonegawa, wiped a thin trickle of sweat from his face and warm excitement seized his body as he envisioned his most handsome self, ascending up to the dais and receiving the Nobel Prize.





# MEN\*\*\*\*\*N

TANYA PAL, SYBA

The process of human reproduction is impossible without the sperm and the egg. Sperms are produced during spermatogenesis and are emitted during ejaculation. The egg is produced during oogenesis and travels to the edge of the Fallopian tube for fertilization. If fertilization does not take place, the egg cell disintegrates and it along with the lining of the uterus are discharged through menstruation. The question is, why is the process of menstruation surrounded by so many taboos and why is it stigmatized the way it is although it is just another

bodily process?

The process of menstruation has been a taboo in many societies for a very long time. The approach that presumes menstruation as unclean, has perpetuated taboos for centuries. These approaches were created by myths that are prevalent in a particular society. With respect to menstruation, it is myths that explain what is right and wrong, and define the framework of social norms in a particular society, and deem whether something is a taboo or not (Chawla, 1992). For example, in India,

the reception of a girl's first menstrual cycle differs from community to community. Some communities celebrate the occasion by gifting the girl gold jewelry, whereas some may treat it as a pedestrian process. But in some cultures, the scale of ostracism amounts to such a level, where a menstruating woman is seen as a social pollutant.

The theory of a social pollutant, works to live up to societal ideals which conform to social norms. The pollutant is seen as something that should be shunned and is not fit to be included within the accepted framework of the society. Sometimes the idea that menstruation is a social pollutant originates from the reason for motherhood as dictated by religion. For example, in Judeo-Christian faiths, the duty of bearing a child was cast onto Eve as punishment for disobeying the word of God in the Garden of Eden. Though attitudes towards mothers and pregnancy may not be extremely negative, people tend to view menstruation as the real "punishment".

It is the imagery of a woman bleeding because she has not conceived a child, at a time when it was a possibility, which is the chief topic concerning these taboos.

Levy-Bhrul noted that the Maoris, regard the blood and "debris" that is "discarded" at the time of menstruation as a human being manqué, or a strange position where the blood is regarded as a human being that has not been born, but is dead (Douglas, 1966).

One tends to believe that, it is mainly in "exotic" and "primitive" societies where the process of menstruation is stigmatized. Sometimes it is also the choice of words that is used to describe and explain the process of menstruation in a "scientific" manner that is demeaning to the sanctity of the process. The emission of the blood and disintegrated egg cell is seen as a "wastage", whereas the millions of sperms that are emitted during ejaculation is not seen as a wastage (Martin, 1991). According to many scientific studies and experiments, menstruation is seen

as an accidental by-product of the way our reproductive systems have evolved.

Menstruating animals have much longer gestation periods as compared to non-menstruating animals and invest much more resources in a single pregnancy. They are hence geared to spontaneously abort fetuses that have succumbed to genetic abnormalities. Humans, can copulate at any point in their reproductive cycles unlike, most mammals which copulate only during ovulation. An egg, can therefore be several days old by the time it is fertilized and these are particularly prone to genetic defects. As the uterine lining thickens, the cells gain the ability to recognize a defective embryo and the pregnancy is aborted via menstruation. It is an approach that prevents the mother from wasting her resources in a doomed pregnancy.

Although the theory doesn't explain why menstruation is also experienced by females who do not engage in intercourse and doesn't have any experimental basis, studies like these do frame the outlook of the society and menstruation is equated to voluntary abortion.

Science, our very own myth buster, is more often than not twisted and has been seen to be the source of many misconceptions.

The common belief is that anything that has anything to do with menstruation is "unclean" or "wasteful". Sanitary pads are promoted as hygiene products, rather than something that serves as a receptacle for menstrual blood.

Modern society will find ways to perpetuate taboos surrounding menstruation in the name of culture and tradition, and will even incorporate science and technology to do so. The question that society needs to answer, is how much longer must people sell sanitary pads in brown paper bags?

Image Source: leavedontstay.com

## BUSTING MYTHS

If you have swallowed poison, you should induce vomiting - FALSE

While many movies particularly James Bond movies advocate this, it is far from helpful. Most poisons are extremely acidic or alkaline, and therefore the stomach (with a pH less than 2) is the most equipped to deal with it. The cells of the stomach lining can withstand extremely acidic environments and in the case of alkalis, the stomach acid neutralizes them. On vomiting we expose our lungs, throat and mouth to this poison which has far worse effects than on our stomach.

# Meet the Department

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DR. NANDITA  
MANGALORE  
— HOD —



ASHMITA CHATTERJEE, SYBSC

HAMSA NARASIMHAN, SYBSC

As the time for our interview neared, we were filled with enthusiasm, and nervous energy. As we sat fidgeting before Ma'am in her office, we were immediately put at ease by her warmth, and friendly smile. We were then sure of what we had been anticipating—that this was going to be a special chance for us to talk to someone we greatly admired, and one who was somewhat of a mystery to us students.

This was the first time either of us were conducting an interview, and just like instructions on 'how to conduct a successful interview' we got off the internet, we started with the customary questions regarding background and qualifications. Born and brought up in Chennai, she had come to Mumbai to pursue her Bachelor's course in this very College. She graduated with a degree in Zoology and Biochemistry, (yes, she also belongs to the Zoology Department). She went on to complete a Ph.D, and began teaching while pursuing her M.Phil.

Returning to St. Xavier's to teach, she said, was the

natural choice. With time, she became the Vice Principal of Science for a period of four years, and Vice Principal of Academics for two, during which she was chosen to become the Head of the Life Science and Biochemistry Department. It was then that she asked to be relieved of her duties as Vice Principal, to focus her efforts on the Department.

She speaks of her journey from being a student of the college to Head of the Department as, "All that changes is the degree of responsibility. At every level you climb the responsibilities go up as well as the administrative work." She added with a grin, that she isn't really fond of the administrative aspect of her work. Well, no one really is.

Was she a trouble maker or a goody-two-shoes? She laughs and says she was a happy student coming from a close knit Zoology batch of just 9 students, and she did what was needed to be done, never stressing herself unnecessarily.

The surprise came when we asked about where her



passion for Life Science stems from. She revealed with a smile, that her primary interest had in fact been Biophysics, a combination of two of her favourite subjects, Biology and Physics.

As there had been no specialized course available for Biophysics then, she had moved on to her other interest, lucky for all you Biochemistry enthusiasts, though her interest in Physics has endured.

With an inclination towards literature, it was a tough decision to choose Science over Arts for Nandita Ma'am.

"I always knew what I wanted to do, and that was to teach. But what I would teach, I didn't know then."

A lesson she learnt during her time as her a teacher? Tolerance. Tolerance, and patience, but then she adds with a laugh, "or maybe that's due to age".

What makes this job special for you, what keeps you on your toes, and makes you want to wake up in the morning and teach a group of sleepy teens?

"Questions. Questions in class. The level and depth that a teacher can take a class to, depends on the questions. They force you to go and read, and grow more as a teacher. I enjoy questions in class." Nandita Ma'am's passion is evident not just merely through words, but also through her personality.

The best moments for her as a teacher, are when students after graduation come back to see her. "Only then do you know that you have made a difference. Affection in the moment, in the environment is natural and of course valuable too, but to come back, is a greater mark of care and affection."

We then moved on to the present, and the future.

"Vibrant, vivacious, and versatile", are the three words Ma'am chose to use, to describe our Department.

When asked about the best aspect of being associated with this Department, she said,

"This department is very vibrant.

Its strength lies in its vibrancy.

Everyone has the full freedom

to air his or her views.

Fresh minds with

fresh insights

are

*Vibrant,  
vivacious,  
and versatile.*

*"I always knew  
what I wanted to do,  
and that was to teach."*

welcome.

There is no staleness, and its beauty, lies in change."

She felt that our Life Science Department is currently very good, but lonely at the top. More inclusive work is needed, to become a positive influence for the growth of other Life Science Departments of academic institutions across the country. "We will continue to grow as we have people who aren't stagnant in our department, but others must too." She underlined the importance of projects, in furthering creative scientific ability.

Her advice for a confused soul- a student unable to plan for his or her higher education;

"If the student is in TY, I would suggest that they make a list of things they do not like, which they don't see themselves doing for sure- 'selecting against'. For example, if they can't see themselves holed up in a lab, they should eliminate that from the list of possibilities.

With what is left, they should look at the common educational qualifications needed, and work hard towards attaining that background. As you move on, you can change. It is important to remember that the decisions you make at 20, aren't for your whole life, you change as you go along. It's okay to change your career along the way."

