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From the Editor's

Dear Readers,

In the July issue of our Newsletter, we received several popular articles from diverse fields. All the authors deserve great appreciation for sharing articles in huge numbers. Please continue sending articles to our Publication team and share published newsletter with your friends also.

I would like to thank the Editorial team including Print, Designer and Publication committee for their efforts throughout the edition.

Your suggestions are always welcome for improvement.

**Dr. R. S. Tomar**
Editor-in-Chief
**Dr. Sushma Tiwari**
Co-Editor



## CIGARETTES BUTTS AND MICRO PLASTICS: AN OLD BUT RECENTLY RECOGNIZED POLLUTANT

**Namita Das Saha[1]*, Partha Saha[1], L K Prasad[2] and M Sheshu Madhav[2]**
[1]ICAR-Central Tobacco Research Institute, RS-Dinhata, Cooch Behar, West Bengal
[2]ICAR-Central Tobacco Research Institute, Rajahmundry, Andhra Pradesh
E-mail: *soilnami@gmail.com*

Micro plastics pollution has been ranked as 2nd most important pollution in the globe. In recent past, the micro plastics pollution and consequent environmental hazards have attracted significant attention of the scientific fraternity and public. Cigarette butts, are the filter part of cigarette which is filter the toxic chemicals, nicotine and tars, thus retains these harmful chemicals in the filter itself. This butt is composed of cellulose acetate, which is a type of plastic and are most abundant type of plastic pollutants in the environment. These butts are litters willingly and as a part of regular habits by the smokers. A single butt can segregate even more than 15,000 detachable strands of micro plastic fiber. These butts get their way into rivers and lakes, and finally into the ocean. Also very often remain on the ground. According to a study, around 300,000 tons of micro plastic fibers may find their ultimate path to the aquatic environment from this butts source each year. Additionally, these butts are loaded with toxic substances like Persistent organic pollutants (POPs), nicotine, carcinogenic tar which further pose strong toxic effect towards the organisms present in that environment. Until now there are a few studies available which focused on the conjoined effect of these toxic chemicals and micro plastics.

But, many scientific studies have revealed about acute toxicity towards many aquatic organisms like mussels, shrimps. Cigarette butts indeed have eco-toxicological effects (Fig 1). When discarded in the environment, they pose a unique challenge due to their ubiquity, persistence, and potential harm. In a nutshell the significant points that are clinked with cigarette butts are as follows:

1. ***Toxic Chemicals***: Cigarette butts contain over 250 harmful chemicals, with at least 69 of them being carcinogenic. These toxins can leak into soils, waterways, lakes, and oceans.

2. ***Aquatic and Terrestrial Impact***: Studies have examined the toxicity of cigarette butts in both aquatic and terrestrial habitats. Lethal effects are common in aquatic organisms, but research on terrestrial life is lagging behind. Cigarette butts can affect growth, behavior, and reproductive output of individual organisms in all three habitats.
3. ***Micro plastic Pollution***: As cigarette butts break down, they release tiny plastic particles called micro plastics, which are hazardous to waterways and marine life.
4. ***Biodegradability***: Even biodegradable cigarette butts pose a risk to the environment, as they still contain harmful substances.

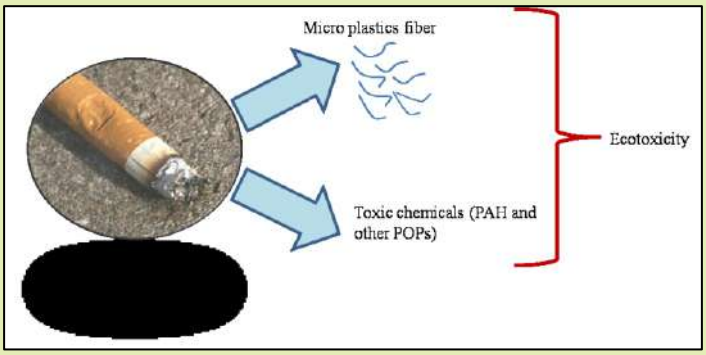


**Fig 1: Glimpse of cigarette butts and associated toxicity aspects.**

In summary, cigarette butts are a persistent form of toxic plastic pollution, impacting ecosystems and potentially entering the food chain.

**Possible solution towards the cigarette butts issues:**
This problem can't be solved only through technology based solution but the social awareness; people's behavior should also be corrected. In fact, the management of cigarette butts and associated pollution problem is a difficult aspect, but that doesn't mean to hold an excuse for us to throw away cigarette butts at our wish at any place! Here are some possible ways out for controlling the problem of butts pollution.

1) Strict rules and regulation from the government should be employed to careless throwing of butts here and there specially at scenic spots like parks, drinking water source protection areas, beaches and other sensitive points and concentrated areas. The act of discarding cigarette butts should be severely punished.
2) A deposit system should be introduced in some areas. Municipal departments should set up special smoking areas in public places to improve the recovery rate of cigarette butts. For rural and remote areas, the government should increase publicity on the harm of cigarette butts to the environment.
3) New types of cigarette filters should be developed which is devoid of any sort of plastics. Additionally, it should be clear that biodegradable cigarette butts should not be a way for the society to continue to throw them, because these butts also carry harmful chemicals.
4) Hazardous waste to wealth transformation should be another approach. Herein, different transformed products possibilities should be explored from cigarette butts. Such an example is cigarette butt-derived carbons obtained by continuous hydrothermal carbonization and activation have ultra-high specific surface area and pore volume, respectively, and show unprecedented high hydrogen storage capacity. Another such example is functional carbon materials to function as super capacitor and remediating agent for water pollutant removal.

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# BEST PRACTICES TO IMPROVE SHELF-LIFE OF MANGO

**Abeer Ali[1], Nimisha Sharma[1]*,**
**R. M. Sharma[1] and Anil Kumar Dubey[2]**
[1]Division of Fruits and Horticultural Technology, ICAR-Indian Agricultural Research Institute New Delhi
[2]ICAR-Central Soil Salinity Research Institute, Regional Research Station, Lucknow, U.P.,
Corresponding author Email: *nims17sharma@gmail.com*

Mango (*Mangifera indica* L.), belonging to the Anacardiaceae family, is one of the most important tropical fruits worldwide, known for its attractive aroma, flavor, and nutritional value. Both mango production and International trade are steadily expanding. India is the world's largest mango producer, contributing approximately 44 percent of the global mango production. Mangoes are cultivated on 2,400 thousand hectares in India, with a total production of 21.79 million tonnes and a productivity rate of 9.07 tonnes per hectare (NHB 2023-24 First Advance Estimate). Despite being the largest producer, India exported only 173,284 tonnes of mangoes as fresh fruit in 2022, which accounts for about 8.08% of its total production (FAO 2022).

Fruits are harvested at the mature green stage (commercial maturity), which means they are physiologically fully developed but have not yet reached the climacteric rise. This stage is crucial for commercial operations involving storage and transportation. While tree-ripe mangoes achieve the best quality, their storage shelf life is limited due to their susceptibility to bruising, decay, and over-ripening. Mangoes are climacteric fruits and enter the 'climacteric phase' after harvest, during which they continue to ripen. Ripening involves significant changes in physiological, biochemical, and sensory properties, such as increased respiration, ethylene production, pigment biosynthesis (carotenoids and anthocyanins), changes in the metabolism of carbohydrates, organic acids, lipids, phenolics, and volatile compounds, as well as the softening of texture to an acceptable quality. Due to the highly perishable nature of mangoes, substantial quantitative and qualitative postharvest losses occur at various stages of the supply chain. Key causes of post-harvest losses include improper maturity at harvest, mechanical damage, sap burn, spongy tissue, lenticel discoloration, fruit softening, decay, chilling injury, pest and disease damage, tight packing, improper transport, and inadequate field handling. Adhering to meticulous post-harvest steps is essential for extending the shelf life of mangoes, ensuring fresh, nutritionus and marketable for an extended period (Figure 1).


