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... think scientifically, act scientifically... think scientifically, act scientifically... think scientifically, act...

Films: A Vibrant & Vital Medium for Communicating Science



Chander Mohan

A film of any hue and duration offers one of the most vibrant platforms to communicate. It is a dynamic medium of engagement, which offers the viewers instant entertainment and engagement at the same time. The unique synthesis of audio and video, if combined appropriately, can keep the audience glued to the screen. It also provides the writers, producers, directors, actors, editors, and other professionals and amateurs an opportunity to extend various modes of support like music, graphics, and so on. Even though, in the current context, digital and social media is tightening its grip over society at large and the youth in particular, film and television still hold sway over them and are expected to go on strongly for at least some more years.

Realising this, Vigyan Prasar (VP), too ventured into this medium a decade ago and since then it has been in the vanguard in our endeavours to communicate science to people. Our efforts have been more focussed in making engaging short films, documentaries, quiz shows, game shows, and so on. But it has not been an easy task. In fact the journey has been akin to a roller-coaster ride because getting more creative people to step into the realm of science & technology and make informative and the same time interesting programmes on science topics is a big challenge. With this in view, we have slowly but steadily put in place a mechanism to recognise their efforts

and engagement for taking such bold steps. One small step that was taken a decade back and which has now become a leap forward is the National Science Film Festival of India (NSFFI), a flagship event of Vigyan Prasar. Though still it is a fledgling as compared to some of the better-known and well-established Film Festivals in the entertaining genres, the dedication, devotion and diligence of the small fraternity of science film makers has stood by us and their love and encouragement is reflected in our receiving over 230 entries for the 8th edition of NSFFI that was held in Guwahati University, Guwahati, in February 2018, as against less than 40 received for the first edition.

As I have stated earlier, NSFFI is crucial to our agenda of communicating science to our people and inculcating scientific temper among them. We at VP salute the film makers, members of the jury, organisers and scores of others who worked behind the scenes but whose contribution was crucial. NSFFI provides an excellent platform to the creative talent and aspirations from across India, and even abroad, to showcase their entertaining as well as educative endeavours. Over 200 film makers from across the entire length and breadth of India - Kashmir to Kanyakumari and Kutch to Khonsa - came at one place and displayed their craft during this unique event. Making and showing science films enabled them all to reach out to the 'common man' and

make him understand how science is inherent, even though sometimes invisible, part of our everyday life. NSFFI thus endeavours to forge a stimulating S&T culture and foster scientific temper through popular science films. It recognises the initiative and output of science film makers on various issues and motivates them to make more such films. The event also provides an interactive platform to film makers, scientists and enthusiasts to create a better understanding of the universe; encourage citizen science and public participation and promote appreciation of science films. I particularly observed that film makers emphatically communicated scientific messages, reinforced learning, incorporated ideas and perceptions and tried to address challenges that confront us in our day-to-day life.

On behalf of VP, I wish to put on record our gratitude to veteran film makers and luminaries who have been associated as Jury Chair and mentors with NSFFI - Shri Shyam Benegal, Shri Adoor Gopalakrishnan, Shri Amol Palekar, Shri Muzaffar Ali, Shri Goutam Ghose, Shri Madhur Bhandarkar, Dr. Chandra Prakash Dwivedi, Dr. Mike Pandey, Mrs Suhasini Mule and several others. While celebrating the success of NSFFI-2018, we have already embarked on the journey of the next edition of Art & Craft of Science Films!

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Lignocellulosic Biomass: World's largest renewable source for biofuels production



Alok Patel

Worldwide concern on the availability of fossil fuels with depleting reserves and the shortage of oil supplies along with ever-increasing petroleum oil prices has kindled extensive interest in alternative renewable energy resources, especially biomass-based fuels. Non-edible lignocellulosic biomass having mainly cellulose, hemicellulose, and lignin are considered as most abundant renewable bio-resource. Production of fermentable sugars from hydrolysates of lignocellulosic biomass, either by physical, chemical or enzymatic hydrolysis is routine work and is used as feedstock in several biotechnological applications

The availability of petroleum-based resources continues to decline with increasing demand of energy worldwide. In order to reduce dependency on fossil fuels, many countries have revived interest in biomass-based biofuels, which are derived from renewable and domestic feedstocks. In India and other developing countries, direct combustion of biomass is used for heat generation and cooking purposes, which is wasteful because it not only causes environmental pollution but also results in low energy efficiency.

Biomass can be used to produce energy and also converted into high-quality bio-products by means other than combustion. The huge amounts of lignocellulosic biomass are obtained from forest woody feedstocks, agricultural residues, herbaceous and municipal solid wastes, and non-food energy crops. Sugarcane bagasse, sugarcane husk, wheat and rice straws and stalks,

leaves and cobs of corn (maize) are most promising plant residue derived feedstocks mainly used in the U.S., Asia and Europe. Lignocellulose is the major part of biomass, which is mainly composed of three types of polymers, namely cellulose, hemicellulose and lignin that are strongly interlinked and associated with non-covalent bonds and by covalent cross-linkages. Plant cell walls have lignocellulose as the primary building block in which cellulose plays a major structural role as organised microfibrils covered with hemicellulose and lignin (Figure 1).

Cellobiose is the repeat unit of cellulose composed of D-glucose subunits linked to each other by β -(1, 4)-glycosidic bonds. A pre-treatment is required to break the lignocellulosic biomass to obtain cellulose which is further treated with enzyme cocktails or sulphuric acid. The treated cellulose releases mono and oligosaccharides composed of pentose

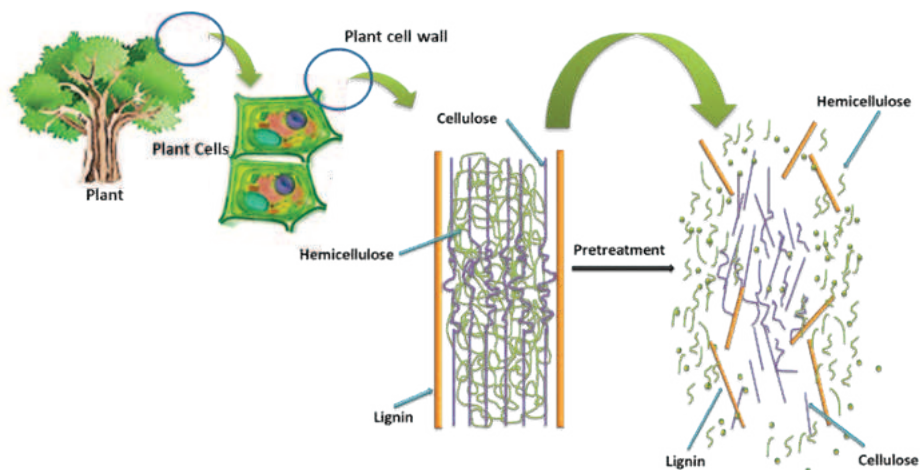


Figure 1. Pretreatment of lignocellulosic biomass

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and hexose sugars—the so-called hydrolysates which are potential carbon sources for lipid synthesis by oil-producing microorganisms or utilised by microorganisms for bio-ethanol production. In the last decade, a lot of research has been done on the efficiency of hydrolysis which is determined by measuring monosaccharide concentration in hydrolysates. However, the hydrolysis of lignocellulose is limited by several factors such as the production of toxic compounds, e.g., furfural, hydroxyl methyl furfural, phenolic acid, and acetate. These by-products show an inhibitory effect on the fermentation process.

Availability of lignocellulosic biomasses

For production of biofuels (ethanol, butanol, biodiesel), lignocellulosic biomass constitutes world's largest renewable resources. The bulk of these residues are obtained from agricultural, industrial, and forest sources (Figure 2). It is to be noted that all available residues are not utilised for biofuels production; some of these are used for fodder, manure production, and paper industries, or directly utilised as fuels.

