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RNA interference

Researchers found that the worm 'Caenorhabditis elegans' develops food habits which are inherited to their offspring spanning few generations.

- **RNA interference** – It is a simple and rapid method of *silencing gene expression* in a range of organisms *by RNA molecules* by neutralizing the targeted mRNA molecules.
- It is also called as *Post-Transcriptional Gene Silencing* (PTGS).
- It is a conserved biological response to double-stranded RNA that mediates resistance to both endogenous parasitic and exogenous pathogenic nucleic acids.
- **Mechanism** – An enzyme called 'Dicer' cut the long double-stranded RNA into small fragments that are known as ***siRNA*** or *small interfering RNA*.
- These siRNA *bind to other proteins and RNAs*, and either *enhance or reduce the expression* of other genes.
    - ***For instance:*** When the roundworm Caenorhabditis injects the bacterium Pseudomonas vranovensis, it also takes up a *siRNA from the bacterium*.
    - This siRNA then *alters the worm's feeding behaviour* such that, from that point on, the worms 'know' to avoid feeding on this bacterium and save themselves from getting sick.
- **Applications** – They are used to target cancer-related genes, controlling neurodegerative disease and in antiviral treatments.
- In food industry, it can help to lower natural plants toxins by genetic engineering.

RNA - Ribonucleic acid
• It is a nucleic acid present in all living cells that has structural similarities to DNA (Deoxyribonucleic acid). • **RNA molecule** – It can *either single or double stranded* but most often single-stranded, has a backbone made of *alternating phosphate groups and the sugar ribose*. • Each sugar is attached to one of 4 bases: adenine (A), uracil (U), cytosine (C) or guanine (G). • **Types** – Messenger RNA (mRNA), ribosomal RNA (rRNA) and transfer RNA (tRNA). • **Relation with DNA** – A *gene* is a segment of a few thousand base-pairs of the DNA molecule and every gene is instructions that tell a cell how to make a protein. • mRNA copies the sequence of As, Ts, Cs, and Gs in a gene in the DNA into the sequence of Us, As, Gs, and Cs in their RNA. • It moves to structures called ribosomes, where the cell assembles the corresponding protein.

Quick Facts

- **Caenorhabditis elegans –** It is a roundworm, often called as 'the worm' because of its widespread use in research to understand neuronal and molecular biology.

- It was the 1st multicellular organism to have its full genome sequenced and neural wiring mapped.
- In fact, discoveries based on studying C. elegans were recognised by Nobel Prizes in 2002, 2006, and 2008.

References

1. The Hindu| RNA interference play a role in diet control
2. ChemistryTalk| RNA interference mechanism

Extra-Pulmonary TB (EPTB)

Many challenges are associated in tackling extra-pulmonary Tuberculosis.

- **TB** – Tuberculosis, is an infectious disease caused by a type of bacteria called Mycobacterium tuberculosis.

  The World Health Organization (WHO) reports over 10 million new cases of TB every year and India alone accounts for 27% of the global TB burden.

- **EPTB** – Extra-Pulmonary TB refers to the TB infection that infects the organs *apart from the lungs*.
- It includes TB infections that develop in the ***lymph nodes, brain, gut, eyes or other organs***.
- While the most common form of TB infections are pulmonary, some *20% of total TB infections are extra-pulmonary*.

  The mycobacterium that causes TB was first isolated in the eye just a year after Robert Koch identified the organism.

- **Twin Challenges**
  - ***Lack of awareness***, even among physicians
  - ***Lack of accurate diagnostic and treatment***
- **Lack of accurate diagnosis** – EPTB is *often stain negative*, which means it is not detectable on regular TB stain tests.
- The infection may surface in any part of the body and present itself like other non-TB conditions.
- Another troubling aspect is the *prolonged presence of disease markers* even after the infection is resolved with treatment.
- **Persistent infection** – Some EPTB patients who complete anti-TB therapy may still find themselves affected by the disease.
  - In the eye, an autoimmune response to antigens triggered by the original infection can lead to a persistent intraocular inflammation even after appropriate

anti-TB therapy.

- **Measures** – In 2014, a group of health experts across India and the WHO came together to formulate ***INDEX-TB***, a set of *guidelines for EPTB management* in India.
- It also released a set of clinical practice points for 10 organs, but good quality evidence was available only for 5 of them.
- However, this work has remained dormant and more needs to be done to foster and build a common approach to EPTB management.

Reference

The Hindu| Challenges associated with extra-pulmonary TB

55 Cancri e

Astronomers finally detect a rocky planet with an atmosphere based on infrared measurements done by James Webb Space Telescope.

- **55 Cancri e** – It is an *exoplanet*, also called *Janssen*.
- Location – It is located in our Milky Way galaxy about 41 light-years from Earth, in the constellation Cancer.