**Figure 1: Steps for post-harvest management of mango.**

**Precooling**

Precooling is the removal method of field heat. Precooled fruits have a longer shelf life than non-precooled fruits.Precooled fruits experience less spoilage, maintain a higher percentage of marketable quality, exhibit less weight loss, retain more firmness, and have an extended ripening time. Fruits precooled at 8°C for 8 hrs had an extended shelf life (Makwana *et al.*, 2014). There are several kinds of precooling.Precooling methods commonly used for mangoes include room cooling, forced-air cooling, hydrocooling, running water, ice cooling, and evaporative cooling.

**Delatexing and cleaning**

Trimming removes the stem left on the fruit. Packing fruits with stems can cause latex stains and lead to decay and secondary infections when the stems break off. Delatexing can be achieved by inverting freshly de-stemmed fruits on plastic or steel mesh racks to allow the latex to drip for 30 minutes, or by dipping the fruits in a 1 % alum solution (0.5 kg powdered alum per 50 liters of water) for one minute (Figure 2). Alum helps coagulate the latex when the fruit is dipped. De-stemming under $Ca(OH)_2$, Tween20, and Tween-80, or de-stemming followed by dipping in 5% NaCl (table salt) solution, is highly effective in reducing sap burn injury.The fruits are washed on the packaging line using conveyors (pH of 6.5 to 7.5). Sanitation is crucial to prevent disease spread and reduce pathogen levels in wash water and packhouse air. Chlorine treatments of 100 to 150 ppm effectively control pathogen buildup during packhouse operations (Figure 3). Use 1 to 2 ml of chlorine per liter of water to clean walls, floors, and packing equipment.

**Sorting and Grading**

Fruits are checked for cracks, sap residue, fruit fly infestation, and anthracnose. Damaged fruits are

**Figure 2: Removing latex from freshly trimmed mangoes using a delatexing tray (a) and by dipping them in a 1 % alum solution (b) (Ntsoane *et al.*, 2019).**

**Figure 3: washing the mangoes using chlorine water and sorting (Brecht *et al.*, 2020).**

**Figure 4: Grading of mangoes (Ntsoane *et al.*, 2019).**

discarded. Only healthy fruits without blemishes proceed to grading (Figure 4), treatments, and packaging, following Codex Alimentarius guidelines. i.e., Extra class: superior quality with free of defects, class 1: good quality with slight defects and class II: It satisfy minimum requirements. Based on size it is graded in to A (100-200G), B (201-350G), C (351-550G) and D (551-800g). Other non distructive method of grading include machine vision technology, computerized vision systems, X-ray CT scanning, MRI imaging, NMR technology, NIR spectroscopy, ultrasound imaging, electronic olfaction, and optical X-ray CT scanning.

**Post-harvest pre treatment**

Postharvest treatment is a crucial stage for mangoes before packing for the supply chain to prevent diseases and slow down ripening. These treatments encompass both non-chemical (hot air and hot water treatment, irradiation method) and chemical methods (synthetic reagents, arabic gum, chitosan and carboxymethyl cellulose).

***Heat treatment***

Thermal treatments in postharvest pathogen disinfection prolong the shelf life of mangoes (Figure: 5). It involves immersing freshly harvested mangoes in hot water or air for a specific duration and at a particular temperature. The exact time and temperature vary based on the mango variety, its size, and the specific disease or insect being targeted. The heat treatments commonly used for mangoes are: (i) Vapor heat treatment, (ii) Forced hot air treatment, and (iii) Hot water treatment. The effectiveness of thermal treatment lies in its potential to inactivate intracellular enzymes responsible for quality deterioration. Hot water treatment technique has been shown to be profitable for the mango fruit industry among other treatments. Heat treatment is reported to improve fruit quality, enhance ripening, reduce chilling injury incidence, and extend shelf life. Hot water treatment (HWT) is the most effective post-harvest method for extending the shelf life of mangoes; particularly in preventing anthracnose and stem-end rot (Aveno and Orden, 2004). For Keitt mangoes, the best hot water treatment is at 52°C for 5 minutes, which also effectively controls anthracnose and extends shelf life for 21 days (Kumah *et al.*, 2011). Hot water treatment at 50°C for 30 minutes is the best to avoid lenticel browning for Dashehari, Sensation, Langra, and Eldon (Prasad *et al.*, 2016).Hydrocooling mangoes after hot water treatment rapidly lower the flesh temperature more effectively than air cooling, and can help reduce hot water injury (Figure: 6).

**Irradiation method**

The irradiation process involves exposing fruits to a specific dose of ionizing radiation within a biologically shielded irradiation chamber. Based on dose requirements, food irradiation applications can be classified into low

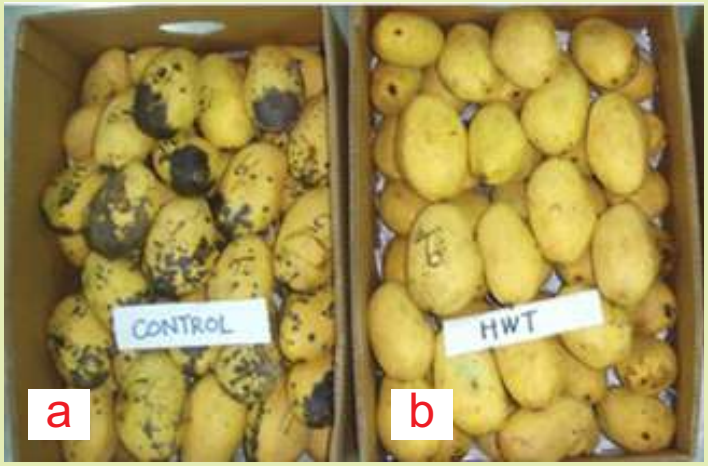


**Figure 5: Effect of HWT in mangoes (a) control infected by anthracnose, stem end rot and fruit rot and (b) Fruits undergone HWT(Ntsoane *et al.*, 2019).**

**Figure 6: Hydrocooling of mangoes after hot water treatment (Brecht *et al.*, 2020).**

dose, medium dose, and high dose categories. This physical process involves subjecting the commodities to controlled doses of ionizing radiation energy, such as gamma rays or X-rays or UV-C light (190–280 nm). UV-C light (190–280 nm) at doses of less than 3 kJ/m² is used to produce a cytotoxic effect against pathogens that cause rotting diseases, including fungi such as Botryosphaeria dothidea, Lasiodiplodia theobromae, Alternaria alternata, and Colletotrichum gloeosporioides. According to Food Safety and Standards Regulations, the maximum permitted dose of irradiation for mangoes is 0.75 kGy. Irradiation accelerates the formation of phenylalanine ammonia-lyase, an enzyme that catalyzes the biosynthesis of cytotoxic compounds, primarily phenols, which act against disease pathogens. This process also increases the content of antioxidants, such as α-tocopherol, β-carotene, and ascorbic acid. Due to safety concerns, the approved dosage for irradiation treatment must be less than 1 kGy. The efficacy of irradiation treatment depends significantly on the cultivar, dosage, and fruit maturity stage. Moreover, the high implementation and maintenance costs of irradiation facilities may render it infeasible for adoption in developing countries.

**Use of edible coating**

In this chemical pre-treatment, synthetic or naturally derived reagents, such as edible coatings, can be used to preserve mango quality (Figure: 7). These films act on as a water and gas exchange rate ($O_2$ and $CO_2$) barrier in order to modify the composition of its internal atmosphere (Singh et al., 2013). Various types of coatings such as carnauba wax, shellac, zein, cellulose derivatives, chitosan and its derivatives and other composite mixtures containing sucrose esters of fatty acids and a sodium salt of carboxymethylcellulose have been tested to extend storage life of mango fruit.