Agricultural residues comprise an extensive variety of types. In common, these residues are divided into two categories such as the crop residues and the agro-industrial residues. The crop residues are the remaining parts of the crop after collection of useful materials, e.g., grains, while agro-industrial residues are the by-products of post-harvest processes. The most common agricultural wastes such as stalks, leaves and cobs of corns, rice and wheat straws as well as sugarcane bagasse are extensively used for microbial lipid production. World's most fertile lands are used for cultivation of food crops. However, with the rapidly increasing population, there is growing problem of food and energy availability. In the past few decades, researchers have focussed more on agricultural residues and some valuable energy crops such as corn and switchgrass

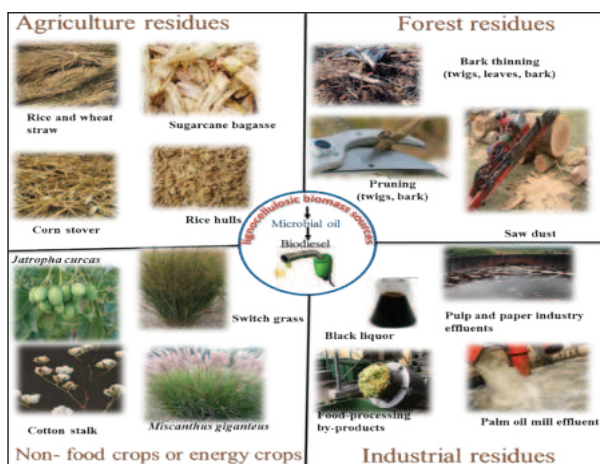


Figure 2. Types of lignocellulosic biomass

respectively, but woody biomass remains an important feedstock for biofuel production. These residues constitute second largest non-food lignocellulosic biomass. The important forest residues are those that are not utilised for saw logs, such as dead wood, and top thin branches. Another important source of lignocellulose biomass are the wood processing industries (sawmill rejects and sawdust) and recycled wood obtained from the destruction of buildings, cardboard boxes and wooden packing crates, etc.

Current industrial practices generate many by-products and wastes that may have a significant impact on the environment if they are not properly dealt with. In many cases, the wastes from these industries have to be treated using expensive and environmentally

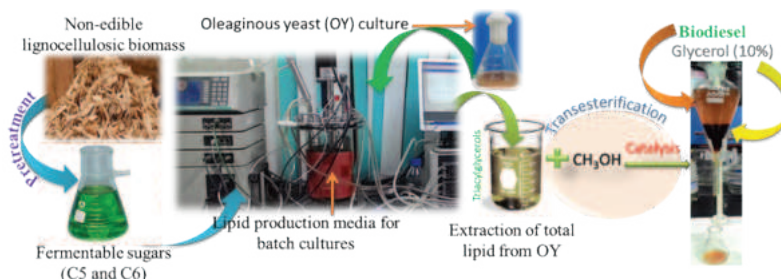


Figure 3. Overview of utilisation of fermentable sugars obtained from lignocellulosic biomasses for biodiesel production by oil-rich yeast

unfriendly methods. Although anaerobic digestion could be used for the treatment of organic wastes, the process can be slow and requires large carefully designed reactors to ensure safety from the accumulating methane. An alternative to anaerobic digestion could be treatment by oil-producing microorganisms to convert any metabolisable waste substrate into lipid that could have significant potential as a future

source of biodiesel. Many industries related to palm oil, pulp and paper, natural rubber, and biodiesel produce a large amount of processing wastes that are occupied with high organic loading and abundance. The pollution problems have been created with the disposal of high chemical oxygen demand (COD) of palm oil effluent. The best possible option to treat this effluent would be to use microbial growth.

Pre-treatment of lignocellulosic biomass

To enhance the digestibility of lignocellulosic material, different pre-treatment methods such as mechanical, thermal, acid, alkaline and oxidative pre-treatment are used. The other pre-treatment methods currently used include ozonolysis, liquid hot water, uncatalysed steam explosion, acid activated steam explosion, ammonia fibre explosion, and CO₂ explosion and the selection of method is based on the nature of the initial content of the materials.

Conclusion

Worldwide concern on the availability of fossil fuels with depleting reserves and the shortage of oil supplies along with ever-increasing petroleum oil prices has kindled extensive interest in alternative renewable energy resources, especially biomass-based fuels. Non-edible lignocellulosic biomass having mainly cellulose, hemicellulose, and lignin are considered as most abundant renewable bio-resource. Production of fermentable sugars from hydrolysates of lignocellulosic biomass, either by physical, chemical or enzymatic hydrolysis is routine work and is used as feedstock in several biotechnological applications, for example for bioethanol and biodiesel production. During hydrolysis, several non-carbohydrate compounds, such as furfural, 5-hydroxymethylfurfural (HMF), acetic acid and phenolic compounds are generated. These by-products have various adverse effects on growth of microorganisms, their metabolism, as well as on final products.

Love: Neurotransmission Effect of Hormones!



B. K. Konwar and Juri Gogoi Konwar

The need to be loved is as basic and indispensable as any other human need, like hunger, thirst, warmth and sleep, and it is addictive too. It is one of the most exhilarating of all human emotions, probably nature's most beautiful way of keeping the human and other animal species alive and procreating.

'The hunger for love is much more difficult to remove than the hunger for bread.'

—Mother Teresa

Love is an intense, universal and immensely intriguing emotion that knows no barriers of time, geography, race, religion, sex and culture. It is an expression of profound affection, caring and attachment. The need to be loved is as basic and indispensable as any other human need, like hunger, thirst, warmth and sleep, and it is addictive too. It is one of the most exhilarating of all human emotions, probably nature's most beautiful way of keeping the human and other animal species alive and procreating. With an irresistible cocktail of chemicals, the brain entices individuals to fall in love. Drenched in chemicals that bestow focus, stamina, vigour, and driven by brain's motivation, individuals succumb to a high level of courting urge. It can be romantic, platonic, interpersonal and even impersonal. Love devoid of romantic or sexual overtones, for instance love between friends, is considered platonic. Bonding between family members or the deep attachment between mother and child is interpersonal love. Impersonal love denotes love for a cause or a principle, close to one's heart. Love and life are inextricably linked. Falling in love is a matter of biochemistry, action of some nine hormones.

American anthropologist, human behaviour researcher Helen Fisher analysed

the happenings in the brains of those who are in passionate romantic love by scanning the brains and found that when they are focussing on the object of their affection, the region of the brain called the caudate nucleus becomes highly active. When two people fall in love deeply, the brain's pleasure centres are activated, causing the release of hormones like dopamine, and serotonin effecting mood swings, sleeplessness, increased heartbeat, and loss of appetite. Newly developed romantic love is more of a 'physical' nature; as the relationship progresses, the regions in the brain associated with long-term commitment, attachment and love begin to witness activity marking the beginning of life-time bond. The regions in the brain activated during hunger and thirst are similar to the pattern of brain activity found among lovers.

Stages of love

According to Helen Fisher there are three stages of falling in love: lust, attraction and attachment. Events occurring in the brain of an individual in love have similarities with mental illness. When one is attracted to somebody, it could be because subconsciously she or he likes the characters/genes of the other. Flushed cheeks, racing heartbeat and cool and moist hands are some outward signs of being in love which are basically caused by biochemistry.

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First stage: Lust

The first stage of love is driven by the sex hormones testosterone and oestrogen – in both male and female. Testosterone is not confined to men only; it plays a major role in the sex drive of women as well.

time, but its response lessens, which means there is a total loss of ability to feel any kind of pleasure. If a person is addicted to fatty food this ultimately might lead to the total loss of pleasure.

While dopamine is the ‘feel-good’

eating, etc., are difficult to change as compared to the acquired ones like playing, listening to music, etc. When one is short of dopamine triggered by habit, like having intimacy, people turn to another, like eating, to fill the gap. A fall in dopamine level makes individuals tired and depleted. Dopamine is double-edged; along with the intense pleasure it causes addiction. In fact, it turns a habit into addiction depending on frequency and dosage. Because natural dopamine stimulants are many and mostly unavoidable, people cannot help acquiring new habits; they can only intervene and choose good ones, the earlier the better.

During evolution, mating and reproduction remained survival priorities requiring effort, competition and fights; thus a reward from nature was essential for motivation. The ‘reward centre’ is in the brain, activated by dopamine when a goal is achieved. First-sight love is a pure dopaminergic (involving dopamine) urge that may or may not develop into mature love. Human beings like other animals are not naturally monogamous. It takes some effort to be loyal to the partner. Nature does not necessarily make people happy, but takes care of replication and reproduction of genes. Nature is not concerned with broken relation, divorce, abandoned children, jealousy and crimes of passion, unwanted pregnancy, and overpopulation.

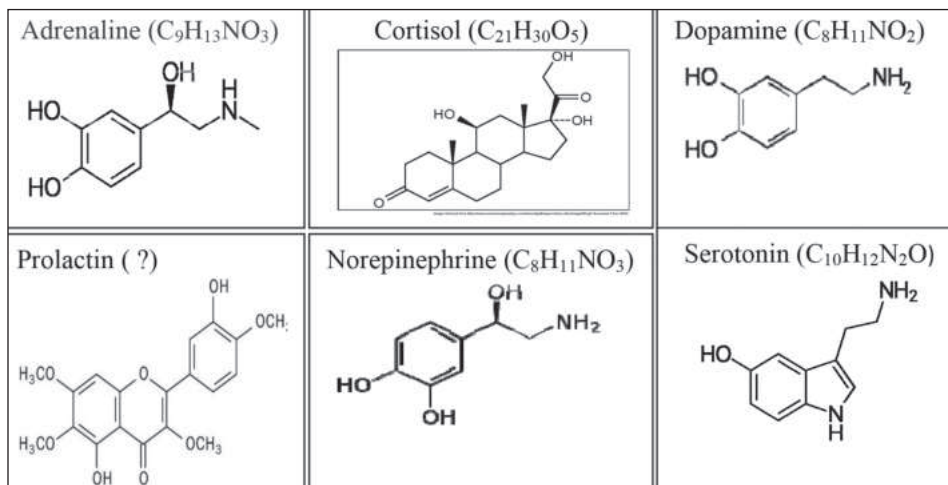


Fig.1. Chemical structure of love-hormones

Second stage: Attraction

This stage of love, attraction is very amazing as one can hardly think of little else. According to American psychologists Ellen Berscheid and Harry T. Reis, new couples also extol the relationship. Very commonly, the lovers think they have a relationship of being closer and more special than anyone else's. Such a feeling makes individuals to stay together. In attraction, a group of neurotransmitters, namely dopamine, adrenaline (norepinephrine), serotonin, and endorphin play an important role.