> ***A light year*** *is the distance light travels in a year, 5.9 trillion miles (9.5 trillion km).*

- **Features** – It *orbits its star* at one-25th the distance between our solar system's innermost planet Mercury and the sun.
- As a result, its surface temperature is about *3,140 degrees Fahrenheit* (1,725 degrees Celsius/2,000 degrees Kelvin).
- Its star is dimmer and slightly less massive than our sun, and it can rapidly complete *an orbit every 18 hours* or so.
- **A Super earth** – It is *about 8.8 times more massive* than Earth, with a diameter about twice that of Earth but smaller than Neptune.
- **Atmosphere** – It has an atmosphere but the current observations *cannot pinpoint the exact composition and its thickness*.
- It is likely rich in carbon dioxide or carbon monoxide, but can also have other gases such as water vapour and sulphur dioxide.
- Being so close to its star, any atmosphere should be stripped away by stellar irradiation and winds but gases dissolved in the vast lava ocean thought to cover the planet replenish their atmosphere.
- **No hope for habitability** – It is apparently with a *surface of molten rock* and also *too hot to have liquid water*.

> *Rocky planet with an atmosphere is a trait considered essential for any possibility of harbouring life.*

***On Earth**, the atmosphere warms the planet, contains the oxygen people breathe, protects against solar radiation and creates the pressure needed for liquid water to remain on the planet's surface.*

- **Significance** – All of the previous exoplanets found to have atmospheres were gaseous planets, not rocky ones.

Reference

The Hindu| Discovery of a rocky exoplanet with an atmosphere

Browning of Food

Some foods, like meat, cakes, breads etc. turn brown when heated.

- A chemical process called the Maillard reaction is responsible for it.
- **Maillard Reaction** – Named after the French scientist Maillard, it is a chemical process that occurs *when amino acids*, which are the building blocks of proteins, *and sugars are heated*.
- **Changes** – It changes the *colour* and also affects the *flavours, aromas, and textures* of foods.
- It is called as non-enzymatic browning as the colour change occurs without the activity of enzymes.
- **Mechanism** –When food is heated, the sugars and proteins present in the food undergo a *condensation reaction* to form a protein-sugar compound called *unstable Schiff base*.
- When the Schiff base is rearranged and dehydrated, various *intermediate compounds form* which react further to produce new flavour and aromas in the food.
- It also results in the reorganisation of the atoms in the Schiff base, creating a *more stable product*.
- These compounds undergo further changes like condensation and polymerisation, leading to the *formation of melanoidins*.

***Melanoidins** is nitrogen containing compound which are responsible for the brown coloration of the food.*

- **Dependent factors** – *Temperature, acidity, moisture* content, and the *types and concentrations of proteins and sugars* in the food.
    - **Acceleration** – Higher temperatures.
    - **Inhibition** – Acidic conditions and the presence of water.
- Ideal temperatures – In the range of 110 degrees C and 170 degrees C, and higher than that can burn the food and render bitter flavours.
    - Foods *brown more quickly at higher temperatures* and dry foods, such as bread crusts, can develop a deep brown colour during baking.

Reference

The Hindu| Browning of Food while Heating

India VIX Index

Recently, India VIX Index surged past the 21 mark amid Lok Sabha elections.

The Volatility Index (VIX) or the Fear Index
• VIX – It is a *measure of the market's expectation of volatility* over the near term. • It is a measure of the amount by which an *underlying index is expected to fluctuate* in the near term, (calculated as annualised volatility, denoted in percentage e.g. 20 per cent) based on the order book of the underlying index options. • **Volatility** – It is often described as the '*rate and magnitude of changes in prices*' and in finance often referred to as risk. • Usually, during periods of market volatility, the *market moves steeply up or down* and the volatility index tends to rise. • As volatility subsides, the Volatility Index declines.

> *The Chicago Board of Options Exchange (CBOE) was the first to introduce the volatility index for the US markets in 1993 based on S&P 100 Index option prices.*

- **India VIX** – It is India's volatility index, a measure of the market's expectation of volatility in near term.
- **Computed by** – The ***NSE*** based on the order book of NIFTY Options.
- **Usage** - 'VIX' is a trademark of the CBOE, and Standard & Poor's has granted a license to NSE, with permission from the CBOE, to use such a mark in the name of the India VIX.
- **Near term** – It depicts the expected market volatility over the *next 30 calendar days*.
- The higher the India VIX values, the higher the expected volatility and vice versa, as per NSE.
- **Impacts** – It typically *rises ahead of events like the Lok Sabha* elections, which could have a major impact on the market trajectory.
- **Significance** – Investors use it to gauge market volatility and base their *investment decisions* accordingly.

Reference

The Indian Express| Surge in India VIX amid Lok Sabha elections



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