Turmeric – the golden spice

The dictionary defines 'turmeric' as an aromatic rhizome of an East Indian zinziberaceous plant, *Curcuma longa*. Curcumin (diferuloylmethane) is the yellow pigment in turmeric used as a spice, food coloring and as a preservative. The powder of the plant is used often as a condiment as in curry powder or as a yellow dye or as a medicine. Over the recent months, this plant has received much attention due to the challenge of the patent filed by a university overseas for the discovery of its wound-healing properties. Organizations in India maintain that this property has been very well-established in India and is not a novel finding in itself. While the debate is proceeding at a leisurely pace one could look at the actual scientific facts on this herb that have been established over the years in the scientific literature. A medline search revealed many interesting reports. Here are few published reports on the biochemistry of turmeric.

Peroxidation of lipids in the living body is known to destroy the cell membrane and ultimately lead to the premature ageing of an individual. Last year, a report on the isolation of the turmeric antioxidant protein (TAP) was isolated from an aqueous extract of turmeric (Selvam *et al.*, *J. Ethnopharmacol.*, 1995). This protein was shown to inhibit unwanted lipid peroxidation in the rat system.

In September 1995, *Cancer Letters* reported a study conducted at the Rutgers State University of New Jersey. During chronic inflammation, chemicals called cytokines are released in the human body that in turn induce the release of nitric oxide. This causes considerable damage to DNA and can even lead to carcinogenesis. This study concentrated on the effect of curcumin (the active principle of turmeric) on inflammation. It was found that curcumin inhibited the nitrite production in mouse peritoneal cells to an extent of 75%. Turmeric was implicated to be an anti-inflammatory as well as an anti-cancer causing agent.

Compounds like eicosanoids can cause the aggregation of platelets that ultimately leads to inflammation at the site of the wound. A study carried out in Denmark by Srivastava and his colleagues (*Prostaglandins Leukot Essent Fatty Acids*, April 1995) revealed that turmeric inhibits the platelet aggregation by modulating the eicosanoid biosynthesis. This could pave the way for the development of drugs that block key enzymes involved in the eicosanoid biosynthesis.

At the National Cancer Institute, Maryland, the effect of turmeric on HIV infection was studied by Mazumdar and his colleagues (*Biochem. Pharmacol.*, April 1995). Clinical trials in AIDS patients have revealed that turmeric actually blocks the functioning of the HIV integrase enzyme (of HIV type 1) that is required for the pathogenesis of the disease. Inhibition of an integrase deletion mutant containing only amino acids 50–212 suggests that curcumin interacts with the integrase catalytic core. This data suggests that HIV integrase inhibition could contribute to the antiviral activity of curcumin, giving hope to the development of new strategies for antiviral drug development that could be based on curcumin.

Several other interesting findings have been catalogued in the databank available on the wonderful uses of this exquisite herb. In essence, it would do one well to garnish generously the rasams, sambars and all that comprises the spicy Indian cusine with more than a dash of this golden spice.

The patents that have so far been filed for its uses are numerous over the last couple of years. The recent patent list from the databank records a variety of findings that range from the use of turmeric as a dye to its use in the detection of cyanide adulterated food products. However, that is an entirely different story altogether.

SCIENTIFIC CORRESPONDENCE

Comments on 'The end phase of sedimentation of Krol Belt succession in Nainital syncline – Stratigraphic analysis and fossil levels' (D. K. Bhatt, *Curr. Sci.*, 1996, 70, 772–774)

The propositions of the author that 'both in terms of lithofacies and chronostratigraphy, the presence of Tal sequence in Nainital and the reported Ediacaran fossils from Nainital do not fulfil basic palaeontological requirements to be acceptable', are strongly refuted as they are not based on basic observable facts in the field. The following discussions would justify our points.