Dopamine

Couples in love possess high levels of the neurotransmitter dopamine. It stimulates ‘desire and reward’ by triggering an intense feeling of pleasure. Couples with surging dopamine tend to have increased energy, less need for sleep or food, focussed attention and exquisite delight in smallest details of the novel relationship. MRI and PET scans carried out by scientists reveal that when one listens to music that excites, the brain releases dopamine during the most exciting moments of the song. A person can produce much dopamine over

hormone, causing high attention, improved short-term memory, elation, boldness and temporary desire to explore and take risk, it tends to cause addiction. When the body releases a high dose of dopamine, it will take hours, days or weeks, before it gets back to normal. Another hormone called prolactin

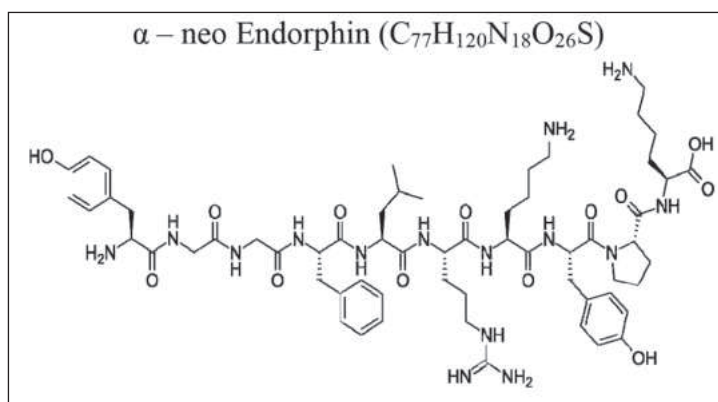


Fig.2. Second stage ‘Attraction’ hormone

is immediately released after dopamine wears off, causing the opposite effects, like depletion, irritability and depression. Thus, when prolactin is high, dopamine is low, and vice versa. In the long run, this cycle of ‘high and low’ affects the stability of the whole body, destabilises the nervous system and lowers immunity, thus increasing vulnerability and speeding up cell ageing.

Innate behaviours like being intimate,

Adrenaline

The initial stages of falling for someone activate the stress response, increasing the blood levels of adrenaline and cortisol. Adrenaline hormone is produced by the adrenal glands during exciting situations or high stress. This hormone is a part of the human body's acute stress response system. It works by stimulating the heart rate, contracting blood vessels, and dilating air passages, all of which work to increase blood flow to the muscles and oxygen to the lungs.

Serotonin

Serotonin is one of most important chemicals that might explain why one falls in love. After studying 20 couples being madly in love for less than six months, Donatella Marazziti and Mario Catena-Dell’Osso of

University of Pisa, Italy, stated that early love, i.e., attraction, really changes the way individuals think. By analysing blood samples from the lovers, they discovered that serotonin levels in new lovers are equivalent to the low serotonin levels of 'obsessive-compulsive disorder' patients.

Endorphins

Endorphins are among the neurotransmitters, which function to transmit electrical signals within the nervous system. They are released when the body feels pain. At least 20 types of endorphins are demonstrated in humans. Endorphins can be found in pituitary gland, in other parts of the brain, or distributed throughout the nervous system. Stress and pain are the two most common factors leading to the release of endorphins and they interact with the opiate receptors in the brain to reduce pain. In addition to a reduced feeling of pain, secretion of endorphins also leads to feeling of euphoria, modulation of appetite, release of sex hormones, and enhancement of the immune response. With high endorphin levels, people feel less pain and fewer negative effects of stress. They make individuals in love feel happiness and joyfulness.

Endorphin release varies from individual to individual, which means that two people who exercise at the same level or suffer the same degree of pain will not necessarily produce similar levels of endorphins. Certain foods like chocolate or chilli-pepper can also lead to enhanced secretion of endorphins.

Third stage: Attachment

It is the long-lasting commitment and the bonding that keeps couples together when they go on to have children. Scientist think there might be two major hormones involved in the feeling of attachment; (i)

Oxytocin and (ii) Vasopressin.

Oxytocin is a mammalian neurohypophysial hormone (secreted by the posterior pituitary gland), that acts primarily as a neuromodulator in the brain that makes a neuron use one or more chemicals to regulate diverse populations of neurons. It plays an important role in the neuro-anatomy of intimacy, specifically in sexual reproduction, in particular during and after child-birth. It is released in large amounts after distension of the cervix and uterus during labour, facilitating birth, maternal bonding, stimulation of nipples and lactation. Childbirth and milk ejection result from a positive feedback mechanism caused by this hormone.

In humans, oxytocin is released by the male and female during the final stage of intimacy, and probably deepens the feeling of attachment and makes couples feel much closer to one another. It also seems to help cement the strong bond between mother and baby. The hormone influences various behaviours, social recognition, pair bonding, anxiety and maternal instincts. Hence, it is sometimes referred to as the 'bonding hormone'. Oxytocin promotes ethnocentric behaviour, incorporating the trust and empathy of in-groups with their suspicion and rejection of outsiders. Oxytocin plays the role in bonding when released in the brain during certain types of human contacts. The hormone is released when a woman nurses her infant, and two people hug. It is also involved in other corollary emotional responses like trust-building and empathy.

There is a dark side to this hormone; while effecting positive behaviours of trust and bonding, oxytocin can also cause opposite behaviours like jealousy, envy and suspicion. Oxytocin triggers and amplifies social feelings of all types, not just the positive, feel-good ones. According to

Simone Shamay-Tsoory of University of Haifa, Israel, when one person's association is positive, oxytocin bolsters pro-social behaviours; but when the association is negative the hormone increases negative sentiments.

Oxytocin has peripheral actions also in the brain. The peripheral actions of the hormone mainly reflect secretion from pituitary gland. Its actions are mediated by specific, high-affinity oxytocin receptors. Actions of the hormone include: (i) Maternal behaviour, (ii) Reflex actions, (iii) Uterine contraction, (iv) Wound healing, and (v) Sexual response.

Oxytocin evokes feelings like contentment, reduction in anxiety, feelings of calmness and security around the mate. This suggests oxytocin may be important for inhibition of the brain regions associated with behavioural control, fear and anxiety. It also functions to protect against stresses; it can alleviate mood and reduce stress with good efficiency. In several species, this hormone can stimulate sodium excretion from the kidneys, but high doses in humans can result in hypothermia (subnormal body temperature). Under certain circumstances oxytocin indirectly inhibits release of adrenocorticotrophic hormone and cortisol; accordingly in those situations, it may function as an antagonist of the other stage-three attachment hormone vasopressin.

Actions of oxytocin

Oxytocin plays an important role in trust building and fear reduction. In rodents, oxytocin was found to efficiently inhibit fear by activating an inhibitory circuit within the amygdala in the brain. Disclosure of emotional events is a sign of trust in humans. When recanting a negative event, humans that receive intranasal oxytocin share more emotional details and stories with more emotional significance.

Oxytocin influences social distance between adult males and females, and may be responsible at least in part for romantic attraction and subsequent monogamous pair bonding. Oxytocin nasal spray aroused men in a monogamous relationship, but not in single men. The hormone might promote fidelity within monogamous relationship.

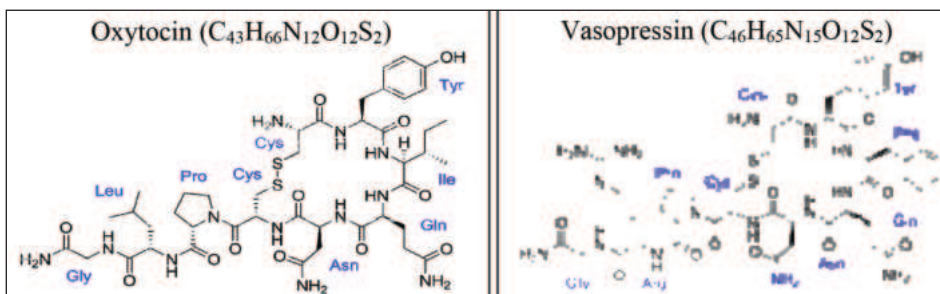


Fig.3. Third stage 'Attachment' hormones

Continued on page 26

Consequences of Obesity in Children



Jyoti Sharma and Sarthak Sharma

Children are fast adopting physically inactive lifestyles and consuming more 'energy-dense, nutrient-poor' diets. Despite increasing the cases of cerebrovascular disease (strokes), cancers, Type II diabetes, osteoarthritis, hypertension and high cholesterol, Indian children are not eating the recommended amount of fruits or vegetables as part of their daily diet. All these factors are having a serious impact on their wellbeing and quality of life.