**Figure 7: (a) Non-waxed fruits and (b) waxed mango fruits (Brecht *et al.*, 2020).**

**Post-harvest problems in mango**

The major post-harvest problems that hinder the export industry are anthracnose, stem end rot, fruit fly, spongy tissue, and jelly seed. These problems cannot be detected in the mature green stage, as symptoms appear only in ripe fruits. An integrated approach to pre- and post-harvest management can effectively control these problems. Hot water treatment is the most effective method for stem end rot, anthracnose, and fruit fly. It should be done within 36 hours of harvesting on delatexed fruits, as the latex in the fruits can cause latex burn. Usually, a temperature of 52–55°C for 5 to 10 minutes is preferred. Irradiation and hot water treatments are recommended for fruit fly control. Chemical methods such as Malathion and hydrolyzed protein bait are also effective. Bagging, despite its cost, results in fruit free from fly damage and minimal anthracnose, with improved color, making about 95% of harvested fruit saleable. Pre-harvest practices such as fruit bagging, sod culture, and the application of Potassium nitrate or Arka Saka Nivarak twice

between 50–70% maturity, or a Sodium chloride spray at a 3–5% concentration, are effective in controlling spongy tissue. Post-harvest practices, such as storing fruits in low storage conditions, are also important.For jelly seeds, the application of anti-gibberellin, such as paclobutrazol at 10 g/l, has been reported to reduce the disorder. Preharvest application of spray formulations containing 10 g/l NaCl, 25 g/l $CaCl_2$, 0.5 g/l KCl, 0.01 g/l $H_3BO_3$, 0.01 g/l $CuSO_4$, 0.01 g/l ZnSO4, and 0.01 g/l $FeSO_4$on developing fruits at 50% to 60% maturity has been found effective in preventing jelly seed disorder.

**Ripening**

Mangoes should be ripened at 18-22°C for optimal appearance and quality. Temperatures above 22°C cause blotchy green, soft fruit, and increased rot, while temperatures below 18°C result in pale yellow skin, more rot, and poor flavour. Ethylene accelerates and ensures uniform ripening. There are two types of ethylene injection systems for ripening rooms: 'shot' (injecting 100 ppm every 8-12 hours for 2-3 days) and 'trickle' (injecting 10 ppm continuously for 2-3 days). Ethylene is available as pure ethylene or Ripe gas (7% ethylene), with Ripe gas being safer and more commonly used. Trickle ripening rooms require an air inlet behind the cooling coil and an outlet on the opposite wall at a low position. Shot ripening rooms must be manually vented by opening the door for at least 10 minutes every 8-12 hours before each ethylene shot.

**Storage**

The best storage temperature to prevent mangoes from ripening is 10 to 12°C with 85-95% RH. Below 10°C, they develop chilling injury, and above 12°C, they soften, turn pale yellow, become highly acidic, and are prone to rotting. However, susceptibility to chilling injury (CI) varies by cultivar and maturity stage. Tree-ripe 'Keitt' and 'Tommy Atkins' mangoes are less prone to CI when stored at 5°C for 2 weeks, while mature green mangoes can develop CI symptoms below 10°C. Dashehari and Langara can safely be stored at 7-8°C for 25 days. The optimal storage temperatures for certain Indian mango varieties are: Dasehari, Mallika, and Amrapali at 12°C; Langra at 15°C and Chausa at 10°C, all with 85-95% relative humidity.

Zero Energy Cool Chambers (ZECC) can be used for storing mangoes by watering twice a day which provide 90% RH and 10-15°C lower temperature from ambient condition by achieving a storage temperature of 7-8 °C. This was developed by ICAR-IARI New Delhi developed ZECC. The ZECC works on the principle of evaporation. After performance evaluation of ZECC in various parts of country, it has been reported that the shelf life of mangoes can be increased by 3-4 days.

Controlled atmospheric storage (CAS) is used to prolong the shelf life of mangos. CAS results in reduced ethylene production, respiratory activity, fruit softening rate, retards chlorophyll degradation (green colour), flavour and maintain organic acids. The combination of CAS and low temperature is widely known to extend the storage life and quality (Singh and Zaharah, 2015) (Table 1). Mangoes are tolerant to high CO2 exposure of 25% for 3 weeks when stored at 12 °C. Meanwhile, gas compositions of CO2>25% and O2<2% are reported to result in unpleasant aroma and damaged skin colour due to elevated accumulation on ethanol.

**Table 1: Effect of CAS on Fruit Quality and Storage of Certain Mango Cultivars (Ntsoane *et al.*2019).**

| Cultivars | Maturity | Conc of $O_2/CO_2$ | Temperature | Storage (Days) | Outcome |
|---|---|---|---|---|---|
| Haden, Keitt, Kent and Tommy Atkins | Mature green | 3/25 | 12-15 | 14-21 | Maintained quality and reduce ripening |
| | Tree ripe | 3-4/25 | 8 | 21 | Reduced CI |
| Banganapalli | Mature green | 5/3 | 13 | 30-35 | Extended shelf life, normal ripening and good quality |
| Alphanso | Mature green | 5/5 | 13 | 30-35 | Improved firmness, SSC, total carotenoids sugars and organoleptic quality |
| Alphanso | Mature green | 5/5 | 8 | 45 | Pre-treatment with hot water or prochloraz retained the antioxidant content |
| Chaunsa | Tree ripe | 3/6 | 10 | 14 | Maintained ascorbic acid freshness, colour, firmness, SSC and firmness |

Modified atmospheric storage (MAS)is achieved through the introduction of nitrogen, carbon dioxide, and other atmospheric gases, and the use of semipermeable membranes such as MAP (Neven *et al.*, 2009). Using micro-perforated polyethylene or Xtend® film as a carton liner extended the shelf life of 'Tommy Atkins' and 'Keitt' mangoes to 3 weeks at 12°C and 1 week at 20°C. Chitosan-covered wax-lined cartons extended the storage of 'Alphonso' mangoes to 20 days at 27°C and 65% RH, without microbial growth or off-flavor(Srinivasa*et al.,* 2002).

**Packaging**

Mangoes for domestic markets are packed in various containers such as wooden boxes, crates, red gram stalk baskets, and jute bags. Each mango is individually wrapped in a soft, expandable, netted polystyrene sleeve to prevent bruising before being packed in insect-proof boxes. Printing or labelling on packaging materials must use non-toxic ink or glue. Mangoes are packed according to international standards (CAC/RCP 44-1995, Amd. 1-2004). Corrugated fiberboard boxes for Banganpalli mangoes must measure 390x260x115 mm, while boxes for Dashehari mangoes should be 320x230x90 mm. These boxes have 5% ventilation and are used in cold storage or during transportation in trucks to distant markets (Figure 8).New packaging technologies, including smart packaging with sensors that detect ripening chemicals and active packaging that maintains quality without additives, are also used to enhance shelf life in cold storage or modified atmospheric packaging (MAP). Ethylene absorbers, such as venting, potassium permanganate oxidation, adsorption onto brominated carbon, and catalytic oxidizers, are used. Titanium dioxide (TiO2) powder is the cheapest and most efficient method for complete oxidative ethylene reduction. 1-Methylcyclopropene (1-MCP) is a gas used as a synthetic plant regulator. It inhibits the ethylene receptor, slowing ripening, reducing respiration, and extending shelf life. Using 1-MCP alone or before hot water quarantine treatment reduces mango softening during shipping. 1-MCP delays softening and peel color changes, while hot water accelerates softening.

**Transportation**

In developing countries, mangoes are often transported using non-refrigerated trucks, which can exert pressure on the fruit, causing tissue softening and microbial deterioration. Without temperature control, shelf life is significantly reduced. However, fruit can be transported at night without refrigeration (up to 3 hours) if it has been precooled.The best temperature for transporting mangoes is 8 to 12°C with about 90% RH. The temperature should be kept constant to avoid condensation and mold growth. Before loading, meticulously inspect trucks or vans to ensure they are free of pests and debris. If the export is from India to the USA, this is conducted jointly by the United States Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) and India's Ministry of Agriculture's Plant

**Figure 8: Mangoes packed in CFB boxes.**

Protection, Quarantine, and Storage division in NH IV, Faridabad. If pests are found during the initial inspection, a second disinfection is required. This involves using insecticides and thoroughly treating all areas, including door gaps and corners. A pest-proof screen should cover the loading area. Once loaded, the van or truck doors should be securely locked and sealed.

