E VER since humans learnt to domesticate cattle — about 10,000 years ago — they adapted to consuming animal milk. We are the only species that does so. Over the centuries, many societies took up dairy farming as the chief source of livelihood raising cows, buffaloes, goats, sheep, camels, donkeys and yaks for milk. Realising the nutritive value of milk, we even learnt to process it into various products. The adaptation led to a sea change in our diet pattern – milk and its products were consumed regularly and in abundance.

Today dairy farming is predominant in Europe, America, parts of Canada (Anglo-American regions) and the Australia-New Zealand belt; while Africa, Asia and Arab countries show less prevalence, mostly rearing cattle for in-house use.

Late Learners
Though consumption of milk has been around for ages, it was not until the 17th century that scientists discovered its composition. Moreover, it was much later that milk digestion was deciphered.

Milk — including that of humans — contains a disaccharide called Lactose. This complex sugar in its nascent form is not readily absorbed in the body and hence needs to break down into simpler components. This breaking down is an enzymatic process involving the enzyme lactase-phlorizin hydrolase encoded as LCT and commonly known as Lactase. Lactase converts lactose to galactose and glucose which are easier to absorb.

Queasy about Milk
Despite a long-standing dietary addition, milk does not go well with many. It was only in the last century that science began understanding the discomfort of those who could not tolerate dairy products: symptoms of bloating, flatus, diarrhoea, nausea arise within an hour or two of consuming them. Some show tolerance to milk derivatives like curd and cheese rather than milk.

Nutrient Dense
The first nourishment a newborn receives is milk. In mammals, milk production originates in the mammary glands of the female, with which the mother suckles the young one.

Colostrum is the first milk produced soon after the baby is born. It contains dense nutrients like proteins, sugars (including lactose), water and is rich in antibodies to provide immunity to the baby.

All You Wanted to Know About Lactose Intolerance
Susheela Srinivas
Intolerance to milk has been baffling scientists who until the sixties believed that the inability to assimilate milk was a deficiency disorder. They thought that those with this anomaly lacked lactase production in their body and hence developed the condition, naming it as Lactose Intolerance.

However, studies in the past few decades revealed startling results which called for an overhaul of understanding milk assimilation.

**Mistaken Identity**
Up until the early sixties, scientists believed that adult humans too could produce lactase. A research survey conducted during the 1970s through 80s indicates that almost three-quarters of the worldwide adult population lacked lactase in their guts making them lactose intolerant, despite the commonality of milk as food!

In other words, only 25% of adults were capable of digesting and assimilating lactose. The study conducted across various ethnic groups indicated that those who tolerated milk belonged to European regions or had ancestral roots of that regions.

For example, people belonging to America, Australia and New Zealand were colonies of European countries, who were chiefly involved in livestock rearing and consumed milk regularly, taking cattle rearing to the new lands.

**Nature’s Rule**
The startling results required an in-depth analysis, prompting scientists to reassess the assimilation of milk at the grass-root level, and this was what surfaced:

As mammals, female humans produce milk to feed their offspring. In this natural process, a baby’s gut wall responds to the presence of lactose by triggering the intestinal cells to produce the lactase enzyme. As infants, we produce copious amounts of lactase to digest breast milk. However, once weaning starts, there is a decrease in demand for lactase. As a natural call, the lactase activity decreases gradually, naturally bringing down lactase activity with complete absence of the enzyme in adulthood.

**Change in Terminology**
A 2001 study indicates that by about the age of five, there is a cessation of lactase activity in the human gut. Lactase activity was now better understood but needed re-defining.

With this newfound understanding, the inability to digest milk is no longer considered to be a malady. With a change in perception, now scientists refer to the condition as Lactose Persistence (LP) — for those groups who still exhibit the presence of lactase, Lactose Non-persistence (LNP) or adult-type Hypolactasia or primary lactose mal-digestion for those who don’t and Lactose Intermediate Persistence (LIP) for those who have limited lactase activity. They believe that with this awareness, there will be a rapid change in understanding the condition among the populace.

**It’s in the Genes**
Humans are the only species who tend to consume the milk of other animals beyond their weaning phase, even rearing the animals to meet the consumption demand.

What about people who can digest milk without any discomfort? Is it by chance that they are capable of lactase activity? The answer lies in our genes.

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**Constituents of Milk**

Cow milk is the most widely used milk, while buffalo, goat, sheep, camel and yak milk too are consumed in different regions of the world.

- Milk is mostly water with dissolved carbohydrates and has a pH of 6.4 to 6.8.
- Lactose contributes to the sweetness of milk and the calorie content of milk.
- Complex phospholipids make up the main fat composition of milk called Butterfat. These lipids also contain fat soluble vitamins like A, D, E and K along with essential fatty acids.
- Casein is the chief protein constituent while water-soluble lactoglobulins make up the whey protein.
- Milk is also a rich source of salts, vitamins A, B-group, C, D, K, E, thiamine, niacin, biotin, riboflavin, folates, and pantothenic acid and essential minerals like calcium, phosphate, magnesium, sodium, potassium, citrate, and chloride.
Just as humans adapted to a different set of teeth in their early stages as hunter-gatherers, the inclusion of milk in their diet led to their digestive system gradually adjusting to the change. The human gut was now persisting in producing lactase due to the availability of lactose in the food. Studies reveal that among such ethnic communities who consumed dairy products regularly, a genetic mutation occurred which was passed on down the generations to accommodate the digestion of lactose. With this acquired genetic trait, the cattle-rearing communities and their descendants developed the ability of lactase activity even in adulthood. This mutation exhibits a selective advantage, spreading extensively in cattle raising societies. Ethnic groups of the Northern European regions are found to be 90% LP, whereas indigenous populations of Africa and parts of Asia are predominantly LNP.