Agrawal family decided to visit doctor as Anuj is feeling very tired and psychologically depressed now-a-days. His family was also feeling that most of his friends started ignoring him and stopped to invite him in most of the common parties due to his sedentary lifestyle. However, they never expected that their fourteen-year-old son was suffering from Type II diabetes, which they came to know after visiting doctor. The doctor explained that Anuj's overweight is primary reason for development of Type II diabetes. The family had never realised that Anuj's weight had increased from 45 to 94 just in last five years. The probable reason of his weight gain might be his love for pizza, burger, spicy chicken, fried food and aerated drinks. However, the doctor informed the family that Type 2 Diabetes in children can be evaded by avoiding weight gain, inactive lifestyle and dietary modifications. Anuj's overweight could be controlled by adopting active lifestyle and improving food habits.

A recent study by the World Health Organisation (WHO) has revealed that India is home of approximate 14.4 million overweight children. The 'Global Burden of Disease' study 2013 reported that by 2025, India will have over 17 million obese children and stand second among 184 countries after China. Obese children are at a significantly high risk for adverse health outcomes including both medical and psychological problems. It is well-established that overweight and obese individuals have increased risk of developing various

chronic diseases, such as Type-II diabetes mellitus, hypertension, and cardiovascular disease (Figure 1). Body mass index (BMI) is a measure of body fat based on the body weight in relation to the height. It is used as a screening tool to determine whether a person is underweight, overweight or obese. Furthermore, increased BMI is associated with higher risk of mortality. Commonly accepted BMI ranges are: Underweight: under 18.5 kg/m²; Normal weight: 18.5 to 25 kg/m²; Overweight: 25 to 30 kg/m²; and Obese: over 30 kg/m².

Obesity arises when energy intake exceeds energy expenditure. Body weight is determined by the interactions between genetic and environmental factors. It is estimated that 40-70% of BMI variation is hereditary, while the other 30% is determined by lifestyle factors. Figure 1 also indicates that sugar or fat is not the sole reason for the recent rise in obesity as emphasised in many literatures. Instead there are many other factors which are responsible for increase in cases of obesity. However, genes, environment, and emotional factors also influence food intake, and mood states that trigger eating of palatable foods for comfort in negative emotional states are important factors. This repetitive eating of comfort foods, rich in carbohydrate, high-fats and sugar, leads to obesity. Obesity in turn regulates mood, which disturbs our brain activity, leading to abidirectional vicious cycle of mood, food, and obesity.

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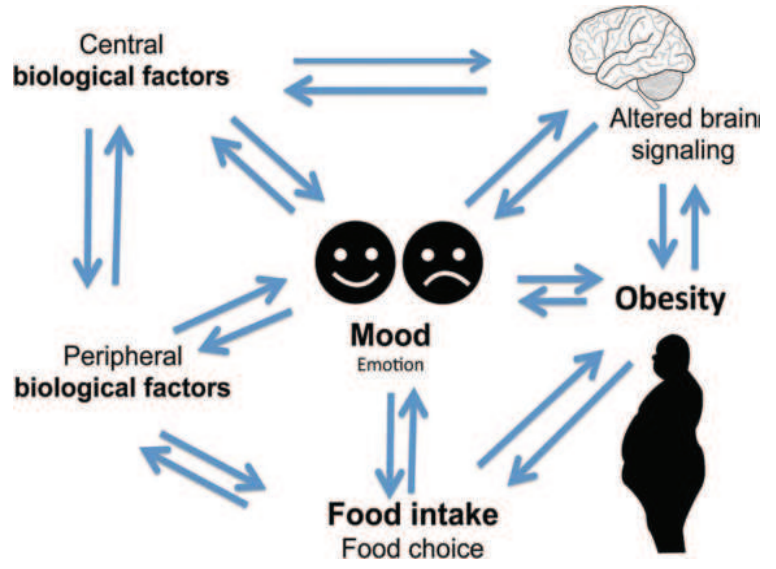
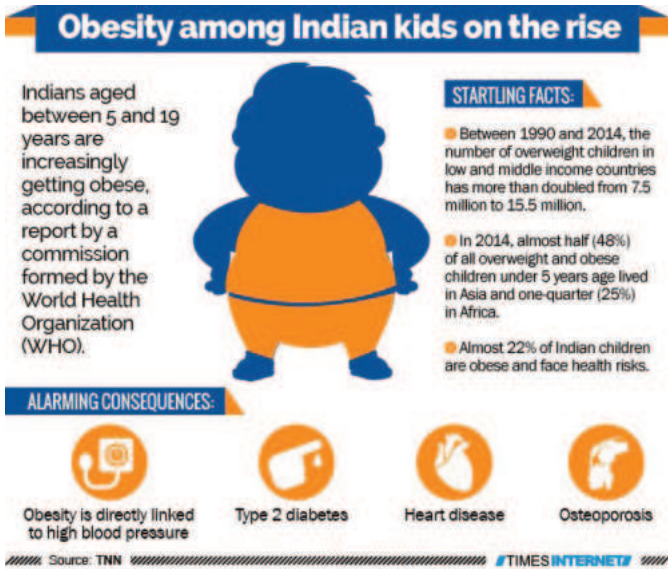


Figure 1: Complex two-way relationship linking food intake, mood, and obesity. (Source: TNN, Singh, 2014. www.frontiersin.org)

Relationship of macronutrients with obesity

Research has been unable to identify the real culprit that leads to obesity. Nowadays, both in the western world and in developing countries, diet predominantly consists of processed, unhealthy foods. Promotional campaigns advertise low-fat diets; however, this instead encourages companies to use high sugar content. The first incidences of hypertension, diabetes, and obesity were noticed in Europe (England, France and Germany), which happens to be the place where sugar first became available to the public. This demonstrates the correlation between the consumption of sugar and obesity. Moreover, the introduction of sugar in developing countries later also coincides with the rise in obesity and heart disease in those countries.

High-fructose corn syrup (HFCS) is a sweetener made from corn starch having the same chemical composition (glucose and fructose) as table sugar, which is sucrose (naturally occurring carbohydrate found in many plants and plant parts). HFCS has become the primary choice of food industries due to its better

shelf life, more palatability and competitive price compared to table sugar. The combination of table sugar and HFCS has resulted in an additional 30% increase in overall sweetener intake and has been found to be a critical component associated with the risks of obesity and cardiovascular diseases. This is related to the inability of fructose as compared to glucose to stimulate the release of the hormones insulin and leptin and to inhibit production of ghrelin, all factors that are known to affect the satiety centre in our brain. Insulin is responsible for regulating blood glucose levels. Leptin made by fat cells, decreases appetite, and ghrelin plays a

role in body weight by increasing appetite. The consumption of fructose also leads in reduced kidney function and increase in arteriolar thickening whereas equivalent amounts of glucose or starch do not induce these affects. Fructose is the only sugar that raises uric acid concentrations, a potential risk factor for inducing gout, a disease in which defective metabolism of uric acid causes arthritis.

High-carbohydrate diets may also be one of the reasons of obesity. One of the common justifications for eating a low-carb diet is that the human body has a limited ability to store carbohydrate and any carbohydrate that our body can't store gets turned directly to fat. Depending on the source, starch generally contains 20 - 25% amylose and 75 - 80% amylopectin, which are broken down by enzymes into monosaccharides during digestion. This is temporarily stored as glycogen in the liver and skeletal muscles, and subsequently converted into lipids to be stored in adipose tissue when consumed in excess.