"Just commit yourself to your short term decisions. If you show discipline to do what you don't like, to the best of your ability, you'll excel at what you do like!"

"It is important to never compare. It adds to unnecessary stress. Just do your best, why compare? Be open to the possibility that maybe you haven't been exposed to your best yet!"

"Curiosity." According to her a student of science must possess curiosity and discipline to become a good scientist.

We then moved on to Nandita Ma'am, the person.

Apart from being a scientist, a teacher and the HOD, Ma'am enjoys reading, both fiction and non-fiction, and solving crosswords. "I'm semi-addicted to scrabble!" she said laughing. She also used to be a sports person, and

"Not much of a food person, and tastes vary from person to person!"

Advice to successor?

"Keep an open mind."

If you were to take part in an auction of bodies of life

“

*It is important to remember that the decisions you make at 20, aren't for your whole life*

would take part in swimming, tennis and athletics. Nature walks, and treks are also some of the activities she enjoys.

When we asked about an alternative career path, something she had given some thought to pursuing, besides that of being a teacher, she revealed that at one point of time, she nearly switched fields to advertising or copywriting, but had "lacked the guts to!" she added with her usual humour and candour.

We ended the interview with our very own rapid fire, you know from the 'how to conduct a successful interview':

Favourite place to unwind in college?

"I used to enjoy sitting in the chapel as a student. The first floor lending library, was also a usual haunt. Used to sit at the back near the fiction section and enjoy the classical music they used to play."

Favourite canteen food?

forms on earth for aliens, what would you say to ensure the highest bid for the human body?

"You need us to evolve!"

If you could change one aspect of the human body, what would it be?

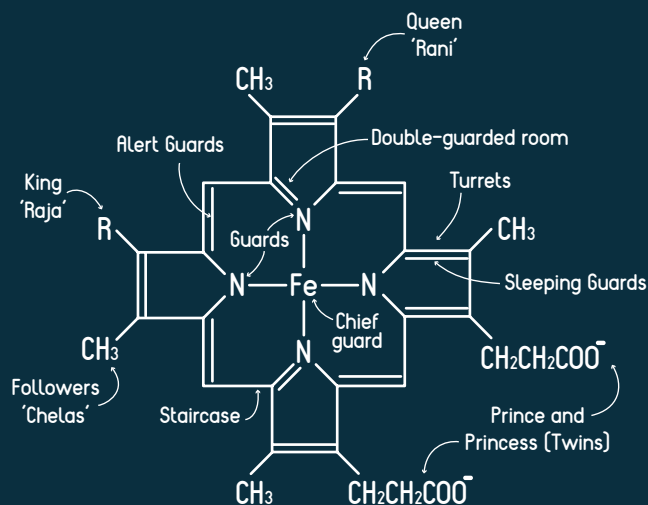
"Ability to self-heal, even just physical healing would lead to much less grief."

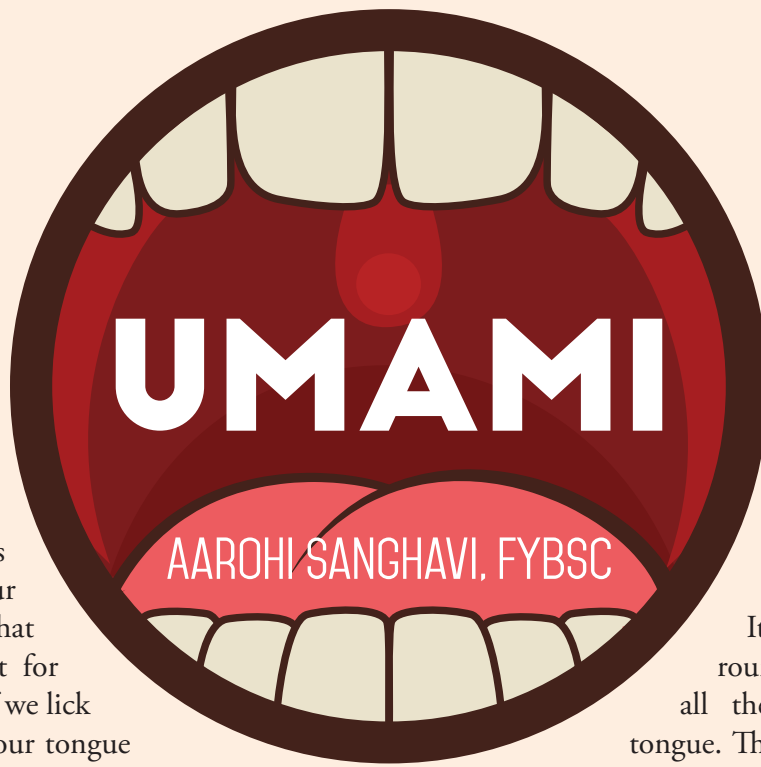
And on that note, the interview came to a close. As we watched Ma'am sprint to her next class, we were left with a feeling of awe at her energy and passion, and contentment. It had been a lovely conversation with a warm, simple, open minded and inspiring teacher, which we will surely hold dear for time to come. We would describe her with the very words she used to describe our department-

***Vibrant, Vivacious, and Versatile.***

## CYTOCHROME C: A FAIRY TALE BY NANDITA MA'AM

Once upon a time, in a kingdom far far away, lived a King and Queen of grand regal splendour (R). They lived in a huge palace with 4 turrets, each guarded by a royal guard (N). The 4 royal guards reported to the Commander-in-Chief Fe. The King and Queen had two little children, the twin Prince and Princess - Propionate and Propionate. Each lived in their own turret. The turrets of the Queen and the Princess were additionally secured by double safety doors (double bonds). The guards in the left wing of the palace were all alert and standing upright (double bonds), while the ones in the right wing were fast asleep! As every King has his followers, so did ours, with his 'chelas' (-CH<sub>3</sub>) surrounding him. And this formed the happy kingdom of Cytochrome C.





We've all always assumed that our tongue is divided and that there is a designated spot for each flavour. That is why if we lick a lollipop with the tip of our tongue it is always sweet. That doesn't seem to be true anymore. Every single taste bud on our tongue, on the hood of the mouth and any other part of our masticatory system can sense and identify every flavour.

We've been taught about the four flavours- sweet, sour, bitter and salty. A discovery made by a Japanese scientist Kikunoi Ikeda in the 20th century, added another flavour to the existing list; 'Umami', the fifth sense of taste. 'Umami' is derived from Japanese adjective 'umai' meaning delicious and 'mi' meaning essence. It is packed and sold as MSG (mono sodium glutamate) which, may not have been the best idea as it inhibits normal brain function. Three grams of MSG leads to something known as "Chinese restaurant syndrome", characterised by headaches, chest pain, numbness around the mouth, etc.

Umami coats the mouth, leaving a peculiar after taste. It compliments all the flavours we know of, and culminates into a wonderful sensory experience. Scientists believe that umami is the representative taste of glutamate ( $C_5H_9NO_4$ ). However, in its acidic form, as glutamic acid, it does not provide the exact same stimulus. In addition to glutamate it is also associated with the taste of ribonucleotides such as inosinate and guanylate and other proteins. Break down of the protein is achieved through cooking (like stock), aging (as in parmesan cheese) or as food ripens (such as a tomato) which releases free glutamates and contributes to umami.

A lot of competitors have tried to beat Heinz in the production of ketchup but its unbeatable taste that is

loved by millions is due to the presence of umami. It provides a more well-rounded flavour as it stimulates all the sensory regions of our tongue. That is why most of us like to dunk our fries, burgers and almost anything