Decoding the Gene
Lactase persistence is an adaptive trait. An active research area since the last decade, scientists are deciphering the genetic coding of the mutation. Research during 2006-2007 uncovered the code: "A single nucleotide polymorphism (SNP) at the position 13910 nucleotide upstream to the gene coding for lactase (LCT; located on chromosome 2) appears to determine the LP/LNP status of most populations studied. The nucleotide C at this position (which is the ancestral condition as determined by comparison with primate genome sequence data) corresponds to the LNP status whereas the nucleotide T at this position (which is a mutation) corresponds to the LP status."

Indian scientists at Biotools Technologies Pvt Ltd., and Govt. Medical Research Laboratory researched for the trait in our country which showed that the SNP at -13910 upstream of LCT does determine LP/LNP status in Indian population as well.

How Do We Ascertain LNP?
As seen, intolerance to milk could stem out of a natural process and should not be confused with an allergic reaction to specific dairy products. For example, allergy to cow’s milk is triggered by the immune system while intolerance is the result of the response of the digestive system.

In the case of LNP, the lactose remains undigested in the stomach and begins to decompose due to the action of gut bacteria. There is an increase in lactic acid, gas and fatty acids which can be easily detected.

Lactose intolerance can occur due to secondary reasons like an underlying medical condition such as coeliac disease, irritable bowel syndrome, or intestinal infection. In such instances, the person is unable to digest milk until remedial action is taken for the cause. By eliminating the reason, lactase activity returns.

Very often intolerance to dairy is mistakenly self-diagnosed leading to nutritional deficiency. Determining lactose intolerance is best done by medical experts. Physicians usually ask:
- To maintain a food diary.
- To avoid lactose in the diet for a specified period and at the end of it reassess the symptoms.
- For a fasting blood sugar test. Then, the person is given a glass of milk or a lactose solution. If there is no change in the blood sugar level, then it indicates LNP as lactose was not assimilated.
- A few other determining tests like the hydrogen breath test, stool acidity test, and in rare cases invasive test such as a stool bowel biopsy.

Is it Safe to Give up Dairy, Then?
Having discussed this far, one wonders if we require dairy products at all. Milk adds nutritional value to our diet. It is an excellent source of proteins, vitamins and minerals. A well-balanced diet including the entire spectrum of nutrients that the body requires daily may not demand the use of dairy products. Perhaps, this was

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Sources: notes by Robert D. Bremel, and Handbook of Milk Composition, by R. G. Jensen
Did you know?

• Birds produce milk too! Some birds like pigeons, doves, flamingos and penguins have extended muscular pouches under their throats called crop. This bag-like addition is an extension of their oesophagus which plays a significant role in nestling young ones.

• The crop produces a thick, cheese-like substance, which the bird regurgitates to feed their hatchlings.

• The substance is called crop-milk and is high in proteins, fat, antibodies and antioxidants to nourish the young ones.

• Just like in mammals, the hormone prolactin governs the production of crop-milk.

• Crop-milk begins to produce a week before the eggs hatch. At this time the parent bird stops feeding to ensure the crop-milk is not contaminated by indigestible elements. The hatchlings depend entirely on crop-milk for nourishment for about two weeks, by the end of which the little birds begin to slowly wean away from crop milk and survive on adult bird food.

• In 2016, a few Indian scientists along with their global counterparts found that a milk-like substance found in the gut of a type of cockroach is one of the most nutritious materials available. The study published in the *Journal of the International Union of Crystallography*, states that a cockroach species *Diploptera punctata* produces a nutrient dense milk-like substance to nourish its young ones.

• The female *D. punctata* lays 9-12 eggs in its brood sac and is the only known species among cockroaches which exhibits viviparity — an evolutionarily advanced condition where the female nourishes the growing embryo, like mammals, by secreting milk. The eggs have the little yolk, but the developing offspring is fed directly by the fluid from the brood sac wall. Soon after the embryo ingests this milk, the protein crystallises in the midgut to provide a continuous supply of nutrition to the growing embryo. These crystals isolated and analysed were found to be a nutritious food source: rich in proteins, carbohydrates and lipids for the growth of the embryo — better than milk!

Here too, one needs medical supervision to supplement the nutrients and maintain a balanced, healthy diet. Nutritionists often suggest plant-based extracts of rice, nuts, soy, coconut and oats. Wherever necessary, supplements may be advised.

For some, synthetic lactase enzymes are prescribed to compensate for the lack of lactase activity.

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how earlier generations benefited as they had the advantage of organic agricultural practices which yielded highly nutritious produce,

However, the present-day focus is on meeting the ever-growing demand rather than nutrition.

Moreover, food additives and storage methods to increase the shelf life of ingredients are stripping the nutrients from food. Food now is high on energy and taste and inadequate on nutritional value. Under such circumstances, rashly eliminating dairy nutrition may lead to nutrient depletion of essential elements our body requires daily, causing severe deficiencies which are detrimental to one’s well-being.

Some are tolerant to processed dairy such as cheese, kefir and curd while they cannot tolerate milk mainly because, in processed products, the bacteria already do part of the breakdown of the sugars to help us assimilate the product. Should you suspect an intolerance it is good to keep a daily journal and set a tab on what is acceptable and avoid that which does not go down well.

Those with mild-moderate intolerance will be able to assimilate some amount of dairy. Establish the safe limit and spread it through the day.

However, for conditions of Lactase Non-Persistence, avoiding dairy will give immediate relief to the symptoms.