Lipids are vital for energy storage and biochemical functioning and act as structural components of cell membranes. Triglycerides are a major form of energy

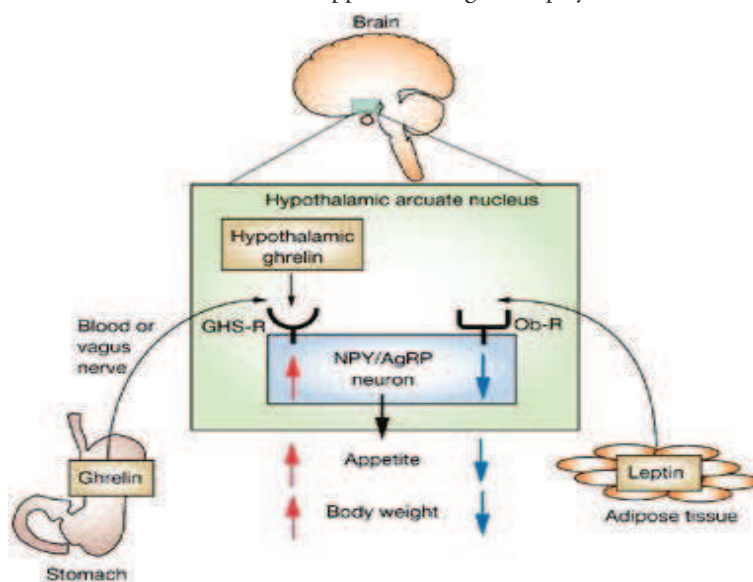


Figure 2: Relationship of Leptin and Ghrelin with obesity (Source: Kojima and Kangawa. Nat Clin Pract Endocrinol Metab. 2006)

storage, located in the). Fat supplies more than twice the number of calories per gram in comparison to carbohydrates. Saturated fat is the type of fat primarily responsible for clogging our arteries and increasing cholesterol levels. Nowadays, food industries are using hydrogenated or trans-fat which is more appropriate for their food processing needs. *Trans*-fats are easy to use, inexpensive to produce and can be used many times in commercial fryers. They also give food a desirable and texture and are used in most of the fast foods and fried foods like French fries, doughnuts, cakes, pie crusts, biscuits, frozen pizza, cookies, crackers, and stick margarines. Artificial trans-fats (or trans-fatty acids) are created in an industrial process that adds hydrogen to liquid vegetable oils to make them more solid. However, these trans-fats are more dangerous and harmful for the heart and raise bad cholesterol (LDL) levels and lower the good cholesterol (HDL) levels. High-fat diets lead to changes in adipose tissue deposition and play a very important role as cause of obesity. Exercise and the consumption of higher amounts of unsaturated fats (mostly found in plants oils) are of importance in managing obesity.

Proteins are required to form new cells and tissues, by their breakdown into amino acids. Protein provides structure to muscles and organs. Proteins also provide the building blocks for immune cells, blood cells, enzymes and hormones. An increase in dietary protein content may be positive for body weight regulation through its effects on satiety, maintenance of body heat, and the production and activity of insulin. When protein replaces carbohydrate in a low-fat diet, it may help in reducing the presence of glucose and an abnormally high concentration of insulin in the blood and may increase the fat oxidation simultaneously.

Food psychology: Food reward, habits and obesity

The interaction between mood, emotional state, and feeding behaviours is complex and it is hypothesised that individuals regulate their emotions and mood by changing both food choices and quantities. Reward and gratification associated with consumption of highly palatable food leads to certain chemicals called hormones activating reward and

Table 1: Smart Ways to Reduce Sugar and fat Consumption

What to replace	By what	Chemical relevance
Sugary soft drinks and juice drinks	Diluted fruit juice or sparkling water, whole fruit	It will decrease the percentage of fructose, which serves as a fuel for the body and is processed almost entirely in the liver where it is converted to fat Fructose in whole fruit comes with fibre, which slows down and reduces the absorption of the sugar in the body Sparkling water will hydrate the body without any significant sugar content
Jam or honey on your toast	Low-fat spread, sliced banana or low-fat cream cheese	Both jam and honey is loaded with fructose and glucose
Processes foods	Natural foods or go for low-sugar version	It will provide less sugar and trans-fat
Cereals loaded with sugar, salt and saturated fat	Whole-grain breakfast cereals, but not coated with sugar or honey	Whole grain breakfast cereals are less processed and contain more vitamins, minerals and phytochemicals.
Sugar in hot drinks, or in your breakfast cereal	Gradually reduce the amount until you can cut it out altogether	Skipping sugar in breakfast may cut down 6 spoons of sugar a day
Sugar-laden energy chews, gels and jelly beans	Natural dates or dried fruit of choice	Quick source of simple carbs and sugar
Sweet, candy bar with sugar	Protein, a handful of pistachios with 1-ounce of dark chocolate	Protein helps to increase 'satiety' or a feeling of fullness, so it can help reduce calories from mindless snacking
Whole milk	Semi-skimmed/ skimmed milk	Low percentage of fat
Mayonnaise, cheese, sour cream and salad dressings	Herbs, spices, vinegar and fresh lemon juice	Low percentage of fat

pleasure centres in the brain, suggesting a neuronal mechanism of food addiction leading to overeating and obesity.

There are several neurotransmitter systems involved in feeding such as serotonin, dopamine, opioids, and gamma aminobutyric acid (GABA), of which serotonin and dopamine are the most closely linked to feeding behaviour. Dopamine mediates reward specifically the 'wanting' or approach behaviours toward a biologically relevant goal more so than 'liking' or enjoyment aspect.

Lifestyle

Children are fast adopting physically inactive lifestyles and consuming more 'energy-dense, nutrient-poor' diets due to modernisation, mechanical lifestyle, availability of processed and fast foods, and increasing dependence on television, computer and mobile phones for leisure. Despite increasing the cases of cerebrovascular disease (strokes), cancers, Type II diabetes, osteoarthritis, hypertension and high cholesterol, Indian children are not eating the recommended amount of fruits or

vegetables as part of their daily diet. All these factors are having a serious impact on their wellbeing and quality of life.

Conclusion

Current literature suggests a high burden of generalised obesity among Indian children and adolescents, with a definite socio-economic difference. According to WHO, people from Asian populations may have vastly different levels of fatness and different fat distribution compared to Caucasian populations ('white' or 'of European ancestry') at a given BMI. Asian-Indian children are increasingly susceptible to unfavourable body composition, as well as regional adiposity. Obese Indian children have a high burden of subclinical inflammation (a characteristic of obesity), insulin resistance and metabolic syndrome at a younger age than their non-obese counterparts. Research studies indicate an increase in the proportion of Type-II diabetes with declining age in India. These factors indicate the direct link between childhood obesity and the diabetes

epidemic in India. According to WHO, the proportion of Asian people with a high risk of Type-II diabetes and cardiovascular disease is substantial at BMIs lower than the existing WHO cut-off point for overweight (BMI great than 25).

Hippocrates, father of modern medicine, said: 'Let your food be your medicine, and your medicine be your food'. In the modern society, apart from heredity and demographic factors, the major causes of obesity are sedentary life style leading to reduced physical activity and surplus of hyper-palatable foods which activate dopamine rewarding centres leading to over-consumption. Besides mood changes, high-fat diets promote increased weight gain, visceral adipose tissue, larger waist circumference, and more cardiovascular disease mortality. These changes again lead to neurobiological impairment affecting mood disorders such as depression and anxiety and stress, which further induces overeating and obesity. However, a diet too high in refined carbohydrates and sugars and low in fat can be as unhealthy as a high-fat diet because it also increases the risk of

diabetes and cardiovascular diseases.

Combined lifestyle interventions target physical activity as well as diet and include psychological techniques such as willpower, motivational interviewing and cognitive behavioural therapy. The influence of food choice includes biological determinants of hunger, appetite, taste, cost, income, and availability of food. A combination of balanced diet, regular exercise and stress management certainly help to lead a healthy life.

Policies are equally important in management of obesity. Apart from malnutrition, Government should equally focus on obesity too. This may lead to stop future generation suffering from multiple complications in their adulthood. Schools may play critical role to control an epidemic of obesity by stopping sell of processed food and aerated drinks in school canteens and regular counselling. WHO has also developed the 'Global Action Plan for the Prevention and Control of Non-communicable Diseases 2013-2020', which includes halt in the rise of global obesity to match the rates of 2010. ■

Love: Neurotransmission Effect of Hormones! (Continued from page 30)

Oxytocin is important for pro-social behaviours like facilitating trust and attachment between individuals. However, it has a larger and more complex role including enhancement of fear and anxiety which is modulatory in nature; that is, it does not directly elicit fear or anxiety. The hormone increases the prominence of certain social stimuli causing the animal or human to pay closer attention to socially relevant stimuli. After the administration of oxytocin, individuals display an enhanced ability to express fear.

Administration of oxytocin differentially influences males and females and such individuals are overall faster in responding to socially relevant stimuli. After administration of the hormone, females show increased amygdala activity in the brain in response to threatening scenes; however, males do not show increased amygdala activation. This phenomenon can be explained by looking at the role of gonadal hormones, specifically oestrogen which modulates enhanced threat perception in females. Oestrogen is believed

to stimulate the release of oxytocin from the hypothalamus.

Vasopressin is another important hormone that plays a role in the long-term commitment stage and is released after sexual activity. It is anti-diuretic hormone, works with the kidneys to control thirst. In females, the hormone is released by the hypothalamus gland during child birth and helps the breast express milk. It helps in cementing the strong bond between mother and child.