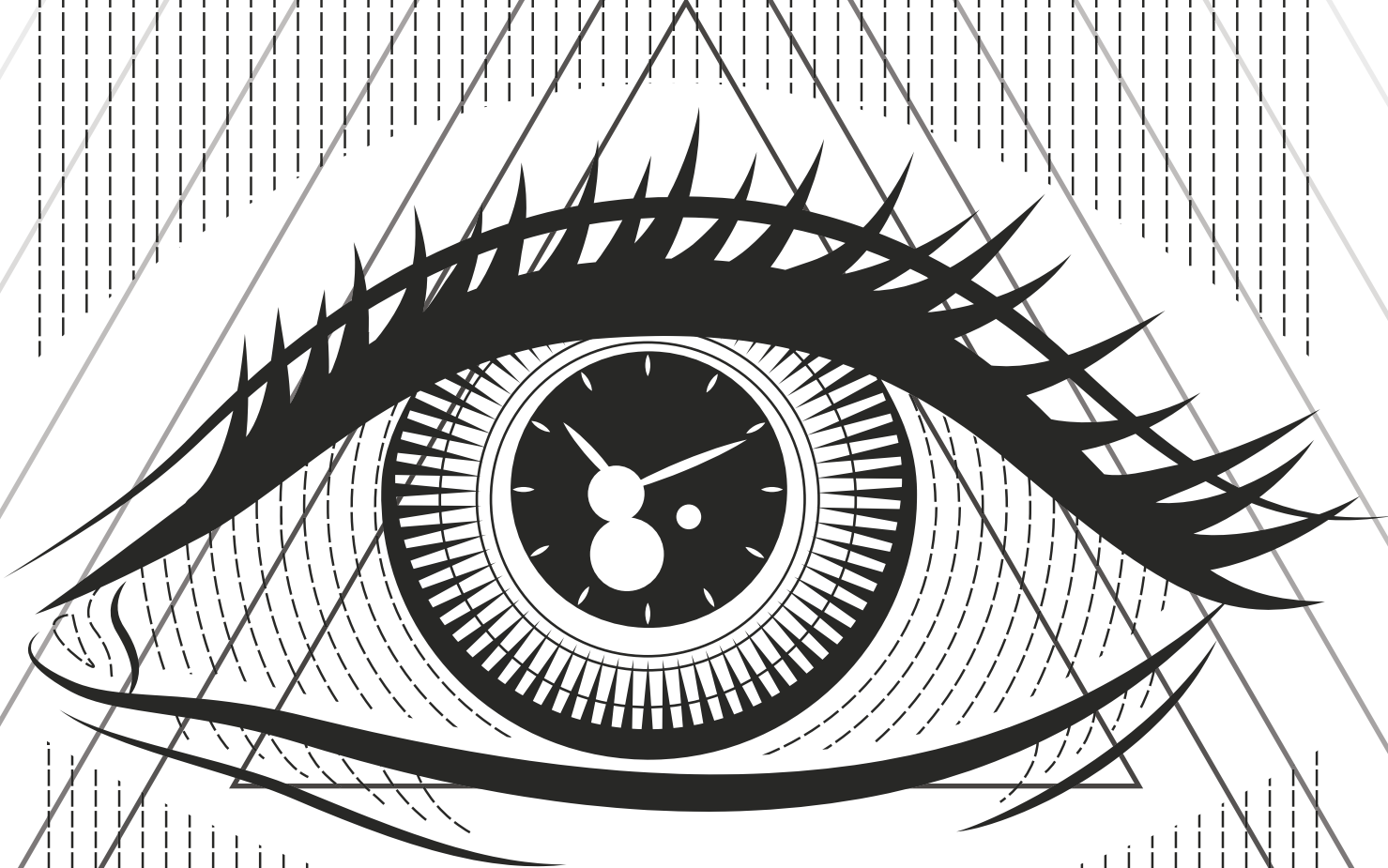
else into the very simple but efficient ketchup. The regular synapses of the brain that pass on olfactory stimuli are not the same for umami. In this case the stimulus is transferred to the gustatory region which transfers the information to the brain. The implications of this are still being studied.

Surprisingly, the first time we may have ever tasted umami was from our mothers' milk. In fact it has been seen that it has the highest concentration of Umami, of all the known mammalian milk samples. Umami was discovered through fish stock. Its peculiarity helped for it to be categorised into a different group. Once this group was made, several other food items which provided the same stimuli were identified and added. The well-known ones are tomatoes, cheeses, Chinese cabbage, meat stock, mushrooms and bacon.

There could be many health benefits obtained from this discovery. For patients with high blood pressure and heart problems, food containing umami maybe be used as a substitute for salt. Along with the good also comes the bad. Glutamic acid may be consumed in small quantities but if the amount increases, it could lead to a block in sensory stimuli and inhibit the neurotransmitting capacity of the brain, affecting memory and learning.

So now you know; you don't need a plate of exotic food for that perfect culinary experience, just ordinary ketchup. It makes one wonder if there are more flavours to be discovered or if there is any limit to the number of flavours our taste buds can identify. Interesting, isn't it?





# BEEN THERE, DONE THAT...OR HAVE I?

SVETLANA D'COSTA, SYBSC

Have you ever had an uncanny feeling of already having experienced a situation before, even though you're absolutely positive about its previous nonoccurrence? You know that this feeling of familiarity should not be as strong as it is and hence is something of a mystery! This "mysterious" feeling is termed as Déjà vu which is French for "already seen". According to a plethora of surveys, it has been reported to have occurred in about 60-70% of the population majorly corresponding to the age groups between 15 and 25. Déjà vu is an arbitrary, spontaneous phenomenon which also occurs in individuals without any specific medical conditions. This makes it extremely challenging for researchers to investigate this grey area. From the early days, various theories ranging from wishful thinking to past life experiences to mismatches in the brain causing us to mistake the present for the past, have been hypothesized to explain this strange feeling. In recent years investigations have curbed speculations and concrete theories have been evolved to explain why this feeling of overwhelming familiarity sporadically exists.

Researchers speculate that Déjà vu occurs when there is a mismatch in the brain during its constant attempt to create whole perceptions of our world with very limited input. Our memory takes small bits of sensory information (a familiar smell for instance) to bring forth a very detailed recollection. Déjà vu is suggested to be some sort of "mix-up" between sensory input and memory-recalling output.

On the other hand, another group of scientists postulated that the information we take in from our surroundings may "leak out" and incorrectly jump from short to long term memory, bypassing typical storage transfer mechanisms. When a new moment is perceived from our short-term memory it feels as though we are drawing upon some memory from our distant past. Cleary, a scientist, ran a series of experiments to determine the elements of a situation that could possibly induce Déjà vu. These comprised word recognition tests, flashing of photographs of different celebrities, places and so on. Her findings, coupled with prior researches and virtual

reality investigations suggest that similar spatial layouts and visual fragments containing isolated geometric shapes from an earlier experience contributes to this feeling of Deja vu.

Due to the phenomenon of Cryptomnesia which means that although information learned is often forgotten, it is still present or stored in the brain and when encountered with a situation similar to the contained information, we experience Deja vu. These theories consolidate the idea that memory is a process of reconstruction as opposed to a fixed recall of events. Various episodes of daily life are stored as individual fragments. The reconstruction comes from these stored fragments and naturally undergoes elaborations, omissions and distortions. Each successive recall is merely a recall of the last reconstruction. The proposed sense of recognition i.e. Deja Vu involves achieving a good match between the present and the stored data. This reconstruction may differ considerably from the original event assuring us that we haven't experienced it before even though its familiarity is overwhelming. Deja vu can also be attributed to scenes that we dream of and often forget but grip us strongly when we experience something similar in real life.

These and other theories do provide a great deal of insight, however, what do we know for certain about Deja vu? For starters, we are completely conscious during its occurrence implying that participation of the entire brain is not mandatory to induce this phenomenon. Brain imaging technologies have confirmed that disturbances occurring in the medial temporal lobe are the culprit of Deja vu. Within the temporal lobe are the hippocampus (involved in memory formation), the Rhinal cortex and the amygdala (involved in emotion). Electroencephalography patterns of signals due to synchronized neural firing between the rhinal cortices, hippocampus and amygdala during déjà vu occurrences have been studied. Analysis of these patterns suggest that coincident occurrence of firing in the medial temporal lobe, may trigger activation of the recollection system.

In conclusion this phenomenon still thrives as a beautiful mystery and there is more to it than meets the eye. The good news is that there's nothing wrong with you. It simply makes one wonder if we can really trust ourselves and our brains! So the next time you experience Deja vu, don't forget to brag about those psychic powers or just sit back and savour the short lived irony!