Detailed lithostratigraphic correlation and basin analysis based on lithofacies isopach maps of Blaini–Krol–Tal sequence between Solan and Nainital[1–4] have clearly demonstrated that the Tal Formation pinches southeast to Rikhnikhal in the Garhwal syncline and does not continue in Nainital area. The arenaceous beds in the form of rhythmite as well as thin quartz arenite bands exposed in the core of the Nainital syncline start appearing even in the upper part of the Krol sequence in the southeastern closure of the Garhwal syncline. This rhythmite horizon, which yields Ediacaran fossils in Nainital[5,6], Garhwal, Mussoorie and Nigalidhar synclines[4,7] belongs to the Upper Krol Formation (Krol-D) and not to the Tal Formation[8–10], which is well exposed in the Garhwal, Mussoorie, Korgai and Nigalidhar synclines[1–3] and yielded characteristic fossil assemblages of Meishucunian to Tsanglangpuian stages[11–17] of early Cambrian age, overlies the Ediacaran fossil yielding Krol Formation[4,7]. The Ediacaran fossiliferous horizon in the upper part of Krol Formation (Krol-D) is characterized by $\delta^{13}C$ values that vary from 1.3 to 1.5‰ PDB in the

Garhwal syncline[18,19]. Similar isotopic signatures have been described from other Ediacaran fossiliferous horizons in the world[20].

The horizon from which Ediacaran fossils were recorded, occurs near the top of the Krol-D sequence exposed in the core part of the Nainital syncline[4–6]. The level from which so-called 'chert–phosphorite Member of Tal Formation fauna' comprising *Coleoloides typicalis* Walcott and *Olivooides multisulcatus* Qian recorded by Bhatt and Mathur[10], is stratigraphically well below the level from which we recorded Ediacaran fossils[5,6]. The law of superimposition of strata does not permit beds with younger fauna to be underlying beds with older fauna unless the sequence is inverted, which certainly not is the case in Nainital Syncline. It is, therefore, clear that the beds from which fauna is described by Bhatt and Mathur[10], is well within the Krol Formation (Krol-D).

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RAVI SHANKAR
V. K. MATHUR

Geological Survey of India,
Sector 'E', Aliganj,
Lucknow 226 024, India

D. K. Bhatt replies:

The disagreement of views pointed out by Shanker and Mathur relates not so much as to the observable facts in the field, but to the interpretation of the field observations, so far as the development of the Krol–Tal stratigraphy in the Nainital area is concerned. A host of recent workers on the basis of regional field observations[1] and/or detailed field work[2–4] have demonstrated that not only the entire succession of the Krol Formation up to the level or Krol–E is present in the Nainital syncline, but also the additional strata described as Krol–F[4] or Tal[2]. This inference is supported by the recent record of small shelly fossils[5].

The delineation of the extent of lithostratigraphic units within Proterozoic basins, having thousands of metre thick stratigraphic development and spanning hundreds of million years, cannot be and should not be based solely upon 'lithofacies isopach maps'. So far as I am aware there exists no parallel example anywhere in the world where similar practice has been followed for determining the lithostratigraphic succession of a Proterozoic basin.

It may be reiterated that the topmost 75–80 m of the Krol Formation and the overlying 75 m thick Giwalikhet Member of the Tal Formation in the section at Nainital have yielded elements of small Shelly fossils[5] that characterize strata of Meishucunian age elsewhere in the Krol Belt[6,7]. The 'Ediacaran fossils' of Shanker and Mathur come from Narainagar Member of the Tal Formation that forms the youngest lithounit within Tal, overlying the Giwalikhet Member, in the Nainital section. Thus the 'Ediacaran fossil' level of Shanker and Mathur marking the strata of 'Ediacaran age' lies some 150 m above the horizon, revealing the oldest record of small shelly fossils of Meishucunian age (see paper under discussion and Figure 4 in ref. 5). This becomes chronostratigraphically incompatible, for the simple reason that the Ediacaran age has to precede the Meishucunian age according to the global chronostratigraphic scale.

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D. K. BHATT

Geological Survey of India,
15–16, Jhalana Institutional Area,
Jaipur 302 004, India