Liquid scintillation counting and AMS $^{14}$C radiocarbon dating of associated charcoals and a carbonized seed of Annona squamosa L. to analyse its antiquity in India

The genus Annona has been derived from the Haitian word anan which means scaly—the presence of scale-like structures on the surface of the fruit of custard apple. Linnaeus changed anan to the Latin Annona meaning ‘fruit of the year’, and this has lent its name to the entire family Annonaceae. It is a large genus distributed in tropical America and the West Indies. A few species of the genus are believed to be native to Africa. There are no species indigenous to continental Asia. Only five species are known to have been introduced in India. Annona squamosa L. and Annona reticulata L. are naturalized in the country. A. cherimola Mill. is found in the hills of South India, on the Deccan plateau and in Assam, but is unsuited to the plains of North India. Annona muricata L. is cultivated on a small scale in Andhra Pradesh, Kerala and Assam and Annona glabra L. is grown in gardens.

A. squamosa (custard apple) is a native of South America and the West Indies, and now is widely grown throughout the tropics in the Old World. It is best suited for hot and relatively dry climates. Although custard apple is not commercially grown, it is still popular almost all over India. It has naturalized and run wild as an escape commonly in the dry deciduous forests. It was thought to be a native of India from its occurrence in the ancient literature, paintings and sculptures. It is possible that custard apple was introduced into India in the early periods.

An Indian origin of custard apple is discounted; it has certainly been regarded to be introduced to the East by the Portuguese in the 16th century or later. The occurrence of custard apple in Indian archaeological context during Neolithic times is disputeable considering the state of our present botanical knowledge.

The term custard apple is loosely applied to several species of the South American tropical genus Annona. According to Mehra, three species have been introduced into India and the term custard apple, bullock’s heart and sweet-sop have been so indiscriminately used in India, that it is now not possible to use them with accuracy. However, the name custard apple to which our specimen from Tokwa be-

Eighteen trees and fruits were described by Cunningham from the varied sculptures at Bharhat, to direct the attention of botanists to the source information of ancient sculptures. Identification of custard apple by Cunningham from the more or less contemporaneous Mathura sculptures was contested on the ground that the tree was first introduced into India by the Portuguese. Cunningham, however, did not dispute the Portuguese introduction, but observing the extensive and widely distant tracts covered with wild custard apple, he suspected the tree to be indigenous.

The palaeobotanist Sithole, did monumental work on plants represented in the Bharhat and Sanchi sculptures, and identified forty plants. With the help of free-hand drawings, he attempted identification of plants portrayed in a style which is partly conventional and partly realistic. The presence of custard apple has been confirmed by Sithole, as claimed by Cunningham in 1879.

In view of the above, we cannot deny the reliability of motifs of plants on ancient monuments. Now, the factual remains of custard apple from Tokwa (Figure 2a), in addition to Raja-Nal-ka-tila and Sanghot, are to be reckoned with, in their own right, to justify the observations of Cunningham, supported

Figure 1. Fruit coat of Annona cf. squamosa showing projecting ovoid-oblong areoles.
by Sitholey. These evidences on the Indian soil may prompt the scholars to decide in an unbiased manner whether or not the Asian-American contacts existed in earlier times, before the discovery of America by Columbus in 1498.

To obtain authentic dates, wood-charcoal samples associated with the carbonized seed remains from the stratigraphic sequence of Neolithic culture at Tokwa, in Mirzapur District, UP were dated at the 14C Laboratory, BSIP, Lucknow, by Ultra Low Level Liquid Scintillation Counting (LSC) method of 14C radiocarbon dating. To our surprise the sample dated to cal. 3470 ± 120 yrs BP; cal. bc 1740, BS-2268. As the AMS 14C dating facility is not available at BSIP, and since the sample is rare, a broken seed sample of custard apple was dated at the AMS 14C Laboratory, Institute of Physics, Bhubaneswar (3MV tandem pelletron accelerator). Interestingly, the AMS date was 3280 ± 140 yrs BP (cal. BP 3473; cal. bc 1530, IOPAMS-10), showing reasonable agreement with LSC date of the Tokwa charcoal sample from the same layer with which the carbonized seed of custard apple was dated.

In addition to Neolithic Tokwa, wood-charcoal samples associated with the carbonized seeds of A. squamosa and other botanical remains from stratigraphic sequence of iron-using culture at Raja-Nalka-tila, Sonbhadra District, UP were also dated earlier in the same laboratory. The sample dated to cal. 2690 ± 70 yrs BP; cal. bc 740, BS-1988, supporting pre-Columbian existence.