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# FY ORIENTATION 2015

## THE FY PERSPECTIVE

NIMISHA RAPHAEL, FYBSC

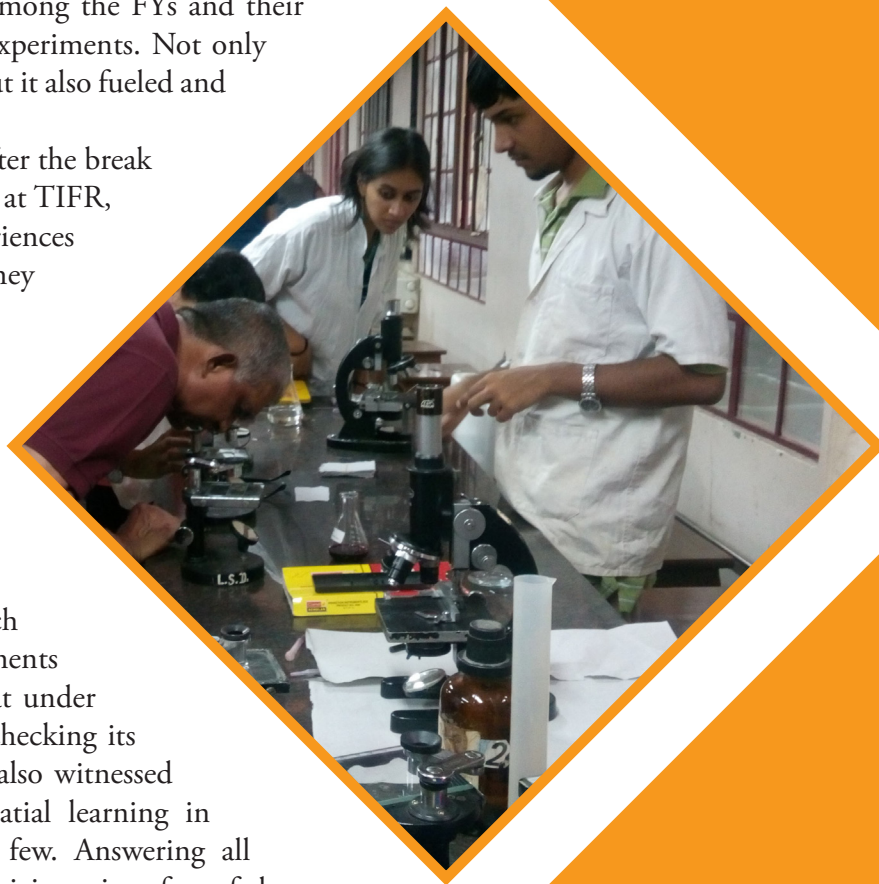
In the month of August 2015, the second and third year students of Life Science collaborated in organizing an interactive orientation for the first year students under the guidance of the department teachers. The session was conducted with the aim to develop a rapport among the FYs and their seniors, through interactions based on science experiments. Not only did this provide a great means for conversation but it also fueled and cultivated our interests in Life Science.

The event began in the Life Science lab soon after the break with two ex-students, currently pursuing studies at TIFR, Mumbai. They started with sharing their experiences during their eventful tenure at St. Xavier's. They went on to give us some useful tips on how to juggle academics and extracurricular activities. Their inspiring words reassured us, that even though it is a struggle, it's worth it in the end.

Our class was later divided into groups, each guided by one senior student. In the Life Science lab, the seniors (SYs and TYs), presented a variety of science experiments which were performed by them. Some of these experiments included pHmetry, observing *Daphnia* heartbeat under a microscope, calculation of human pulse and checking its variation after exercise. It didn't stop here. We also witnessed isolation of the chick embryo, short term spatial learning in cockroaches (using Barne's maze), to name a few. Answering all our questions patiently, they even helped us participate in a few of the experiments.

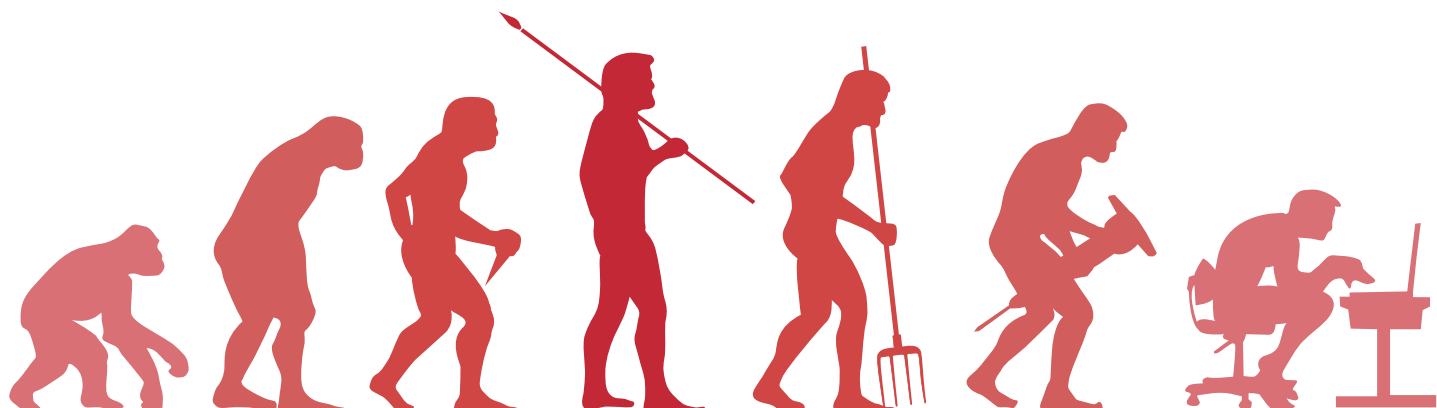
It was not only informative but also an enjoyable experience for us FYs as we bonded with our seniors. The enthusiasm each of them had for the subject, left us spellbound. As the session, which lasted nearly three hours, came to a close, we gained a sense of clarity on our queries and apprehensions regarding Life Science as a subject.

The idea of such an interactive session was implemented for the first time this year and it should certainly be conducted every year. We thank all our dear teachers and seniors for making this a memorable event!









# THE RACE TO LONG LIFE

AKANSHA GANGULY

Alumnus of the Department, Batch of 2015

“ My grandmother started walking five miles a day when she was sixty. She’s ninety-seven now, and we don’t know where the heck she is. ”

*Ellen DeGeneres*

**H***omo sapiens*. The most dominant species on planet Earth despite not being the strongest nor the pluckiest. Our ability to adapt and our constantly evolving intelligence and skills make us reign supreme over the most treacherous terrains and the harshest climates. It is no wonder that humans occupy the broadest niche in the planet’s biosphere. Much of our success as a species arises from the centuries-old socio-biological tradition of handing down the experience and wisdom gained by the elders to the young, who then modify this knowledge so as to best suit the current environment. One may argue that many social animals like monkeys, lions and orcas do the same; what makes our system any different? Well, seen any grandfather dolphin surrounded by young pups as he whistles about his young heydays?

To be more precise, we are unique because no other primate species has such a long and healthy post-reproductive age lifespan (68-78 years) wherein 3 or more generations can coexist so easily. To corroborate this fact, there is a “Grandmother Hypothesis” which states that the evolution of a long lifespan is the result of selection acting on grandmothers and their ability to provide resources for their kin, thus improving their own reproductive success. So how and why did humans get to live such long lives?

It has long been speculated that human longevity is

the cumulative result of diet and genotype. The increase in our lifespan began around 1.8 million years ago with changes in a particular gene called APOE (apolipoprotein E). The APOE gene in early stages of human evolution existed in only one form called APOE ε4 which leads to an increased risk of coronary artery disease (CAD), Alzheimer’s disease (AD), dementia and increased cognitive decline. However, in this modern age the gene’s effect has been greatly diluted by the emergence of its less potent forms (known as ε2 and ε3) that developed over a long period of evolution. So how did we get past this genetic constraint and begin to lead such long lives? The answer, however clichéd it might seem, is simple: exercise.

There is a great deal of evidence that suggests exercise became an essential part of human lifestyle around the same time as the APOE gene began evolving to its less harmful forms. With the evolution of *Homo erectus*, our ancestors began a new regime centred around meat-eating, hunting and gathering. This was a contrast to the sedentary lifestyle led by our early ancestor *Australopithecus* who, as evidence suggests, travelled much shorter distances than *H. erectus*. These activities involved covering much greater distances in single-day bouts than any other primate and required large amounts of stamina and cardiovascular endurance.



Extensive genome typing has shown that APOE ε4 is the main ancestral gene for the protein in humans, and the divergence into the ε4, ε3 and ε2 forms happened around 200,000 - 300,000 years ago. Living chimpanzees exhibit similarity with the ε3 version of the gene, which suggests that our ancestral gene was evolutionarily novel for our species. It has been hypothesised that increased physical exercise and activity have reduced the deleterious effects of the original gene. Recent work done shows that exercise and physical activity have an epigenetic interaction with the APOE gene to mediate the effect of the ε4 gene on CAD. Even though a direct link has not yet been established between exercise and brain aging, it has been found that physical exercise reduces cognitive decline in people carrying the ε4 trait and also reduces their risk of dementia and AD by improving the amount of grey and white matter in their brains.

Despite some uncertainty over the timing of old age, the early evolution of longevity (approximately 1.8 million years ago) with *H. erectus*, is most consistent with

hypotheses for the evolution of the post reproductive lifespan, that link successful aging to the origins of hunting and gathering.