Medical use of love hormones

Synthetic dopamine is prescribed for acute pain, attention disorders, high prolactin and low dopamine conditions, in renal failure, cervical injury and cardiovascular problems, and in effecting increased blood flow to the heart. Synthesised serotonin is usually prescribed as an anti-depressant, to fight addiction, help one to regain self-control, and boost one's will power and sense of wellbeing. Serotonin gives deeper and longer pleasure and counter-balances the

addictive nature of dopamine.

According to the World Health Organisation, oxytocin is one of the most important hormones in basic health system. When oxytocin is taken in doses or as spray it causes relaxation and arousal in most men and women. Synthetic oxytocin is given to people with autism and social phobia to help them face society. However, when taken at the wrong time it can make a person more gullible and naive, trusting the wrong people. Oxytocin is the fear-killing hormone, notwithstanding the consequences. It increases immunity, slows down cell-aging and increases life-expectancy, mood stability and one's sense of well-being.

Ingested oxytocin is destroyed in the gastrointestinal tract, so it must be administered by injecting or as nasal spray. It has a half-life of typically about three minutes in the blood, and given intravenously does not enter the brain. The trust-inducing property of oxytocin might help those who suffer from social anxieties and mood disorders. ■

Sundarbans – A Haven of Biodiversity



Soumadip Sen

Today, the major dangers to wildlife come from global climatic change, unregulated hunting and poaching of wild animals for trade, pollution, over-exploitation of natural resources and extensive deforestation to make room for the ever-expanding human population. Despite multiple challenges and demands on its resources, India's efforts at preserving its wildlife are highly praiseworthy.

The densely forested wetlands of the Sundarbans, formed by the delta of the rivers Ganges-Brahmaputra-Meghna, constitute the largest river-mouth system in the world. The Sundarbans forest spreads approximately over 10,000 sq km across the Indian state of West Bengal and the neighbouring country Bangladesh, of which 40% lies in India, and the remaining 60% in Bangladesh, making it the largest block

from its most common mangrove tree, the 'sundari', a Bengali word for 'beautiful'. But behind the beauty, this tangled mangrove forests on the Bay of Bengal is the kingdom of a creature rarely seen by humans– one of the most efficient predators, the legendary Royal Bengal tiger (*Panthera tigris*), the guardian of the Sundarbans. The Bengal tiger has an attractive flame colour, with stripes ranging from dark brown to black;



The Sundarbans spreads across India and Bangladesh (Credit: Google maps)

of tidal halophytic mangrove forest on Earth. It supports a large, biodiversity-rich ecosystem well known for its unique and rich variety of flora and fauna as well as the scenic landscapes. Parts of Sundarbans in the two countries are listed as World Heritage Sites by the UNESCO, in recognition of their high biodiversity and the occurrence of threatened species, underlining their importance as conservation landscapes. As the forest spreads over the lower Gangetic delta, it is flat and alluvial, and is intersected by several wide rivers and a number of winding creeks from north to south.

The Sundarbans takes its name

the belly and the interior parts of the limbs are white, and the tail is orange with black rings. The tigers of Sundarbans are excellent swimmers and their prey mainly comprises deer, boars, monkeys, monitor lizards, birds, crabs and fish.

Then comes the spotted deer or *Chital* deer (*Axis axis*), which are extensively seen in the Sundarbans and enhances its beauty to a great extent. Other mammals comprise of wild boars, porcupines and Rhesus macaque, which is one of the best-known species of Old World monkeys, having a wide distribution and large population across the area. Among the reptiles, the King



The Royal Bengal Tigers in Sundarbans are excellent swimmers

cobra, the common cobra, Banded krait, Russell's viper make up the community of venomous reptiles, while the python, Chequered keelback, Dhaman, Green whip snake, and several other species constitute the non-venomous snakes. Sundarbans also harbours a good number of rare and globally threatened animals including estuarine crocodile, common otter, fishing cat, water monitor, Gangetic dolphin, river terrapin, Snubfin dolphin, marine turtles like Olive Ridley, Green sea turtle, and Hawksbill turtle.

There are about 248 bird species found in the Sundarbans including a large number of migratory birds from higher latitudes that visit the area in winter months. Among them some of the distinct ones are herons, egrets, storks, Green pigeons, sand pipers, spoonbills, darters, seagulls, partridges, great variety of wild geese and ducks. These indicate that the Sundarban Reserved Forest is a natural biodiversity hot spot. Besides *sundari* trees (*Heritiera fomes*), the Sundarbans flora is characterised by the abundance of Gewa, Goran and Keora all of which occur prominently throughout the area.

Honey bees (*Apis dorsata*) play a significant role in natural pollination and regeneration of mangroves. Moreover, they serve as a livelihood of the villagers. For generations, poor fishermen and villagers around Sundarbans have been collecting wild raw honey from honeycombs build inside the forest in large numbers from April to June every year. The honey gathering season brings lots of expectations in the villages of Sundarbans, as it provides people with much needed extra income.

On average, the fishermen earn around Rs. 4,000 to Rs. 5,000 each during the season. But collecting honey is a risky business, since it often leads encountering the deadly Royal Bengal Tiger, which has the worst reputation as a man eater.



The spotted deer or Chital found widely in Sundarbans

The active delta of the Sundarbans is a network of rivers, creeks, estuaries, channels, mudflats, coastal dunes and small islands of salt-tolerant mangrove forests that are continuously changing due to the impact of the ocean tides. The area encounters many cyclonic storms and in the coastal zones of West Bengal, the wind acts as a basic driving



Some of the most beautiful birds seen in Sundarbans

force for generating surface waves. According to researchers, this great kingdom of nature is under the severe threat of erosion and drowning due to sea level rise and increasing cyclonic activity. As per the reports of West Bengal University of Animal and Fishery Sciences, sea levels around the Indian sub-continent are rising at the rate of about 2.5 mm/year. But in case of Sundarbans, the relative sea level rise is higher than this which is due to the subsidence of land.

With its typical vegetation and diverse wildlife, the Sundarbans has been a showpiece of nature. Its dynamic and vibrating ecosystem formed by interactions of land and water, is considered as one of the most productive wetlands on Earth. This vast greenery acts as a huge sink of unlimited capacity for absorbing CO₂ and other pollutants from air and water which makes the surrounding environment free from pollution. These mangrove forests are a highly productive ecosystem and maintain a high standing biomass, compared to other forests. The Sundarbans ecosystem, however, has been hit with several threats. Poaching is a big problem

for the ecosystem. Also, uncontrolled felling of trees is a large problem. Tigers keep the forest protected because they keep away human intervention and they protect the forest from being destroyed.

Different surveys are conducted from time to time in collaboration with Wildlife Institute of India, West Bengal's Forest Department, and World Wide Fund for Nature (WWF)-India, with active participation and cooperation of Bangladesh Forest Department. An unprecedented effort of camera trapping and field surveys across tiger-occupied habitats was undertaken by the Govt. of India and as per its assessment report '*Status of Tigers in India, 2014*', tiger population in the Sundarbans has remained stable and is estimated to be around 76 (62 to 96) tigers. Major part of the Sundarbans has now been camera trapped for capturing unique individual tiger photos. All these survey report and statistics clearly point out that the condition of most of the endangered species is very critical, especially the Royal Bengal Tiger.

As per the reports of WWF and



Honey collection is risky task in the Sundarbans Forest (Credit: Google images)

several wildlife research organisations, the decline in the number of the tigers in the Sundarbans is primarily due to three reasons. Firstly, it is illegal wildlife trade. Prior to the international ban on tiger trade in 1993, tiger populations were being severely decimated by poaching and trade. In spite of the ban, the illegal trade of tigers for their skin, bones, claws and teeth has increased dramatically in the past few decades. Poaching driven by the international illegal wildlife trade is the largest immediate threat to the remaining tiger population.

Then comes prey loss. Tigers suffer severely from loss of natural prey like deer, wild boar and other animals. Decline in the number of prey because of direct poaching for meat and trade, competition with livestock over food, and habitat degradation because of excessive wood removal for fires are some of the reasons responsible for decline in the prey which sustain the tigers. Lastly, conflict with humans is also a major reason for tiger decline. As tigers continue to lose their habitat and prey, they are continuously coming out of their territories in search of food and as a result get involved into conflict with humans of the surrounding villages. Sometimes in retaliation, tigers are killed by angry villagers.

There is a typical custom in the villages of Sundarbans that is praying to the *Bonbibi*, the forest deity. It is believed to be the single most common way locals try to ward off tiger attacks. She is thought to protect those who work in the forest from tigers.