To identify the carbonized seeds up to a specific level, seed size (L x B x T) of four common species of Annona in the Indian region was worked out on the collection provided by the NBRI Herbarium, Lucknow (Table 1). In A. squamosa, oblong seeds are 13–16 mm long, whereas in A. cherimola seeds are 15–21 mm long. A. muricata seeds are 15–18 mm long, and A. reticulata oblong seeds are less than 13 mm long. The ancient oblong seed (16 mm long) shows close resemblance with that of extant seeds of A. squamosa. Furthermore, the characters of fruit-coat surface were studied. In A. squamosa L., fruit coat shows projecting and somewhat ovoid to narrowly oblong auroles. Among the other closely related species, A. reticulata L. fruits have a characteristic network of lines indicating the edges of individual fruits; A. cherimola Mill. shows scaly surface, A. glabra L. shows smooth or faintly reticulate surface, and A. muricata L. fruits are covered with recurved fleshy spines. The carbonized fruit coat from Sanghol during the Kushana period, with projecting and ovoid-oblong auroles shows close affinity with that of A. squamosa. Hence, the seeds from Neolithic Tokwa have been referred as A. squamosa.

The findings of seeds of custard apple from the Neolithic cultural sequence at Tokwa have placed its antiquity approx. 3500 yrs BP. Botanical evidence and firmly established radiocarbon dates, characters of fruit coat and seed-size statistics are bound to change the historical accounts narrating the discovery of America by Columbus in 1498. Occurrence of custard apple in the pre-Columbian times is no way accidental. It is difficult to establish at present about how and when it reached diverse unconnected zones, and who was responsible for its introduction.

In view of the above, the factual remains of custard apple in Indian archaeological records show Asian-American trans-oceanic contacts before the discovery of America by Columbus. Since the validity of factual botanical evidences in archaeology is basic to the whole enterprise, it should certainly be borne in mind that pre-Columbian communication of the Asian and American region is not to be ruled out. The rich cultural heritage of India is likely to produce many more evidences like that of custard apple, which may prove to be of enormous archaeological significance. This correspondence is aimed to strengthen the archaeological interpretations in times to come.

Pharmacognosy can help minimize accidental misuse of herbal medicine

An estimate of the World Health Organization (WHO) states that around 85–90% of the world’s population consumes traditional herbal medicines. Use of herbal remedies is on the rise in developing and developed countries (Figures 1 and 2). Of late, the use of traditional medicinal medicines has increased by leaps and bounds in the West and in the near East. The US herbal medicine consumption alone was worth US$ 17 billion in the year 2000 and the global market for herbal medicines today is estimated to be a whopping US$ 60 billion. The size of the herbal health care and personal care market in India is estimated to be between Rs 2500 and 3000 crores. With these figures marching up steadily, the number of deaths and other toxic reactions resulting from the use of herbal medicines is also on a rise. How are we prepared to tackle this? Can a specialized field like pharmacognosy help minimize the concerns?

Pharmacognosy (Figure 3) basically deals with the standardization, authentication and study of natural drugs. It is closely involved with allied fields, viz. phytochemistry and toxicological screening of natural products. Much of the research in pharmacognosy has been done in identifying controversial species of plants, authentication of commonly used traditional medicinal plants through morphological, histological, physico-chemical and toxicological parameters, especially heavy-metal estimation and radiobiological contamination in plants, prescribed by an authoritative source. The importance of pharmacognosy has been widely felt in recent times.

Most of the cases of accidental herbal medicine misuse start with wrong identification of a medicinal plant prescribed. Many of the traditional systems have records where one common vernacular is supplied in place of two or more entirely different species. Ginseng, which is a common Indian drug, is sold under 13 different names in the market. For example Chinese or Asiatic ginseng (Panax ginseng), American ginseng (Panax quinquefolius), Siberian ginseng (Eleutherococcus senticosus), Ayurvedic ginseng (Withania somnifera) and Russian ginseng (Acanthopanax senticosus), to name a few. Such names could create confusion over prescription, which may eventually lead to serious consequences. For instance, by the end of the 20th century, there were continuous reports of cases in Belgium and some European countries of people, who, after taking slimming drugs containing ‘Fangchi’, a Chinese herbal remedy, developed extensive and indirect nephrotoxicosis, renal tubule atrophy and depletion, and/or renal failure. It was found that Aristolochia fangchi had been mistakenly used instead of Stephania tetrandra in the slimming drugs. At