Analyses of paleolife-history schedules suggest that the long post reproductive lifespan of humans began to evolve in sync with the shift towards higher aerobic activity in *H. erectus*, when the only available APOE allele was ε4. Thus, evidence that exercise and physical activity can moderate the effects of APOE status on brain aging suggests that physical activity played an important role in relaxing disease-related constraints on the evolution of humans' uniquely long life spans.

With the advent of the Digital Age, as we slowly cede back into a globalised sedentary lifestyle, it is no surprise really that we are seeing a substantial increase in brain and cardiovascular diseases. In truth, we have created a gross mismatch between thousands of years of genetic heritage and our modern environment. Only by understanding our own unique evolutionary history can we overcome our current problems and look to a healthier future.

Image source: Vector Open Stock

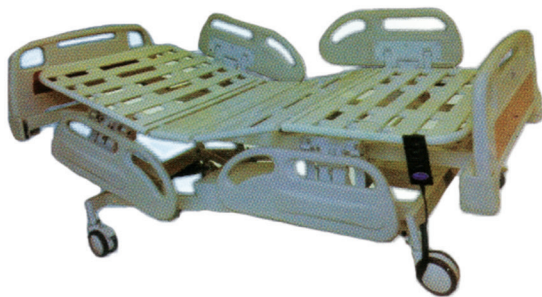
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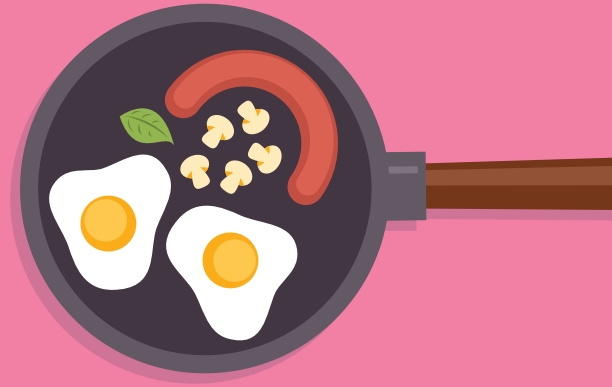
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# FADS AND FALLACIES OF DIETING AND INDIAN FOOD WISDOM



*a talk by*  
*Rujuta Diwekar*

ANANYA AGNIHOTRI, SYBSC

AMRITA KALATHIL, SYBSC

Ms. Rujuta Diwekar, eminent nutritionist and author, is a household name. Her work and “fitness fundas” have been received with a magnanimous response. The Department of ‘Life Science and Biochemistry in collaboration with the Women’s Development Cell organized a talk by Ms. Diwekar. She was welcomed to College by Dr. Nandita Mangalore, the Head of Department with a token of gratitude.

Ms Diwekar, an independent, career-oriented woman herself, began the talk by stressing on how today women must stop allowing the nutrition industry to affect them mentally and physically. Women, more than men, fall prey to food fads and body image issues, which prevent them from participating and achieving success in various fields of greater importance. Though all of us are aware of the negative impact of the weight loss industry on our psyche, we encourage it, especially through social media (read ‘gym selfies’). Essentially Ms. Diwekar wants us to stop measuring our worth using a weighing scale-an inanimate object that can’t tell if one person is standing on it or two.

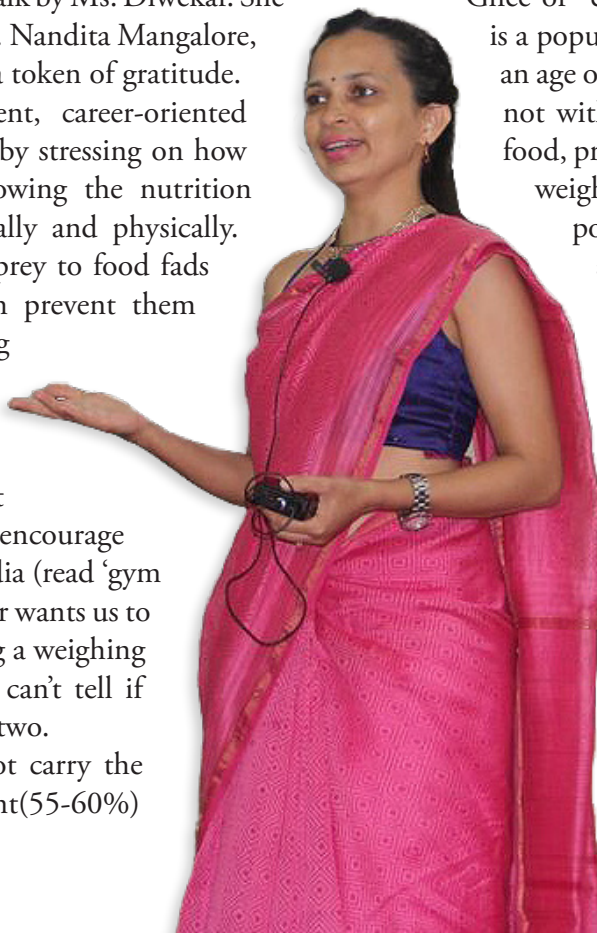
Youngsters, these days do not carry the bone and muscle tissue content(55-60%)

appropriate for their ages because they count calories and are afraid to gain weight, which according to them is ‘not beautiful’.

‘Health conscious’ people avoid fatty foods like the plague. The question is, is this an informed choice?

Ghee or “clarified butter”, as the West calls it, is a popular victim of the fat free diet. Ghee is an age old component of the Indian diet- and not without reason. It adds satiety value to food, prevents over-eating, and consequently, weight gain. This ensures that our food portions are smaller, leading to better assimilation of nutrients. Even the West acknowledges that ghee is good for brain function and gives us healthier skin.

Fats are also important for absorption of certain essential vitamins such as Vitamin D. Vitamin D2 is converted to D3, the form in which the body utilizes it, in the presence of sunlight and dietary fats such as ghee. Low levels of Vitamin D absorption, can retard thyroid gland functioning, among other processes. Another example



of a food fad, is removing the yolk from eggs before consumption because they are high in calories. But this habit has been deemed detrimental, as we lose out on the vitamin and mineral content of the yolk, as well as the phospholipids that reduce cholesterol levels.

The most recent misconception we have started to harbour: 'carbohydrates are the new fats.' For example, rice has seen a reduction in intake, even though it has been the most widely cultivated and consumed grain since ancient times in our country. Rice is easily digestible and improves sleep quality. The activity of the Human Growth Hormone peaks between 10 pm to 5 am, during which we should be asleep. Deep sleep provides optimum conditions for HGH to do its job, such as increasing bone and muscle density, and regulating hormonal balance.

Opportunistic brands claim that their processed foods contain ingredients that are organic and locally grown, such as multigrain products. These now substitute our home cooked meals for breakfast, such as Poha and Paranthas which are nutritionally more adequate.

We come from a culture that is against the mixing of grains, because each grain is better suited to our body in a particular season. For example, Jawar and Bajra should be consumed in the summer and winter respectively, because one cools the body down while the other, a high energy food, increases body heat. Wheat and rice, on the other hand, can be had all year round.

Ms. Diwekar also brought to our notice how we have no qualms about exotic oil garnishing we use in our salads, but cringe at the amount of oil used in pickles and papads. Not only does the oil in pickles preserve them over extended periods of time, but also the pickle as a whole helps maintain gut microflora which is important for lactofermentation. Indians have never had their vegetables raw-but always cooked or pickled, and we should continue to practice this tradition and not shun it for salads.

Many of us will agree that Green tea tastes quite unpleasant, but we force it down our throats anyway, because polyphenols and antioxidants equal to a healthier and younger looking self. Everything that is healthy doesn't necessarily have to "taste like card paper". Our very own masala chai can replace green tea, giving us a sense of satisfaction, and the very same health benefits.

The Food and Agricultural Organization of the UN has declared certain fruits as NUS (neglected and

underutilized species). In India, Jackfruit, Guava, Jamun and Ber fall under the NUS category because we jump at the opportunity of purchasing exotic fruits like Kiwi, or even waxed Apples that are from the US and China. In fact, Banana, the cheapest and most easily available fruit in the local market with a multitude of health benefits, is now looked down upon as the poor man's fruit.

Among the various questions raised by the audience, a noteworthy one was about access to nutritious food as a hostelite. Simple solutions offered by Ms Diwekar were to "invest in a hot plate" and sign up for a "dabba service".