By virtue of being the top predator, the tiger functions as an umbrella species for the conservation of biodiversity, ecosystem functions, goods, and services in

forest systems of Asia. The 'Project Tiger', a pioneering conservation initiative of the Government of India administered by the National Tiger Conservation Authority, aims to harness this role of tigers for the conservation of ecosystem. The main aim of Project Tiger was to create safe havens and ideal environmental conditions for the



survival and growth of tigers and its prey to ensure preservation of a viable population of this wonderful 'big cat' in the country for scientific, economic, cultural, aesthetic and ecological values. Project Tiger was launched by the Government of India in 1973 as a centrally sponsored conservation programme aimed at saving the tiger population in India. It also identifies and eliminates the factors responsible for the decline of tiger. The major threats or factors recognised by Project Tiger are poaching that is driven by an illegal international demand for tiger parts and products, depletion of tiger prey caused by illegal bush meat consumption, and habitat loss due to the ever-increasing demand for forested lands.

The Sundarbans, which is an excellent tiger habitat and the largest sanctuary for the Royal Bengal Tiger in the world, stands across the common boundary of

India and Bangladesh; as a result both the countries have shared a common concern for the animal and has taken certain bilateral initiatives for ensuring the survival and conservation of the tiger in the unique ecosystem of Sundarbans. As per the reports of Ministry of Environment, Forest and Climate Change, Government of India on 6 September, 2011 has signed a Memorandum of Understanding (MoU) with Government of the People's Republic of Bangladesh, on the conservation of Sundarbans, which also includes conservation of the Royal Bengal Tiger. Both countries have recognised the need to monitor and conserve the Sundarbans, which is home to rich biodiversity consisting of large variety of rare species of flora and fauna, and acts as a vital protective barrier shielding the mainland from flooding, tidal waves and cyclones. According to this MoU, both countries will share technical knowledge with the common goal of conservation and management of biodiversity of the Sundarbans as well as organise joint tiger estimation at regular intervals.

For decades conservation has been the practice of protecting wild plant and animal species and their habitats from extinction. In today's world, wildlife conservation has become an increasingly important task due to the adverse effects of human activities on wildlife. Today, the major dangers to wildlife come from global climatic change, unregulated hunting and poaching of wild animals for trade, pollution, over-exploitation of natural resources and extensive deforestation to make room for the ever-expanding human population. Despite multiple challenges and demands on its resources, India's efforts at preserving its wildlife are highly praiseworthy. It is because of the continuous efforts of the Govt. of India along with the help of many national and international organisations that the tigers still remain in a precarious existence in India. Faced with threats of habitat loss and organised poaching, tiger populations need scientific monitoring, protection and trans-boundary cooperation among other things to ensure their long term survival.

Parkinson's disease — Knowing About Medications, Alternative Therapies and Surgery



Dr Yatish Agarwal

Parkinson's disease can be profoundly frustrating, as walking, talking and even eating may become more difficult and time-consuming. Depression is also not uncommon. However, if you take adequate steps, it is possible to have a good to great quality of life. Working with your doctor and following recommended therapies is critical in successfully treating the symptoms. Friends and family are often your best allies; however, the understanding of people who know what you're going through can be especially helpful.

A common nervous system disorder that generally affects the middle-aged and elderly individuals, Parkinson's disease is a chronic condition with no definite cure. Still, if you take adequate steps, it is possible to have a good to great quality of life. Working with your doctor and following recommended therapies is critical in successfully treating the symptoms. Most people with Parkinson's disease often do dramatically well with medications, and a host of alternative and complementary treatments. In some advanced cases, surgery may be useful in tiding over the symptoms.

Medications

Medications may help manage problems with walking, movement and tremor. These medications increase or substitute for dopamine, a specific signalling chemical (neurotransmitter) in the brain.

People with Parkinson's disease have low brain dopamine concentrations. However, dopamine can't be given directly, as it can't enter your brain.

You may have significant improvement of your symptoms after beginning Parkinson's disease treatment. Over time, however, the benefits of drugs frequently diminish or become less consistent, although symptoms usually can continue to be fairly well-controlled.

Medications your doctor may prescribe include:

Carbidopa-levodopa

Levodopa, the most effective Parkinson's disease medication, is a natural

chemical that passes into your brain and is converted to dopamine.

Levodopa is combined with carbidopa (Sinemet), which protects levodopa from premature conversion to dopamine outside your brain, which prevents or lessens side effects such as nausea.

Side effects may include nausea or light headedness due to a drop in blood pressure, a condition known as orthostatic hypotension.

After years, as your disease progresses, the benefit from levodopa may become less stable, with a tendency to wax and wane ("wearing off"). Some people may also experience involuntary movements (dyskinesia) after taking higher doses of levodopa. Your doctor may lessen your dose or adjust the times of your doses to control these effects.

Carbidopa-levodopa infusion

The U.S. Food and Drug administration approved a drug called Duopa in 2015. This medication is made up of carbidopa and levodopa. However, it is administered through a feeding tube that delivers the medication in a gel form directly to the small intestine.



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Duopa is for patients with more advanced Parkinson's who still respond to carbidopa-levodopa, but who have a lot of fluctuations in their response. As Duopa is continually infused, blood levels of the two drugs remain constant.

Placement of the tube requires a small surgical procedure. Risks associated with having the tube include the tube falling out or infections at the infusion site.

Dopamine agonists

Unlike levodopa, dopamine agonists do not change into dopamine. Instead, they mimic dopamine effects in your brain. Though they are not as effective as levodopa in treating the symptoms, they last longer and may be used with levodopa to smooth the sometimes off-and-on effect of levodopa.

Dopamine agonists include pramipexole, ropinirole and rotigotine (given as a patch). A short-acting injectable dopamine agonist, apomorphine, is used for quick relief.

Some of the side effects of dopamine agonists are similar to the side effects of carbidopa-levodopa, but also include hallucinations, sleepiness and compulsive behaviours such as hyper sexuality, gambling and eating. If you're taking these medications and you behave in a way that's out of character for you, talk to your doctor.

MAO-B inhibitors

These medications include selegiline and rasagiline. They help prevent the breakdown of brain dopamine by inhibiting the brain enzyme monoamine oxidase-B. This enzyme metabolizes brain dopamine. Side effects may include nausea or insomnia.

When added to carbidopa-levodopa, these medications increase the risk of hallucinations.

These medications are not often used in combination with most antidepressants or certain narcotics due to potentially serious but rare reactions. Check with your doctor before taking any additional medications with a MAO-B inhibitor.

Catechol-O-methyltransferase (COMT) inhibitors

Entacapone is the primary medication from this class. This medication mildly prolongs the effect of levodopa therapy by blocking an enzyme that breaks down dopamine.

Side effects, including an increased risk of involuntary movements (dyskinesias), mainly result from an enhanced levodopa effect. Other side effects include diarrhoea or other enhanced levodopa side effects.

Tolcapone is another COMT inhibitor. However, it is rarely prescribed due to a risk of serious liver damage and liver failure.

Anticholinergics

These medications were used for many years to help control the tremor associated with Parkinson's disease. Several anticholinergic medications are available, including benztropine or trihexyphenidyl.

However, their modest benefits are often offset by side effects such as impaired memory, confusion, hallucinations, constipation, dry mouth and impaired urination.

Amantadine

Doctors may prescribe amantadine alone to provide short-term relief of symptoms of mild, early-stage Parkinson's disease. It may also be given with carbidopa-levodopa therapy during the later stages of Parkinson's disease to control involuntary movements (dyskinesias) induced by carbidopa-levodopa.

Side effects may include a purple mottling of the skin, ankle swelling or hallucinations.

Alternative therapies

Some research has shown that regular aerobic exercise may reduce the risk of Parkinson's disease. Furthermore, a number of alternative therapies may come in handy in bringing relief. These treatments include:

Yoga

Yoga is one of the most beneficial complementary therapies for Parkinson's disease, helping to increase flexibility;



improve posture and steadiness of gait; loosen tight, painful muscles; build confidence; and, through these benefits, enhance the quality of life. However, due to Parkinson's, you may be required to modify the asanas (poses) to fit your physical abilities.

Seated and assisted postures may be more accessible for those with limited mobility and/or any feelings of unsteadiness. Practices that involve sounds such as chanting, playing, listening, and moving to music, singing, drumming, and "kirtan" have also been found beneficial. Music therapies can be effective in gait training by providing a steady rhythm for gait and stride. Simple rhythmic movements around a room or shifting from one foot to the other and alternating arm swings while sitting in a chair are staples of yoga classes in Parkinson's. Movement with music has also been shown to improve endurance, range of motion, strength, and hand coordination.

These yogic effects are enhanced when the movements cross the midline of the body due to brain hemisphere coordination required in these actions. Such movements include eagle arms or self-hugging, touching opposite ear, or crossing hand to opposite knee in a seated twist.