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# REKHA DAN: THE RENOWNED SCIENCE COMMUNICATOR FROM WEST BENGAL PASSES AWAY

**S. K. Basu**
PFS, Lethbridge, Alberta, Canada;
Email: saikat.basu@alumni.uleth.ca

Distinguished Teacher - Science Club Worker - Science Writer - Environment Lover Rekha Dan (Pal) breathed her last at her residence in North 24 Parganas (WB) on Friday (05/07/2024) afternoon around 2.25 m. She was born on 18-3-1953 and was 71+ years old at her recent demise. During her student life (around 1969-1970) she came in contact with school teacher Kalyani Dasgupta. Later, she was closely associated with the Gobardanga Renaissance Institute from its inception (November 4, 1973) till the end of her life. She has been the fifth among seven children of her mother, Snehlata Pal and father, Harisadan Pal. The unforgettable death of her father in her childhood helped her to master the battle of life. She passed old XI (Science) from Khantura High Girls School in 1970. From the prestigious Habra Shree Chaitanya College, she completed her BSc in the Bio Science branch and passed with distinction in 1973. On the advice of Prof. Shankarkanth Mukhopadhyay, Head of the Anthropology department of that college, she was admitted to the Anthropology department of the Ballygunge Science College under Calcutta University. She successfully completed her MSc toward the end of 1977.

The Khantura Pritilata Shiksha Niketan (Girls Department) was established in her own village not long ago. In 1976 she joined here as a teacher. She completed her BEd degree from the Gobardanga Hindu College between 1978-1980. She retired from the same school in 2013. She was very active from the beginning of her career as a scientist in the Science department of the Gobardanga Renaissance Institute. She actively participated in numerous science fairs, exhibitions and rook leading role in the local science club movement. She also had outstanding expertise in scientific model making and in executing various science project works. Rekha Dan successfully connected the school girls with the science department of the club and has been involved in various scientific educational and awareness activities. She went to New Delhi in 1972 to attend the NCE and on All India Children's Science Exhibition that started on 14th November on Jawaharlal Nehru's birthday under the initiative of T.

Since its inception, the Gobardanga Renaissance Institute has been present with models in this exhibition every year. In 1978, she joined the exhibition as a teacher guide for five participating students. Rekha Dan was highly skilled in the art of science communication and actively educated and sensitized students on various aspects of Life Sciences and Environmental Sciences.

She also actively participated in the first ever All India Science Club Conference organized by Gobardanga Renaissance Institute between 14-15 August in 1979; and provided her commendable leadership and management skills in making this program a big success. Later she was also involved in the first West Bengal Beekeeping Conference held in 1980. This time she translated a science research article by Professor Tarakmohan Das as a science facilitator to help local beekeepers become aware of new developments in the discipline of Apiculture. She eruditely name her essay as 'The value of a tree is 15 lakh 70 thousand rupees'. Based on currentvestinates this valuation gas been set at even more than 5 crore rupees. The title was later widely used by the West Bengal government in environmental advertisements as an extremely popular and catchy slogan. Currently (period 2020) its monetary value stands at more than 4 crore rupees (according to current market rates).

The first West Bengal Science Writers Conference was held in 1982 under the management of Gobardanga Renaissance

Institute. Almost all the famous science writers of the time were present at the BITM campus in Kolkata. Prominent science writer Dr. Dhirendranath Gangopadhyay inaugurated this auspicious conference. A 150-page commemorative book was also published that is still remembered by many today. Inspired by the Gobardanga Renaissance Institute founder, legendary social woker and humanite, Mani Dasgupta; she participated in writing on various topics in the newspaper 'Gobardanga' (News - Literature - Science). She had a great talent for feature writing.

Rekha Dan has also written many science articles for popular science magazines like Gyan O Vigyan, Gyan Bichitra, and Ki K O Ken; and in the 'Nature and Man' section of the Kalantar Daily, Kishore Gnology, Vigyan Mela, various local science periodicals, newsletters, bulletins and in the Anukul Patrika published from Bangladesh. In many such magazines, she has written on various aspects of science, technology, society and environment. She has extensively published articles on different topics related to nature and environment. A book on these has already been published by Gyan Vichitra Prakashani, 'Vigyan Sadhanay Bengali' and others in 2017. However, before this another book was published as a popular folklore work in 2000 entitled 'Wei Poka'. Both books have been veey well received by her readers. A third book with her remaining writings is on the pipeline. She has served as a Biology instructor for many years at the club's summer science camps. From 1989, Gobardanga Renaissance Institute first started Flower Fair, then Agriculture and Flower Fair. For this reason, she used to have spontaneous enthusiasm for various activities such as collecting donations from house to house, bringing flowers from different houses. In the early days of her career between 1999-2007, she was involved as one of the organizers at the Gobardanga Book.

Since 1977, she stayed active with the Calcutta Radical Humanist Association (RHA). She visited the RHA's room on the third floor of the College Street Coffee House several times. Through this source, she met many prominent personalities. She also contributed regularly to the publication of Jnana Vichitra Patrika published from Tripura and also took time to visit Tripura and interact wirh science communicators there.

From the beginning, Rekha Das was highly enthusiastic about the work that the Gobardanga Research Institute did. The organization started it's journey since 2010. The land of about seven and a half kathas here was bought with her passionate enthusiasm and generous donation for promoting science in the society. This land now has two three-storied buildings. Ms Danshe always extended her continuous help and support in establishing all the library facilities and future endeavours of the organization in the publication of several magazines and books, organized seminars, symposium, meetings, conferences; in the establishment and running of the famous Biodiversity Protection Management Committee (BMC) to mention only a handful.

Rekha Dan has been a regular presenter in various science rekated programs of Akashvani, Kolkata. In 2000, he was awarded the 'Gopal Chandra Bhattacharya Memorial Award' by the Science Assoc: of Bengal. From 2010, Rekha Dan started suffering from various issues related to neurodegeneration. After 2015 she fell seriously ill. Despite various medical efforts, she could not recover. She was always enthusiastic about all the activities of the school. She always tried to keep herself busy as an curious anthropologist. With two children (daughter and son) and her husband (Deepak Kumar Dan), Rekha Dan has been relentlessly engaged in all family activities. She was always used to a very simple lifestyle. Both her eyes have been donated to Prabha Eye Bank.

# NANOCELLULOSE: A PROSPECTIVE MATERIAL FOR GREEN SUSTAINABLE AGRICULTURE

**Monika Kundu*, Ananta Vashisth, Banwari Lal, P. Krishnan and Subhash Nataraja Pillai**
Division of Agricultural Physics, ICAR-IARI, New Delhi
Email: *gkmk07@gmail.com

**Introduction**

The name nanocellulose refers to the nonmetric-scale dimensions of this natural polymer. There are three types of nanocellulose, categorized depending on their production and extraction: crystal-shaped nanocellulose (NCC), nanocellulose fibers (NFC), and bacterial nanocellulose (NCB). The generation of new materials based on nanocellulose has become an increasingly attractive area of development, because these nanomaterials have the characteristics of sustainability, biodegradability, non-toxicity, and economic production. Applications of nanomaterials include important industries such as paper, food, electronics, pharmaceutical, biomedical engineering, construction, packaging, etc. These nanomaterials are used in the food industry to improve the quality of food products. They can prevent microbial degradation of packaged foods, improve their colour, flavour or texture, and increase the bioavailability of vitamins and minerals.