She concluded that among the best ways to stay healthy and fit was to measure the "farm to plate distance", which is finding out where the food was grown, and how much distance it covered to reach us. The best option is to eat food that is grown locally, around us, because it minimizes the chances of the food item containing preservatives, of contamination or spoilage due to transport. Another yardstick by which the health quotient of our food can be measured is the "Grandmom test", which entails checking with our grandmother if what we're eating now, is what she was eating when she was our age. Finally, as college students, we must ensure we get around ninety minutes of exercise a day. This will keep problems such as "pre-menstrual syndrome" and other complications associated with menstruation like back ache and abdominal cramps, at bay.

The bottom line, is that we don't have to opt for expensive health alternatives like green tea or broccoli when we have masala chai and lauki (bottle gourd) within reach. We must appreciate, preserve and put to use the knowledge handed down to us by generations of people who have benefitted by just doing the simple things Indian food science propagates. As the West slowly realizes the importance of Yoga, turmeric and the need to cut out synthetic, processed foods from their diet, we are actually heading in the opposite direction. Modernization has blinded us, and we have begun to slowly adopt the unhealthy lifestyle, characteristic of the West. A little discretion while buying our groceries and making food choices, and a little bit of exercise every day, is all it takes to live a healthy life, and this is precisely what Ms. Diwekar wishes for us to understand. Once again, we thank her for taking time out of her busy schedule to come to St. Xavier's College and deliver such an enriching lecture.

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# CURRENT RESEARCH

## SYNTHESIS AND CHARACTERIZATION OF NANOPARTICLES FROM DIFFERENT BIOLOGICAL SOURCES

Chrislyn Gonsalves, Prachi Salanke, Sangeeta Shetty and Priya Sundarrajan

Over the past few decades, there has been an immense development in the field of nanoparticle research. Nanoparticles are a promising candidate in the field of research, due to their wide range of applications in various fields. Though, nanoparticles can be synthesized using various chemical and physical processes, these methods make use of toxic chemical reagents, need high energy input, give rise to environmental pollution by generating hazardous waste products, and also, these processes are tedious and time consuming. The 'Green synthesis' makes use of various biological sources, from plants to microbes, to synthesize nanoparticles. Also, green synthesis provides a rapid and less complex way to synthesize nanoparticles. Over the past few years, tremendous amount of research has been done on metallic nanoparticles like silver, gold, palladium etc. However Silver nanoparticles have gained a particular interest due to their wide range of applications from antimicrobial activity to therapeutic potential.

In our research project, we aim at synthesizing silver nanoparticle using different biological sources and their extracts like; neem leaf, hibiscus leaf and flower, mirabilis flower, triphala, chicken liver, vaal, dried shrimp, soaked almond water, ginger-garlic concoction, chilli, onion, khaskhas, sweet lime peel, capsicum etc. The analysis of nanoparticles will be carried out by using spectrophotometer. XRD and TEM analysis of the particles will be attempted to confirm the dimensions of these reduced silver particles in nanoscale, Various applications of the synthesized nanoparticles will be attempted, like antibacterial properties, conjugated enzymes etc.



## ISOLATION OF ETHANOL FERMENTING YEAST FROM VARIOUS SOURCES AND THEIR CHARACTERIZATION

Tanvi Ballikar, Sangeeta Shetty and Priya Sundarrajan

Bioethanol are important source of green and renewable sources of energy. Use of bioethanol as energy source will reduce the dependency on non-renewable energy sources and reduce CO<sub>2</sub> emissions. With this in aim the present project was initiated in our lab. Ethanol fermenting yeasts will be isolated from various sources. They would be characterized and checked for ethanol producing ability using various sugar substrates and conditions of fermentation like pH, temperature variation, osmotolerance etc. Their efficiency of ethanol production would be checked using these conditions.

## EVALUATION OF APOPTOSIS INDUCED BY XENOESTROGEN BPA IN DEVELOPING ZEBRAFISH EMBRYO

Janhavi Rathi, Keya Kulkarni, Dr. Radhika Tendulkar

Bisphenol A (BPA) is commonly used in hardening of plastics, resins and dental sealants. At high temperatures, BPA hydrolyses and leaches out of these materials. A concern in recent times is the ability of BPA to act as a xenoestrogen and hence is considered an endocrine-disrupting chemical. However, there are conflicting studies about its effect. While some suggest that BPA is an agonist of estrogen and thus antiapoptotic, others indicate it to be an antagonist of estrogen and hence proapoptotic. In light of this ambiguity, the current study aims to evaluate the role of BPA in apoptosis of the developing zebrafish embryo. Our earlier studies have provided evidence of BPA inducing morphological and functional changes in zebrafish embryos at doses well below the permissible levels. To take this initial finding further this project evaluates the effect of BPA on embryonic fin development, DNA fragmentation and other apoptotic processes. Protein profiles of BPA exposed embryos at different developmental stages will be studied to identify putative targets of BPA action.



## CHARACTERIZATION OF PROKARYOTIC AND EUKARYOTIC RIBOSWITCHES

Krithika Pevekar and Maya Murdeshwar

Riboswitches are mRNA structures, present mostly in the 5'UTR of mRNA and act as receptors for small molecules. Binding of the small molecule ligands cause a change in mRNA secondary structure leading to downstream gene regulation. Being a regulatory element responding to specific small molecules, riboswitches have several medical applications. The current project on 'Characterization of Prokaryotic and Eukaryotic Riboswitches' revolves around this fact and focuses on finding riboswitches for the two second messengers c-di-GMP and (p)ppGpp.

c-di-GMP is responsible for characters like quorum sensing, motility, biofilm formation and cell-cell communication. (p)ppGpp helps cell survival under nutritionally stringent and environmentally stressful conditions, as observed in *M. tuberculosis* dormancy, wherein the bacterial pathogen survives within the body of healthy individuals, without causing symptomatic tuberculosis. We believe that a riboswitch responding to (p)ppGpp, if found, could be an attractive target for anti-TB therapy. Currently, we are using a bioinformatics approach to identify c-di-GMP riboswitches in the upstream region of genes involved in synthesis and degradation of c-di-GMP, and those involved in regulating phenotypes controlled by c-di-GMP.

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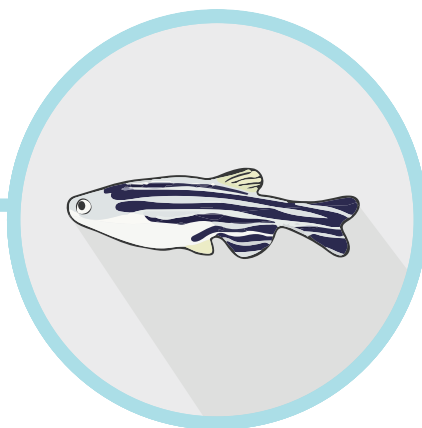
## EFFECT OF SLENIUM ON SPERM MOTILITY IN ZEBRAFISH UNDER DIABETIC CONDITIONS

Candice D'Costa and Manasi Kanuga

Diabetes is a major health concern worldwide today due to its rapidly increasing incidence. One of the many problems associated with diabetes, is the high level of oxidative stress observed in affected populations. High oxidative stress has an impact on male testes and therefore on male reproductive functions. Due to the supraphysiological levels of glucose and fructose in the seminal fluid sperm, development and other functions are hampered.

Selenium is a known antioxidant and some recent findings suggest that this mineral is essential to various aspects of human health. Since the role of selenium as an antioxidant is known, this study aims at determining the effect of selenium on sperm motility under diabetic conditions.

There are several advantages for using zebrafish (*Danio rerio*) as a model organism. To list a few, they are small and relatively easy to maintain, their genome has been sequenced, and currently they are being developed as a model for diabetes. Therefore, there are two aspects to this project: the first is to study the impact of the presence of fructose and glucose on male fish gamete physiology and to test effect of selenium on sperm motility under diabetic conditions.



## EFFECT OF ACUTE AND CHRONIC ZINC TOXICITY ON ADULT ZEBRAFISH NEUROGENESIS

Benaz Irani and Bhaskar Saha

Neurogenesis is a complex biological process that continues even after birth. Adult teleost fishes continue to retain 16 different highly proliferative regions in the brain. We use Zebrafish as a model system to study the effect of the metal ion zinc in the proliferation/cell death across various regions including the olfactory bulb, telencephalon, optic tectum, etc. in the zebrafish brain. Zinc is a vital micronutrient, which modulates the neuroprotective effect it is known to have on the brain. Although several studies have indicated that zinc deficiency leads to neurological dysfunction, studies on zinc toxicity is scarce. We aim to study the effects of chronic and acute zinc toxicity on cell proliferation/death in zebrafish brains and its possible behavioral outcome. We plan to perform in vivo experiments involving 5'bromodeoxyuridine (BrdU) incorporation assay followed by immunohistochemistry as well as in vitro primary cell culture assays. Moreover, we aim to study the effect of high doses of zinc on learning and memory using a T maze. Outcome of our study will be able to provide a possible toxicological role of zinc on adult neurogenesis and its related behavioral processes.