Rhythm awareness or working with breath ratio, moving to the rhythm of the breath, or yogic kriyas performed to repetitively prescribed tempos often bring benefit. This might include alternate nostril breathing with a 3:3:3 ratio (inhale 3, hold 3, and exhale 3) or moving the arms up for a count of four, out for a count of four, and down for a count of four.

Some movements that can be done on the floor or in bed can help with morning stiffness. Lateral stretches like reclining crescent and gentle hamstring warm-ups like apanasana, knees-to-chest pose, to supta padangusthasana, supine hand-to-big-toe pose are great ways to begin the day.

The use of a wall or chair for stabilization or yoga props that cushion stiffer areas of the body help ensure greater comfort and safety. Asanas that strengthen core and posture, like *uktasana* (chair pose), modified *navasana* (boat pose), or variations of *salabhasana* (locust), can aid in countering the rounding shoulders and forward head that often accompany Parkinson's.

Starting with dynamic movement is especially helpful for tight muscles because these movements are warming and help the loosening process. Music at intervals in

class, for warm-ups or standing postures, may help relieve stress, and there is a strong connection between experiencing music and dopamine levels which are adversely affected by Parkinson's. Nature sounds or music may also be helpful for relaxation, as may the incorporation of chanting for improvement of breath and posture.

You could adopt the following template for a one-hour yogic practice routine:

Begin by sitting in a chair. Draw attention to your posture and the rhythm of your breath. Allow your breath to expand in a calm way, over the course of three to four minutes. Chant Om three times. Now let's begin with the asanas:

Seated cat asana (extension and flexion)

Place your hands on your knees and inhale as your chest and abdomen move forward; exhale as you dome the spine and contract the belly area. Continue to alternate for two to three minutes.

Core twists with hands on shoulders (twisting right and left)

Inhale centre and exhale as you revolve your chest to each side. Continue until the strong muscles in the sides of your waist feel warm and awake.

Lateral movement of the spine

Release one hand down and extend your top arm as you turn your face down toward the lower shoulder, taking three long, deep breaths. Make sure you come up to centre slowly, on an inhalation. Repeat on the other side.

Elbow kayaks

Interlace your fingers behind your head, pressing your head lightly into your hands; "paddle" your elbows forward and back, one at a time, as though you are kayaking and your elbows are your oars, enjoying a deep side-body opening and smoother mobility in the shoulders as you move.

Seated or standing joy kriya

From a stable standing position or seated in a chair, lightly sniff in as you sweep your arms upward and cross at your wrists. Then sniff in again, reaching about two-thirds of your inhale capacity as you

swing your arms down then out wide like an orchestra conductor. Then sniff in again, to your capacity, as you swing arms back to the crossed wrist position.

Exhale through your mouth or your nose as you sweep your arms down and back past your sides, bend your knees, and slightly bend forward. Repeat five or more times, using the momentum of each movement to take you to the next, and feel how the swinging starts to become natural and invigorating.

Leg swings

If you are standing, you will swing one leg forward and back, catching and then holding under the knee for three breaths. Use a support if needed for balance. Do three rounds on each side.

Apanasana

If you are sitting in a chair, try *apanasana*, alternate squeezing knees into the abdomen on an exhalation. Repeat three times.

Arm circles

Keeping your breaths long and deep, begin with your arms outstretched in front of you, palms together, and circle your right arm forward as your left arm circles back. Reverse directions. Now try starting with your hands on your shoulders and your elbows touching and making opposite circles with your elbows. Then just for fun, bring your arms alongside your torso and try rolling your shoulders in opposite directions. If you didn't get it today, don't fret. These wacky arm circles get easier with trying!

Dynamic camel pose

Sitting to the front edge of your chair, bring your hands to the sides of the chair seat and inhale, inflating your chest and arching your spine to a backbend. Take care that you keep the back of your neck long; and avoid flinging your head back. Exhale; relax the squeeze between your shoulder blades, and return to your starting position. Do five repetitions of chair camel to the rhythm of your breath, then hold the spine arched for three breaths. You can also do a traditional kneeling camel pose if you wish.

Hip stretch (ankle over thigh in a figure-four shape)

Remaining in this hip opener, you can add cat/cow movements to the spine and

pelvis. Try humming when you breathe out and you may find your hip relaxing more easily!

Chair bharadvajasana

This version of a twist feels a little odd but has shown benefit in many neural disorders. It uses the eyes and body movement to work across the hemispheres of the brain. Take it easy and come out if you feel any dizziness.

Sit very upright and sideways in your chair with your right hip toward the back of the chair. Take your hands to either side of the chair back and gently revolve into a twist, keeping your knees even. Gaze to the right and keep your eyes looking to the right as you turn your head to the left.

It is common for this movement to challenge your ability to maintain a long deep breath. You may also find that the movement seems jerky. Don't be discouraged if it seems a little awkward in the beginning. Do it once on each side, and if you find yourself comfortable, gradually build to two times on each side.

Singing snake pose

Still in your tall seated posture and lower your chin down toward your chest. Inhale here. As you exhale, stick out your tongue and gaze upward. Repeat this three times before bringing your head back to a neutral position. Then flutter your eyes open and closed, as though you were taking pictures with your eyes. Repeat this until the eyes feel moist.

Soft forward fold in a chair

Rest your forehead on a table or bolster. Stay here for 10 deep breaths.

Shavasana

You could do this in bed or on the floor for 10 to 20 minutes. Start with a 1:1 ratio breath (meaning your inhalation and exhalation are the same length), relaxing your abdomen on the inhalation, with minimal pause between breaths. Gradually move to a 2:1 breath, with the exhalation lengthening to twice the length of the inhalation. Continue until your body feels very calm and relaxed.

Bhramari

Subsequent to the deep rest of shavasana, it is a perfect timing for

breath practices which create a pleasant healing vibration in the brain. Humming in bhrumari or “bumblebee breath” can lead us into a more meditative state and is known to help with memory. Start with a low pitch humming the breath out for three breaths. Mid-range next and then high like the buzz of a mosquito. Try relaxing your tongue or varying the vibration with an “ing” sound (like in the word “sing”).

Alexander technique

The Alexander technique, named after its founder Frederick Matthias Alexander, attempts to develop the ability to avoid unnecessary muscular tension by retraining physical movement. The technique — which focuses on muscle posture, balance and thinking about how you use muscles — may reduce muscle tension and pain. The technique is based on the belief that poor habits in posture and movement damage spatial self-awareness; and could provide benefit through physical and mental retraining. The benefits are however uncertain.

Massage

Massage therapy employs many different techniques. In general, masseurs or therapists press, rub, and otherwise manipulate the muscles and other soft tissues of the body. They most often use their hands and fingers, but may use their forearms, elbows, or feet. Massage therapy can reduce muscle tension and promote relaxation.



Acupuncture

During an acupuncture session, a trained practitioner inserts tiny needles into many specific points on your body, which may reduce your pain.

Tai chi

An ancient form of Chinese exercise, tai chi employs slow, flowing motions that may improve flexibility, balance and muscle strength. Tai chi may also prevent falls. Several forms of tai chi are tailored for people of any age or physical condition.

A study showed tai chi may improve the balance of people with mild to moderate Parkinson’s disease more than stretching and resistance training.

Meditation

In meditation, you quietly reflect and focus your mind on an idea or image. Meditation may reduce stress and pain and improve your sense of well-being.

Music or art therapy

Music or art therapy may help you to relax. Music therapy helps some people with Parkinson’s disease to improve their walking and speech. Participating in art therapy, such as painting or ceramics, may improve your mood and help you relax.

Pet therapy

Having a dog or cat may increase your flexibility and movement and improve your emotional health.

Surgical procedures

Deep brain stimulation

In deep brain stimulation, surgeons implant electrodes into a specific part of the brain. The electrodes are connected to a generator implanted in the chest near the collarbone that sends electrical pulses to the brain and may reduce the Parkinson’s disease symptoms.

Your doctor may adjust the settings as necessary to treat your condition.

This surgery involves risks, including infections, stroke or brain haemorrhage. Some people experience problems with the deep brain stimulation system or have complications due to stimulation, and the doctor may need to adjust or replace some parts of the system.

Deep brain stimulation is most often offered to people with advanced Parkinson’s disease who have unstable medication responses. It can stabilize medication



fluctuations, reduce or halt involuntary movements (dyskinesias), reduce tremor, reduce rigidity, and improve slowing of movement.

However, this treatment isn’t helpful for problems that don’t respond to levodopa therapy. It also doesn’t stop the progression of Parkinson’s disease.

Living with any chronic illness isn’t easy. It is quite normal to feel angry, depressed or discouraged at times. Parkinson’s disease, in particular, can be profoundly frustrating, as walking, talking and even eating may become more difficult and time-consuming. Depression is also not uncommon. However, you can take help of antidepressant medications. They can help cheer you up. Friends and family are often your best allies; however, the understanding of people who know what you’re going through can be especially helpful. ■

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