**1. Synthesis methods of nanocellulose**

**1.1 Mechanical process**

Cellulosic materials are required to go through mechanical

treatment for defibrillation. Pre-treatment processing, either by chemicals or enzymes, is done before mechanical fibrillation to ease the process. Chemical treatments help in widening the space between hydroxyl groups, increasing the inner surface, altering crystallinity, and breaking cellulose hydrogen bonds, thus enhancing surface areas, which helps boost the reactivity of the fibers. There are many mechanical methods for converting cellulosic fibre to nan cellulose, such as homogenizing, micro fluidization, grinding, cry crushing, and high-intensity ultra sonication (HUIS).

### 1.2 Chemical process

Nanocellulose is generally prepared from natural cellulose fermented by higher plants, seaweeds and microorganisms by using chemical processes such as acid hydrolysis, mechanical treatment, oxidation treatment, and enzymatic degradation.

Various green techniques for nanocellulose synthesis have been proposed such as enzymatic hydrolysis, ionic liquid, and so forth. Although nanocellulose is derived from cellulose, it possesses completely diverse characteristics from original materials.

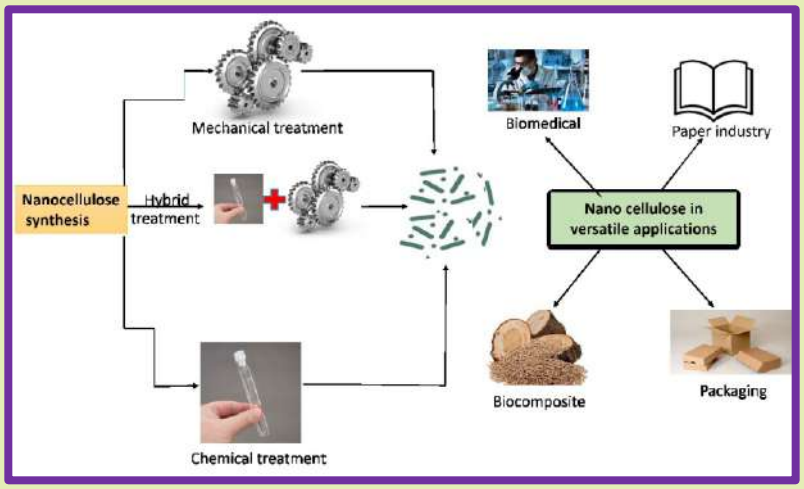


**Fig 1.: Various methods of nanocellulose synthesis and diversified application areas.**

### 2. Properties of nanocellulose

The basic properties of nanocellulose are similar to common cellulose including weak water solubility and ease of chemical modification despite various micro-morphologies under different physical, chemical, and biological treatments. However, they show outstanding mechanical properties, excellent thermal stability, large specific surface area, unique rheological and optical properties. The common nanocellulose can be categorized in two major types, cellulose nanocrystals (CNCs) and cellulose nanofibrils (CNFs) depending on their preparation methods, micro-morphology, and characteristics. The specific structures, properties, and yields of nanocellulose are closely related to the source of cellulose and isolation conditions. It shows enhanced crystallinity, high surface area, rheological properties, alignment and orientation, biodegradability, biocompatibility, low toxicity, etc. Nanocellulose has gained much attention for various biochemical applications due to its remarkable physical properties, exceptional surface chemistry and superb biological properties.

### 3. Applications of nanocellulose

**Food:** food stabilizers, dietary fibers, thickeners, flavor carriers, suspension stabilizers and can be used to diminish the caloric value of food. It can also be useful for producing fillings, crushes, biscuits cream, ice cream, chips, wafers, soups, puddings, etc.


**Fig 2.: Various applications of nanocellulose in food.**

**Sensing:** Nanocellulose (NC) could increase the sensing ability of graphene-based composites by inhibiting agglomeration. CNCs and conducting polymers have enhanced synergistic effects in glucose bio sensing, water defluorination, strain sensing, flame resistance, supercapacitors, and cancer therapy.

**Packaging:** Food packaging materials are an extremely important part of the food processing industry and have always been the research focus in the food field. As ideal food

packaging materials, they should protect commodities, maintain food quality stability, increase commercial food value, promote sales, and facilitate storage and logistics. Non-biodegradable polymers derived from fossil fuels are the most used materials in food packaging

**Energy:** An interesting application of this material is the Paper Battery. Researchers have been working on developing various devices with exceptional energy storage capacity using a mix between nanocellulose and a conductive polymer.

**Wastewater Treatment:** The enormous amount of hydroxyl groups present on the nano cellulose surface allows establishing interactions with heavy metals and organic compounds such as methylene blue dye using green aerogel composed by cellulose Nano fibril and graphene oxide-silica, Congo red dye with modified nanocellulose using polyproline and disperse yellow dye. At the same time, cellulose nanomaterials can act as filtering membranes to remove microorganism and additional pollutants from contaminated water.

**Biomedical:** Nanocellulose-based composites are characterized for being highly biocompatible and scarcely toxic, which are the major reasons for its use in numerous biomedical applications. Incorporation of nanocellulose to drug delivery systems could control both the manner drugs are released and the interactions with target molecules, thus increasing the effectiveness of drug administration. Changes on nanocellulose surface must be carried out to link drugs, non-ionic chemicals with hydrophobic character, to the nanopolymer.

**Textile:** Due to the molecular structure and its large active surface, nanocellulosic materials have found great applications in the textile field, especially for medical applications. The special specific characteristics can be summed up in its antistatic behaviour, low level of impurities and humidity and good mechanical and liquid adsorption properties

**Conclusion**

Nanocellulose has numerous advantages such as biodegradability, environmentally safe, renewability, cheaper, lower weight, higher strength, and stiffness. Nanocellulose based transparent films can be used for coating technologies, food packing, inherits excellent barrier properties. Thick films can act as an oxygen barrier that contributes a significant role in the food and preservative. Nanocellulose has vast market potential in terms of the countless advantages, but potential risks and hazards if any, should also be studied extensively.

## SIGNIFICANT EVENTS IN THE HISTORY OF TOXICOLOGY

**Syed Shabih Hassan**
Department of Fisheries Resource Management,
College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana – 141004, Punjab, India
Email: *fish_ab@rediffmail.com*

The study of poisons is known as toxicology. Poisons are defined as naturally occurring or artificially manufactured substances that cause biochemical abnormalities and/or physical lesions in the body after entering through any pathway and in relatively tiny amounts. Toxicants and toxic agents are other names for poisons. Toxicology is a science and an art, just like medicine.

A pivotal event in the chronicles of toxicology is the poisoning of Britannicus, the stepbrother of Emperor Nero, in ancient Rome. This is a noteworthy incident because pufferfish extract called tetrodotoxin, a dangerous chemical—was used in it. This was among the first known cases of deliberate poisoning for political purposes. The biological son of Emperor Claudius, Britannicus, was poisoned in AD 55 at a feast that Nero threw. Most likely, the poison was used to get rid of Britannicus as a possible heir to Nero's crown. This incident not only exposes the murky side of Roman politics but also shows how poisonous poisons were first understood and used deadly effectively. The poisoning of Britannicus highlights the historical relevance of toxicology as the study of poisons and their effects on living things, influencing the evolution of the subject and our knowledge of the effects of chemical agents on human behaviour and health across time.

The early cave dweller recognized poisonous plants and animals and used their extracts for hunting or in warfare. By 1500 B.C, written recordings like Ebers papyrus indicated that hemlock, opium, arrow poisons and certain metals were used to poison enemies or for state executions. Poisons such as arsenic, aconite and opium were also known to Hindu medicine as recorded in the Vedas. The ancient Chinese used aconite as an arrow poison. Greeks, Romans and Italians used poison for execution and murder of their political opponents.

Socrates was charged with religious heresy and corrupting the morals of local youth and was executed with extract of hemlock (*Conium maculatum*) and Greeks recognized hemlock as the state poison. The active chemical in hemlock was the alkaloid coniine which, when ingested causes paralysis, convulsions and eventually death.