## STANDARDIZATION OF SAPONIN EXTRACTION FROM YAM TUBERS (*Amorphophallus*) AND EVALUATION OF ITS ANTIMICROBIAL ACTIVITY

Anushree Mondal, Surajvanshi Suvarna, Shruthi Nair, Roma Khot, Mayura Behere, Seekha Parida, Shweta Singh and Roshan Veigas  
Staff-in-charge: Maya Murdeshwar, Bhaskar Saha, Prashant Ratnaparkhi and Nandita Mangalore

Department of Life Science and Biochemistry,  
St. Xavier's College (Autonomous),  
Mumbai – 400001, India.

### Abstract

Edible yams (*Amorphophallus* sp.) are carbohydrate rich, staple tuber vegetables of West African origin characterized by the presence of steroidal saponins, furostanol and spirostanol glycosides. Of these, the saponins possess antimicrobial, antifungal, anti-cholesterol and anti-tumour properties. In this study, the Soxhlet method was used for extracting saponins from yam. Results indicate that non-hydrolyzed samples yielded higher amounts of saponins as compared to hydrolyzed samples. The antimicrobial activity of the extracted saponins was determined using *Escherichia coli* and *Staphylococcus aureus* cultures.

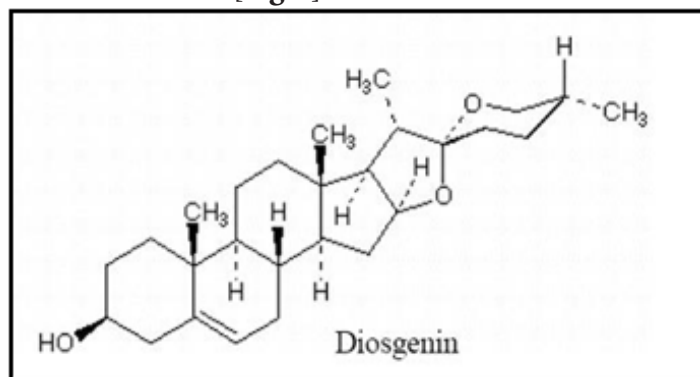
**Keywords:** Saponin, Soxhlet, Yam (*Amorphophallus*)

### INTRODUCTION

Yams are perennial trailing rhizome plants. The crop serves as an important staple food in several parts of the world as their dry material predominantly consists of carbohydrate (69.9–77.5%). Moreover, the crude protein, crude fat, crude fiber and ash contents of yam are in the range of 6.7–7.9%, 1.0–1.2%, 1.2–1.8%, 2.8–3.8%, respectively. Yam tubers contain vitamin C (13.0–24.7mg/100g dry weight), mucin (2.11g/100g dw), minerals (K, P, Ca, Mg, Fe, Cu, Co), phytosterols (sitosterol, stigmasterol

and campesterol) and steroidal saponins (furostanol and spirostanol glycosides). The species of yam found in India is *Amorphophallus* also known as elephant foot yam. It is widely used in Indian medicine and is recommended as a remedy in all three of the major Indian medicinal systems: Ayurveda, Siddha and Unani in the treatment of piles.

Phytochemicals found in foods and spices are progressively gaining popularity over conventional synthetic drugs mainly because they act via multiple targets that synergize to efficiently prevent or treat chronic illnesses. Phytochemicals are also safe (with minimal or no toxic side effects) and better bioavailability. Food saponins have been used in complementary and traditional medicines against a variety of diseases including several cancers. Diosgenin, a naturally occurring steroid saponin, is found abundantly in yams. Diosgenin is a precursor of sex hormone (progesterone), corticosteroids (cortisone), contraceptives and various synthetic steroidal drugs that are extensively used in pharmaceutical industry. Diosgenin displays anticholesterolomic activity by decreasing plasma and hepatic triglycerides and improving glucose homeostasis by promoting adipocyte differentiation and inhibiting inflammation. It suppresses cancer cell growth through multiple cell signaling events associated with proliferation, differentiation, apoptosis, inflammation and oncogenesis. Chemically, it is similar to cholesterol and other steroids [Fig-1].



**Fig-1. Structure of Diosgenin.** This food saponin is obtained from yam and has several beneficial medicinal properties.

This study describes a simple procedure for the extraction and quantification of saponins from yam samples, and investigates putative anti-microbial effects of saponins.

## MATERIALS AND METHODS

**Selection and pre-processing of yam.** Yam tubers were sourced from different local markets in Mumbai. They were washed under free flowing water to remove any soil and dirt particles, peeled, cut into thin uniform slices and subjected to oven drying and sun-drying for 72h and 96h, respectively. The dried yam pieces were ground into a coarse powder, weighed and stored in air tight containers at room temperature.

**Processing of yam powder.** For the extraction of saponins, either hydrolyzed or non-hydrolyzed yam powder was used. For hydrolyzed sample, Hydrolysis, to release saponins from glycosides, was carried out by treating 40g yam powder with 2N HCl for 3.5h at 95°C in a water bath, followed by cooling and neutralization with 2N NaOH to pH 7. The resulting extract was centrifuged at 4000rpm for 25 min at 25°C in an Eppendorf centrifuge. The residue obtained was dried at 55°C and used for extraction. For the non-hydrolyzed sample, 40g of dry yam powder was used directly for extraction.

**Extraction of Saponins using Soxhlet apparatus.** The Soxhlet apparatus was set up as shown in Fig-2.



**Fig-2. Setup of the Soxhlet Apparatus.** The apparatus was set up in separate batches using methanol and petroleum ether as solvent. The yam sample (after coarse grinding) would be tied up using two layers of muslin cloth before being inserted into the siphon for the extraction process to occur. The temperature at which the extraction was carried out for each sample was determined by the respective boiling points of the solvent being used.

40g of hydrolyzed/ non-hydrolyzed dried sample was extracted in 250 ml of petroleum ether (B.P 60-80°C) and methanol (B.P 64.70°C), separately, as mentioned in **Table-1**. Each extraction was repeated twice to ensure constant weight of resulting extract.

Solvent	Extraction Conditions
Petroleum ether	1) 65°C/ 6h 2) RT/ 4h
Methanol	1) 80°C/ 7h 2) 65°C/ 7h

**Table-1. Conditions for Soxhlet extraction process.** Both, the hydrolyzed and unhydrolyzed samples were extracted using these conditions.

**Post-extraction processing.** This post-extraction process is an alternative to using the rota-evaporator. The extracted fractions were kept at 55°C for 10 min and then completely oven-dried. The partially purified extract was stored at -20°C for further use.

**Chemical Tests.** The presence of saponins was detected using the following chemical tests:

**Frothing test.** A small amount of dried powder extract was shaken vigorously with distilled water. A pinch of sodium carbonate was added to dissolve the insoluble material in water. The froth produced by saponins has a characteristic honey comb structure and persists longer.

The following tests were performed on the liquid extract obtained after extraction using the soxhlet apparatus:

**Test for steroids. 1. Sulphur powder test.** A small amount of sulphur powder was added to the liquid extract. Sinking of the powder to the bottom indicates the presence of steroids.

**2. Liebermann-Burchard test.** To 2 ml of the liquid extract, 2ml of acetic anhydride was added, followed by a few drops of concentrated  $H_2SO_4$  along the sides of the test tube. A violet-blue ring formed at the junction of the two layers indicates the presence of steroids.

**3. Salwoski's test.** To 1 ml of the extract, concentrated  $H_2SO_4$  was added along the sides of the test tube. A yellow coloured ring turning to red if seen at the junction of two layers indicates the presence of steroids.

**4. Test for glycosides.** 5ml of diluted  $H_2SO_4$  was added to the extract in a test tube and boiled for 15 min in a water bath. It was then cooled and neutralized with 20% KOH. A mixture of 10ml of equal parts of Fehling's solution A and B was then added and the solution boiled for further 5 min. The formation of a dense red precipitate indicates the presence of glycosides.