Philosophical and legal history considers the true account of Socrates' trial and execution in ancient Athens to be a pivotal moment. In fact, in 399 BC, the Athenian philosopher Socrates, who was born in 470 BC, was tried and given a death sentence. Among the accusations made against him were impiety (religious heresy) and corrupting the Athens young. His associations with young Athenians, who looked up to and emulated him, as well as his intellectual teachings, were the source of these charges. The political and social climate of Athens at the time had an impact on Socrates' trial and execution in addition to his philosophical beliefs. A jury of residents deliberated on the accusations made against him during the trial, which was held under the Attic judicial system.

During the trial, Socrates stood up for himself and made the well-known decision to uphold his morals without pleading for forgiveness. Having been convicted by a slim margin, Socrates was allowed to suggest his own sentence. As a rejection of the legal system, Socrates proposed that he be honored at public expense, which went against the verdict of the jury, who had probably expected a more mild penalty. This resulted in another referendum, in which the majority supported the death penalty. Socrates was put to death by swallowing a cup of hemlock, an extract from a deadly plant. This particular method was selected because, in ancient Athens, it was a comparatively merciful kind of capital punishment that allowed the condemned person to retain their dignity and autonomy over their own destiny.

The trial and demise of Socrates have been perpetuated throughout the works of his pupils, most notably Plato in the "Apology," "Crito," and "Phaedo." These dialogues, which have had a significant impact on Western philosophy and ethics, examine Socrates' defence of himself during the trial as well as his views on justice, piety, and the immortality of the soul. Essentially, even though Socrates was executed by consuming hemlock, there are important issues regarding the nature of knowledge, morality, and the place of the individual in society that are raised by his trial and death, which go far beyond the simple charges of religious heresy and corrupting youth.

**Demosthenes committed suicide by consuming a poison hidden in his pen.**

One of the most famous stories from ancient history is the poisoning suicide of Athenian statesman and orator Demosthenes. This is the true tale, based on historical records: During the chaotic era of ancient Greece, Demosthenes lived. Specifically, he lived through the rise of Macedonian dominance under Philip II and his son Alexander the Great. Demosthenes engaged Philip II in a number of speeches and political maneuvers, and he was well-known for his fierce resistance to Macedonian hegemony. Alexander the Great insisted that all Greek city-states acknowledge him as their supreme leader following his conquest of the Persian Empire. Demosthenes persisted in his opposition, which ultimately resulted in his banishment from Athens in 323 BC. He sought safety in a number of locations, but Alexander's forces kept pressing him.

Alexander's designated regent of Macedonia, Antipater, faced capturing Demosthenes in 322 BC. Demosthenes decided to take his own life in order to avoid being captured rather than being taken alive and possibly subjected to public shame or punishment. Historical narratives state that Demosthenes consumed hemlock poison, which was frequently employed in Greek executions. Demosthenes, a gifted politician and orator who zealously upheld Athenian democracy and autonomy against foreign dangers, tragically committed suicide. His passing solidified his reputation as one of the finest orators in classical antiquity and highlighted the fierce political conflicts and personal sacrifices made during the Hellenistic era.

Cleopatra, the Queen of Egypt experimented with strychnine and other poisons on prisoners and poor. She committed suicide with Egyptian Asp (Egyptian cobra sometimes used in executions).

A well-known tale from antiquity is the one about Cleopatra's demise at the hands of an Egyptian asp. Egypt was ruled by the Roman Empire during a turbulent time during the reign of Cleopatra VII, the last reigning monarch of the Ptolemaic Kingdom. After defeating her lover Mark Antony in the Battle of Actium, Octavian (later Emperor Augustus) was about to display Cleopatra as a captive in Rome in 30 BC. Cleopatra made the decision to commit suicide rather than endure the humiliation of being held captive and losing the independence of her realm. Ancient historians like Plutarch and Cassius Dio claim that Cleopatra made the decision to end her life by biting an Egyptian cobra, sometimes referred to as an asp. This particular suicide method was selected for a number of reasons: it represented Cleopatra's link to Egypt and its mythological connotations, and it was considered a respectable and noble way for royalty to end their life.

According to historical traditions, Cleopatra's death was not exactly as she died. Some claim she was bitten on the breast or arm, while others think it was her arm or even a venom-dipped hairpin. Whatever the exact process, the outcome remained the same: Cleopatra chose to end her life

rather than surrender to Roman captivity and died soon after the bite. With Cleopatra's demise, the Ptolemaic dynasty came to an end and Egypt's full integration into the Roman Empire began. Her narrative has been preserved in popular culture, literature, and art displaying as beauty, intellect, and tragic fate.

King Nero used poisons to eliminate his stepbrother Brittanicus and employed his slaves as food tasters to differentiate edible mushrooms from their more poisonous kin.

One of the most famous episodes in Roman history is the tale of Emperor Nero employing poison to kill his stepbrother Britannicus; nevertheless, the specifics are lost in the mists of antiquated stories and conjecture. Being the biological son of Emperor Claudius, Britannicus posed a threat to Nero's succession ambitions. After Claudius's death in AD 54, Nero ascended to the throne and allegedly saw Britannicus as a challenger to his authority. Historical historians like Suetonius and Tacitus claim that Agrippina the Younger, Nero's mother, was a major factor in Britannicus' downfall.

During a feast that Nero hosted in AD 55, Britannicus unexpectedly became ill and passed away. His death's circumstances led to instant suspicions of poisoning. According to reports, the poison in question was tetrodotoxin, a lethal chemical that was extracted from pufferfish that was known to induce abrupt death and was difficult to detect. Historians disagree on Nero's precise role in Britannicus' poisoning. Some claim that Nero ordered the poisoning directly in order to ensure that he would always have no opponents as emperor; others think that Agrippina, Nero's mother, planned the scheme in order to get rid of Britannicus and guarantee Nero's rule. Whatever the specifics, Britannicus's poisoning death serves as an example of the vicious and frequently deadly political gamesmanship that took place in the Roman imperial court. It emphasizes how poison was used under the Julio-Claudian dynasty, a time of ambitious political maneuvering and family strife, to eliminate opponents and consolidate control.

King Mithridates VI of Pontus, was afraid that he would be assassinated by his enemies. He used his prisoners as guinea pigs to test the poisons. He started taking antidotes for many poisons. He consumed a mixture containing about 36 ingredients. But, when he was caught by his enemies and wanted to commit suicide, he could not do so and he took the help of one of his slaves to stab himself to death. The term mithridatic (meaning antidote) is derived from his name.

A lady named Toffana prepared arsenic containing perfumes and such cosmetics were named as Aqua toffana. These perfumes were used to kill enemies.

A chilling and fascinating historical narrative, Toffana and the "Aqua Toffana" is frequently connected to poisonings that occurred in Renaissance Italy. Toffana was allegedly involved in the creation and distribution of a hazardous drug known as Aqua Toffana. Giulia Tofana is thought to be her full name. This stuff was a colourless, odourless liquid that included compounds related to arsenic rather than a perfume or cosmetic in the conventional sense. It was subtly promoted and offered to women, especially those wishing to leave violent relationships or unwelcome marriages, as a beauty product or cure.

According to historical sources, women employed Aqua Toffana as a covert and undetected way to kill foes, including their husbands or other opponents. The poison's potency rested in its capacity to imitate the signs of common ailments, making it challenging to identify and protecting the identity of the offender. It is said that Giulia Tofana and her network functioned in secret, serving ladies who came to her from all over Italy. The fact that Tofana operated in secrecy and that there aren't many thorough historical documents make it difficult to pinpoint the specifics of her life and actions. Despite this, the myth of Aqua Toffana has endured over the ages, acting as a warning about the lengths people would go to in times of need. The narrative of Aqua Toffana sheds light on the ways in which women, power, and violence interacted in Renaissance culture while also addressing more general issues of survival, autonomy, and the moral quandaries surrounding deadly retaliation.

In France, a lady named Catherine de Medici along with Marchioners de Brinvillen used most effective poisons in the name of providing treatment to sick and poor people. Later she was imprisoned for killing 2000 infants.

As King Henry II's wife, Catherine de Medici ruled France from 1547 until 1559. Her reign is frequently linked to scheming and political scheming. The rumours that surround her purported employment of poisons against her foes are among the more sinister parts of her legacy. It was well known that Catherine de Medici was surrounded by confidantes and advisors who were engaged in a range of political plots, such as efforts to destroy adversaries and challenges to her authority. The Marchioness de Brinvilliers is one of the people who is frequently brought up in relation to Catherine's purported use of poisons, but there is little historical evidence that clearly links them to these activities, rather, it is based largely on hearsay and later reports.

In 1670s France, almost a century after Catherine's demise, the Marchioness de Brinvilliers, Marie-Madeleine-Marguerite d'Aubray, was embroiled in a well-known poisoning incident. She was charged with killing and poisoning members of her own family, for which she was ultimately put to death. Nevertheless, there is little proof to establish a clear connection between her actions and Catherine de Medici, nor to imply that Catherine was personally responsible for the use of poisons. The fact that Catherine de Medici was a formidable and occasionally brutal political figure at a turbulent time in French history is perhaps why she is associated with poisons. She was seen as a crafty and occasionally Machiavellian queen due to her involvement in a number of plots and conflicts, such as the Wars of Religion. But specifics of her alleged use of poisons are still mostly unknown and frequently embellished in later narratives and tales. To sum up, although Catherine de Medici's reign was characterized by political intrigue and power struggles, including charges that she used poison against her enemies, there is little historical evidence that explicitly links her to these activities, and historians continue to disagree over it.

**Historical Developments**

The field of toxicology has seen considerable advancements throughout history, including in antiquity, in the middle ages, the age of enlightenment, modern toxicology, and the years following World War II.

**Antiquity / Ancient Past**

The founder of Chinese medicine, Shen Nong (2696 BC), also known as Wugu Shen, is credited with tasting 365 different herbal plants. He also produced a book on "Herbal Medical Experiment Poisons." Shen Nong's translations to "Divine Farmer" or "Divine Peasant" or "Agriculture God" vary. Shen Nong is credited with a number of important inventions and legends, including the classification of herbs, the discovery of medical uses for them, the teaching of agriculture, their cultural heritage, and their mythical position. Even though there are no extant works specifically credited to Shen Nong, his reputation as a pioneer in Chinese medicine continues to have a significant impact on the philosophy and practice of traditional Chinese medicine.

Homer (c. 850 BC) described the usage of venom-poisoning arrows in his epic tales, The Odyssey and The Iliad. The allusions to poisoned arrows throughout Homer's works give the struggles and perils that heroes face a sinister and lethal touch. These epic tales have an air of supernatural danger because the employment of such weapons emphasizes the ancient belief in the effectiveness of venoms and poisons in combat.

Hippocrates (460–337 BC) demonstrated in his writings (400 BC) that the Greeks were knowledgeable about poisons and the fundamentals of toxicology, especially in relation to treating poisoning by interfering with absorption. Hippocrates' contributions established the groundwork for a more methodical study of poisons and how they affect the human body. His writings affected the advancement of medical knowledge and ethics in ancient Greece and abroad, in addition to playing a significant role in the field of early toxicology.

Poisonous plants were mentioned often in 'De Historia Plantarum' by Aristotle's pupil Theophrastus (370–286 BC). In addition to making significant contributions to early botanical knowledge, Theophrastus' "Historia Plantarum" shed light on plant toxicity and its possible risks, emphasizing the importance of comprehending it for both scientific and practical reasons. His research established the groundwork for later toxicological and botanical investigations.

Nicander of Colophon (185-135 BC), physician to Attalus, King of Bythnia, was allowed to experiment with poisons using condemned criminals as subjects. Following his research, he penned a dissertation titled "antidotes to poisonous reptiles and substances," in which he listed 22 distinct poisons, including as opium, white lead, lead oxide, aconite, cantharides, hemlock, and hyoscyamus. He suggested sucking the poison from an animal's bite and using linseed tea to make people throw up as cures.

Sulla, circa 82 BC: Sulla enacted the first recorded poisoning law in Rome in 82 BC to guard against irresponsible administration. Poisons could not be purchased, sold, or processed according to the legislation. Through the Lex Cornelia de Sicariis et Veneficiis, Sulla made a significant addition to Roman jurisprudence that addressed poisoning crimes and ensured justice in cases of intentional harm caused by toxic poisons.

Pedanius Dioscorides (40-90 AD): By dividing poisons into categories such as plant, animal, or mineral and realizing the importance of emetics in treating poisoning, the Greek physician Dioscorides made a particularly important contribution to the field of toxicology. There were illustrations and descriptions to go along with the classification. Pedanius Dioscorides made a significant contribution to the field of toxicology with "De Materia Medica," a comprehensive list and categorization of poisonous substances that offered fundamental information and useful advice for comprehending and controlling toxicological risks in pharmacology and medicine.

**Middle Ages**
Maimonides (AD 1135–1204) wrote a treatise on how to heal poisonings from snakes, insects, and crazy dogs. He wrote the first toxicology treatise, "Treatise on Poisons and Their Antidotes," which was widely used for decades. Maimonides also expressed his misgivings about certain cures and disproved several of the prevalent ones at the time. Poisoning adversaries to kill enemy was becoming more common during the Middle Ages.

**The Enlightenment Era**
In 1945, Sir Rudolph Peters conducted research on the mechanism of action of arsenical battle gases, which led to the development of British Anti-Lewisite, an effective antidote for the treatment of soldiers exposed to these gases.

**Modern Toxicology**
It is an extension of the physical and biological sciences' late 19$^{th}$ and early 20$^{th}$ century progress. The world saw an expansion in science during this time, which helped to establish the foundation for the modern era in many fields of study. A number of iatrogenic deaths were caused by the introduction of ether, chloroform, and carbonic acid. These regrettable results led to early investigations on harmful and poisonous effects as well as investigation into the reasons of the deaths.

Understanding the detrimental effects of chemicals and other substances on biological systems, such as humans, animals, and the environment, is the goal of the multidisciplinary scientific area of modern toxicology. To evaluate and control the dangers connected to toxic substances, it incorporates information from a variety of fields, including biology, chemistry, pharmacology, medicine, environmental science, and public health.

The key aspects of modern toxicology include:

1. **Risk Assessment:** Evaluating the potential hazards of chemicals based on their toxicity, exposure levels, and routes of exposure. This helps in determining safe levels of exposure for humans and other organisms.
2. **Mechanisms of Toxicity:** Studying how toxic substances interact with biological systems at the molecular, cellular, and organ levels. This includes understanding how chemicals cause damage, such as oxidative stress, DNA damage, and disruption of cellular functions.
3. **Toxicokinetics:** Investigating the absorption, distribution, metabolism, and excretion (ADME) of toxicants within the body. This helps in understanding how chemicals are processed and eliminated, influencing their toxicity.
4. **Toxicodynamics:** Exploring the mechanisms by which toxicants exert their effects once they reach their target sites in the body. This includes receptor binding, enzyme inhibition, and disruption of physiological processes.
5. **Toxicity Testing:** Developing and using experimental models and assays to assess the toxicity of chemicals. This includes in vitro studies using cell cultures and in vivo studies using animal models, as well as alternative methods such as computational toxicology and high-throughput screening.
6. **Environmental Toxicology:** Studying the impact of chemicals on ecosystems and wildlife, including bioaccumulation, ecological risk assessment, and the effects of pollutants on biodiversity.
7. **Regulatory Toxicology:** Applying toxicological data to develop regulations and guidelines for the safe use and disposal of chemicals. This includes setting permissible exposure limits (PELs), establishing safety standards, and assessing the risks associated with industrial chemicals, pharmaceuticals, pesticides, and consumer products.

In the fields of public health, occupational safety, environmental protection, and the creation of safer chemicals and medications, modern toxicology is essential. With the goal of better understanding and reducing the negative impacts of toxic compounds on both human health and the environment, it keeps changing in tandem with technological and research method advancements.