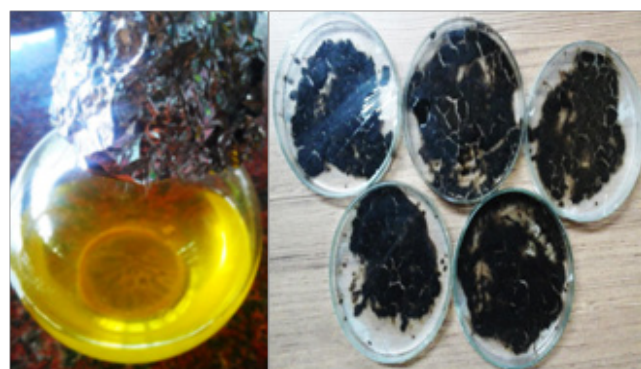
**Detection of saponins using Thin Layer Chromatography (TLC).** The partially purified extract obtained after soxhlet extraction was tested for its level of purity and the efficiency of the procedure using TLC. Commercially available silica gel G TLC plates and Chloroform: Methanol: Acetic acid: Distilled water (64:34:12:8) as the mobile phase was used. Each sample was concentrated in methanol and spotted using a capillary tube. A standard purified saponin was spotted as a reference. After completion of the run, the plate was dried and placed in an iodine vapour chamber for developing for 20 min, after which the plate was dried in the oven at  $55^\circ C$  for 10 min. All intense yellow coloured spots were marked and the  $R_f$  values were calculated.

**Antimicrobial property of extracted saponins.** Standard agar cup diffusion was performed. A stock solution was prepared by soaking 320 mg of extracted sample in 10 ml of methanol for 48h. This preparation was filtered through sterile Whatmann filter paper and the supernatant diluted to 8mg/ml, 0.8mg/ml, 0.2mg/ml and 0.02mg/ml using methanol. 20ml of molten nutrient agar (HiMedia) was seeded with 18h microbial culture suspension of *Escherichia coli* and *Staphylococcus aureus* (O.D. 0.3 Mcfarland's Standard) and poured into a Petri plates. After solidification, wells were bored in the agar and 0.03ml of each of the different concentrations of the extract were added into wells. Methanol was used as the negative control. The plates were incubated at  $37^\circ C$  for 24h. Antibacterial activity was assayed by measuring the diameter of the inhibition zone formed around the well.

## RESULTS

**Extraction of saponins using Soxhlet apparatus.** Soxhlet extraction of saponins (Fig-3) was standardized wrt a) choice of solvent, b) time and temperature of extraction, c) solvent:feed ratio to maximize saponin extraction from

the yam tubers. Soxhlet extraction using hydrolyzed samples did not yield any detectable amount of saponins, even after starting with a higher amount of yam tubers. The strong hydrolysis procedure might have led to their degradation. The non-hydrolyzed samples gave good yields of saponins as evidenced from the chemical tests. Methanol was found to be a better solvent for oven-dried samples and petroleum ether for sun-dried samples. The reason for this could not be determined. A solvent:feed ratio of 250ml:40g was found to be optimal for saponin extraction by the Soxhlet method.



**Fig-3. Saponin extracts.** Left panel: The liquid extract obtained after Soxhlet extraction. Right panel: Sun- and oven-dried extracts.

**Chemical tests.** Out of the 18 dried samples, 12 samples showed positive frothing test with varying levels of characteristic honey-comb froth, confirming the presence of saponins. Among the Soxhlet-extracted samples, 14 extracts showed negative results for the steroid tests while all were positive for glycosides.

**TLC analysis.** The  $R_f$  values of some extracts showed clear yellow bands (Fig-4) comparable to those of the standards: pure saponin and cholesterol. Literature states that saponins give an  $R_f$  value of 0.75. An  $R_f$  value 0.76 was obtained by the protocol used in this study, in solvent system of chloroform: methanol:acetic acid: distilled water (64:34:12:8).

**Antimicrobial activity of saponin extracts.** The concentrations of 8mg/ml, 0.8mg/ml, 0.2mg/ml and 0.02mg/ml showed no zone of inhibition around the

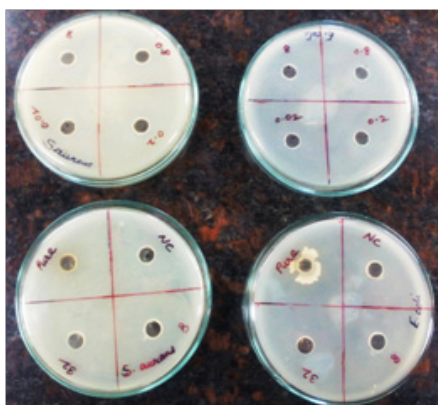


well, indicating that these concentrations of the saponin extract could not



**Fig-4. TLC Analysis.** Some extracts showed distinct yellow spots (encircled) with Rf value 0.76, characteristic of saponins. The first lane from left is standard purified saponin, and the second lane from left is pure cholesterol.

inhibit the growth of *Escherichia coli* and *Staphylococcus aureus* (Fig-5). Further analyses are required.



**Fig-5. Antimicrobial assay.** The agar cup diffusion assay performed showed no detectable levels of antimicrobial activity against *E. coli* and *S. aureus* cultures.

## DISCUSSION

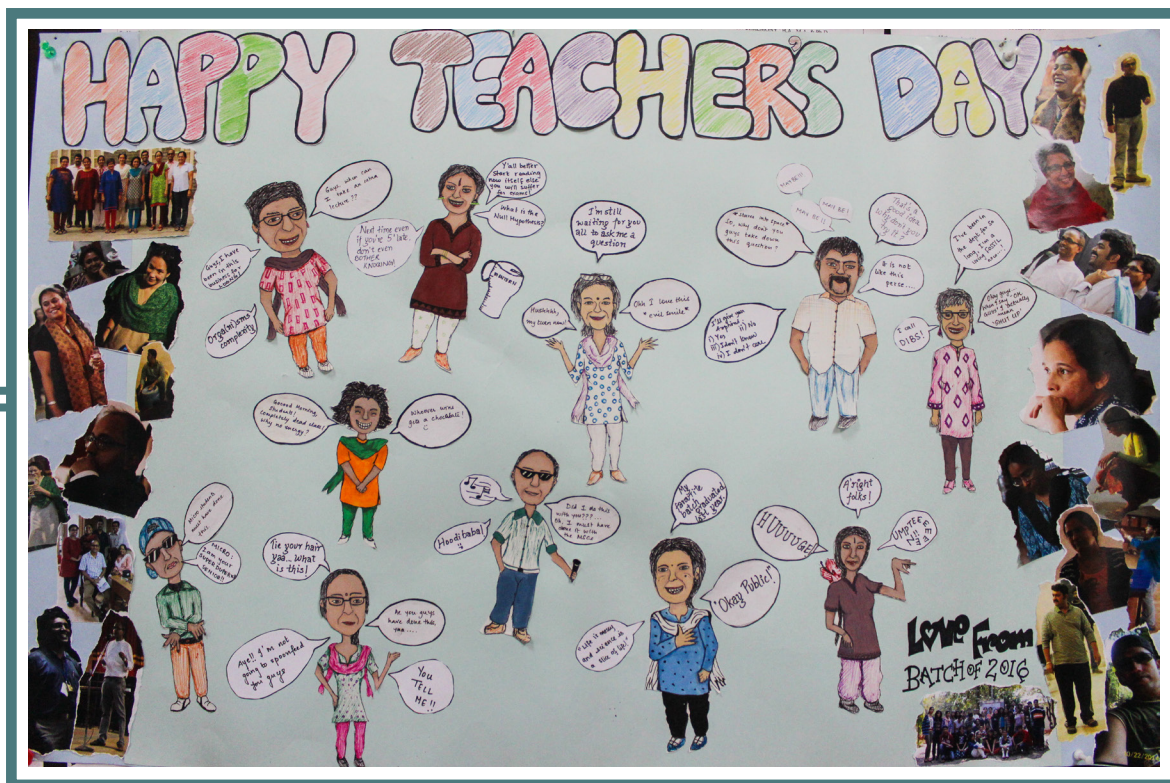
India is one of the highest consumers of elephant yam. Due to the varied medicinal and pharmacological benefits of its saponin content, the present study aimed at extracting saponins from their indigenous source – the edible yam. The results of the study indicate that Soxhlet extraction of saponins is an efficient method of isolation of these chemical compounds. Methanol an amphiphilic

solvent, can be used to obtain higher yields. an amphiphilic compound, can be used to obtain higher yields. Hydrolysis to separate saponins from glycosides was carried out but was unsuccessful. The hydrolysis caused degradative loss of saponins. Although TLC analysis showed the presence of saponins in some extracts, no antimicrobial activity was observed, indicating a higher concentration of saponins must be used for this assay. The saponins extracted by the Soxhlet method can be used for various medicinal and commercial purposes.

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