**After World War II**
The twentieth century is distinguished by a sophisticated comprehension of toxicity. The discovery of several biochemicals that support bodily activities as well as DNA, the life molecule, was made. The molecular level of harmful effects on organs and cells is now revealing our level of understanding. It is known that modifications to particular cellular molecules and biochemical moieties result in practically harmful effects. Beyond a basic awareness of dangerous chemicals and their effects, advanced toxicological comprehension is required. The following features are indicative of advanced toxicological knowledge levels:

1. **Mechanisms of Toxicity:** Understanding the detailed biochemical, molecular, and physiological mechanisms by which toxins exert their effects on biological systems. This includes knowledge of receptor interactions, enzyme inhibition, oxidative stress pathways, and genetic predispositions.
2. **Dose-Response Relationships:** Ability to interpret

and model dose-response relationships, including concepts such as threshold doses, non-linear responses, and factors influencing toxic potency.

3. **Toxicokinetics:** Detailed understanding of how toxicants are absorbed, distributed, metabolized, and excreted by the body (ADME processes). This involves knowledge of pharmacokinetic principles applied specifically to toxic substances.
4. **Toxicodynamics:** Understanding the biochemical and physiological mechanisms through which toxicants exert their effects once they reach their target sites in the body. This includes the study of target organ toxicity and adverse outcome pathways.
5. **Risk Assessment:** Advanced ability to assess the potential risks posed by toxic substances to human health and the environment. This involves integrating toxicological data with exposure assessment to estimate risks and inform regulatory decisions.
6. **Toxicity Testing Methods:** Knowledge of advanced methods used in toxicity testing, including in vitro assays, computational toxicology (QSAR models, molecular docking), and in silico approaches for predicting toxicity.
7. **Environmental Toxicology:** Understanding the impacts of toxic substances on ecosystems and wildlife, including bioaccumulation, biomagnification, and ecological risk assessment.
8. **Toxicogenomics and Systems Toxicology:** Utilization of genomics, transcriptomics, proteomics, and metabolomics to study the molecular mechanisms of toxicity at a systems level. This includes understanding how genetic variations influence susceptibility to toxicants.
9. **Emerging Issues and New Technologies:** Awareness of emerging toxicological issues such as nanotoxicology, endocrine disruption, and the toxicology of emerging contaminants (e.g., microplastics). Also, knowledge of new technologies and methodologies being developed to advance toxicological research.
10. **Regulatory Toxicology:** Recognizing the fundamentals and methods of toxicology as they relate to regulatory regimes. This involves becoming aware of global laws, risk-reduction techniques, and the part toxicologists play in the formulation of public policy.

Overall, an advanced understanding of toxicology includes a thorough understanding of risk assessment, environmental impacts, toxicokinetics and toxicodynamics, dose-response relationships, advanced testing techniques, and the application of toxicology in regulatory and policy contexts.

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# IMPORTANT DAYS, EVENTS AND FESTIVALS IN THE MONTH OF JULY 2024

**V. Sunitha**
Department of Geology, Yogi Vemana University, Kadapa, A.P. 516005
E-mail: vangalasunitha@gmail.com

**1st July – National Doctors Day**


On July 1st, India celebrates Doctor's Day to recognize the value that doctors have in our lives. This day is intended to honour medical industry advances as well.


**1st July – National Postal Worker Day**

Every year on July 1st, National Postal Worker Day is commemorated to honour and show gratitude to all the men and women who routinely and tirelessly deliver all of our mail and deliveries.

**2nd July - World UFO Day**

July 2nd is designated as World UFO Day. Haktan Akdogan, a UFO hunter, founded it. In 2001, the first World UFO Day was observed, encouraging people to examine the heavens for unexplained flying objects.

**11 July - World Population Day**


Every year on July 11, World Population Day is commemorated to draw attention to the urgency and significance of population issues.

**12 July - Paper Bag Day**


Every year on July 12, people celebrate Paper Bag Day to recognise the significance of the development of the paper bag, which we typically take for granted. A teacher named Francis Wolle created the first machine for mass-producing paper bags in 1852.

**15 July - World Youth Skills Day**


Every year on July 15, World Youth Skills Day is observed to promote awareness of the value of technical, vocational education, and training as well as the development of other skills important to both national and international economies.

**17 July - World Day for International Justice**


Every year on July 17, people around the world mark World Day for International Justice. It is often referred to as International Justice Day or the Day of International Criminal Justice. Today, the developing system of international criminal justice is acknowledged.

**18 July - International Nelson Mandela Day**


Every year on July 18, there is a celebration of International Nelson Mandela Day. The holiday honours Mandela's life and contributions in a lasting fashion that will result in the necessary transformations.

**20 July - Moon Day**


Moon Day honours the occasion of the first lunar landing in 1969.

**22 July – Pi Approximation Day**


Since Pi has a value of 22/7, it is celebrated on July 22 each year as Pi Approximation Day. In contrast, Pi Day is observed on March 14, which is close to the value of 3.14 and also happens to be Albert Einstein's birthday.

**22 July - National Mango Day or Mango Day**


It is observed on July 22. Today is the day to learn some interesting facts about the sweet and juicy mango, including its history.

**22 July - Chandrayaan 2 launching date**

On July 22, 2019, Chandrayaan-2 was launched from Sriharikota's Satish Dhawan Space Center. It was India's second lunar expedition.

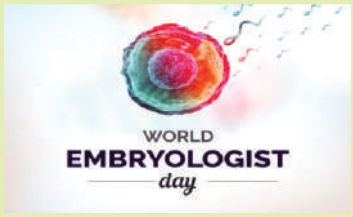
**24 July - National Thermal Engineer Day**


Every year on July 24, National Thermal Engineer Day is commemorated to highlight the significance of developing the thermal engineering field and to offer the electronics industry creative, excellent, and affordable thermal management and packaging solutions.

**25 July – National Parent's Day (Fourth Sunday in July)**


On the fourth Sunday in July, which falls on July 25 in 2021, National Parents Day is observed. This day is dedicated to all the parents who have a significant impact on the lives of their children. There are no words to describe how much they give up and love their kids unconditionally.

**25 July - World Embryologist Day**




Since Louise Joy Brown was the first child to be born via in vitro fertilisation on July 25, 1978, the day is commemorated annually as World Embryologists Day.

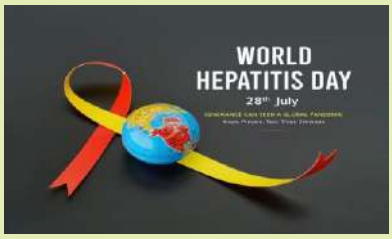
**26 July - Kargil Vijay Diwas**


On July 26, we celebrate Kargil Vijay Diwas, which was inspired by the triumph of Operation Vijay. The Kargil War, which lasted roughly 60 days, came to a close on July 26. To honour the Kargil War Heroes, this day is observed.

**28 July - World Nature Conservation Day**


Every year on July 28, people throughout the world celebrate World Nature Conservation Day to recognize how important a healthy environment is to current generations as well as a stable and productive society. Our natural resources must be preserved, managed sustainably, and protected.

**28 July - World Hepatitis Day**




Every year on July 28, World Hepatitis Day is commemorated to provide a chance to intensify regional, global, and national efforts to combat hepatitis. Additionally, this day serves to raise awareness of the hepatitis disease and the effects it has on those who have it.

**29 July - International Tiger Day**


Every year on July 29, people around the world celebrate International Tiger Day to raise awareness about the need to maintain tigers' natural habitats. Global Tiger Day is another name for today.

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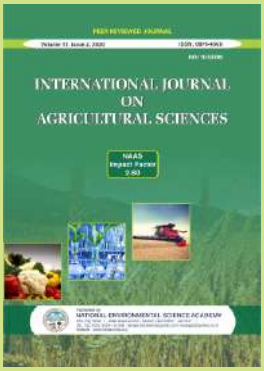





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