# Vaginal pheromone and other unusual compounds in mung bean aroma

2-Acetyl-1-pyrroline (2AP), the molecule responsible for rice aroma, was also traced to the tiger pheromone[1,2]. We have detected 2AP in two strains of mung bean in Bengal[3] which are famous for their aroma and we now report other flavour compounds in this comestible. After removing 2AP as citrate or hydrochloride, other volatile aroma molecules remain untrapped and most of these have the same 'tone' as that of second-grade mung bean strains (which do not contain 2AP) and are absorbed in bleaching earth (Tonsil), suggesting the presence of nitrogen in the molecules. All the aroma molecules are presumably Maillard reaction products because they are formed after boiling and frying.

These aroma molecules were separated by steam distillation of fried mung bean and trapped into $CCl_4$. Only the upper aqueous layer contained some pigments. Several peaks were detected after injecting $CCl_4$ in a packed squalane column (column temp. 40–60°C, FID temp. 150°C) which is suitable for compounds like 2AP.

The material was then analysed with the help of a GCMS (Fison's Instruments, column temp. 40°C, 1 min holding, to 60°C at 5°C/min, run time 30 min).

For comparison a blank run was made with pure (solvent) $CCl_4$. The compounds identified with the help of a computerized library search were dimethyl disulphide; benzaldehyde; 2,4- (or 2,5-) dimethylpyrazine; 3-ethyl,2,5-dimethylpyrazine; 2-ethyl,5-methylpyrazine; and phenylmethylamino ethanol. Only the first two are well-known compounds but, interestingly, dimethyl disulphide has been reported to be a male-attracting pheromone in hamster vagina[4]. This may be compared with the presence of boar-taint phermone (androstanone) in vegetables like celery[5]. Many sulphur-containing compounds are known to occur in vegetables and fruits, especially in durian where trimethyl disulphide and 42 other sulphur-containing compounds have been detected[6]. Benzaldehyde may be formed from Strecker degradation products; such aldehydes are known to be important in food flavour[6]. It also occurs in bitter almonds in nature. Dimethyl pyrazine is a common Maillard reaction product, especially of glutamine–fructose reactions[6], but it is of unusual interest because 2,5-dimethyl pyrazine has been reported to be a puberty delaying pheromone in female mice[7]. Thus, coincidentally, two mammalian pheromones are produced by Maillard reaction in mung bean aroma.

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ACKNOWLEDGEMENTS. We are indebted to Electron Microscope Centre of Calcutta University (CU), Prof. D. K. Bhattacharyya and Dr Santinath Ghosh, Department of Chemical Technology, CU, Ecolab, IIRA, Calcutta and Prof. J. Dutta, Dr E. Ali and Dr P. Bhattacharyya for constant cooperation.

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# Predicting climate change

Understanding how the ecosystem works or may respond to disturbances over time, continues to worry ecologists, especially to know that most of the 'field studies last only one to two seasons'[1].

Meher-Homji's opinion (*Curr. Sci.*, 2000, **78**, 777–778) must give readers not only the limitations of most of our field experimentations[1,2] and scope of unaccounted possibilities[3], but speculations blown into theoretic deductions. One of the serious gaps, rather an urgency, pointed out by him, is the lack of meteorological stations in places much required.

We draw attention to one such location – a Trans-Himalayan cold desert in north-western India, that was lashed by unprecedented rains in the recent past[4,5]. Incessant rains, reported as a recent phenomenon in the year 1995, damaged many famous monasteries in the Ladakh region, beside collapsing more than 50 houses and buildings, within two months[4]. A couple of years later, many people were rendered homeless or suffered extensive losses, with cattle loss exceeding over 6000, and hundreds of hectares of standing crop getting washed away[5], in the adjacent sparsely populated district of Lahoul-Spiti in Himachal Pradesh, where human density is a mere 2 persons per sq. km.

A tempting correlation has been put forward to link such changes to global warming[5,6]. However, relatively short-term yet distinct climatic fluctuations in history are not new[7,8], and may be much more complexed[9–11].

Geographically, Spiti is hemmed in by lofty mountain peaks rising to an average elevation of 6000 m above mean sea level in the Trans-Himalayan tract bordering Ladakh and Tibet, for which an observation recorded nearly a hundred years ago in the Kangra *Gazetteer*[12], reads as follows: 'rainfall is insufficient, except when monsoon current is very strong, to have any effect on the production of crops or even of grasses'.

Interestingly, meteorological data for Spiti are available, collected by an owner of a shop, but are quite equivocal. Our observations on relative humidity recorded randomly during the summer

months were 3–4 times lower than those shown in the record for nearly all the previous years. Disparity also existed in the rainfall record when compared with information noted at the district government office at Kaza, Spiti valley. This place is one of the several locations where climatic distinction should precede the convenience of operating a reliable meteorological observatory.

Since relatively small changes in precipitation regimes may have a major impact in the arid and the semi-arid areas[13], the desert ecosystem could prove sensitive to small differences in precipitation rates, but requires accurate monitoring over a significant period of time to predict environmental or climatic changes.


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# Drying up of Saraswati

I enjoyed reading A. V. Sankaran's article on the river Saraswati (*Curr. Sci.*, 1999, **77**, 1054–1060). He is, however, wrong in supposing that the *Vedas* came into existence more than 8000 years ago; that the decline of the Vedic civilization was caused by the decline of the Saraswati five to six thousand years ago; and that, contrary to what is generally believed, the Harappan civilization succeeded rather than preceded the Vedic Age.

We have an unbroken record of the early Hindus, from the *Rig Veda* on; there is no break in the record. Indeed, this is the thing that makes Hinduism so unique; it is the only religion which has, so to speak, lived a full life, and for which a carefully documented record of its entire life history is available. This literature does not contain a single reference to anything remotely resembling the scale and majesty of the Harappan civilization at its peak. Nor does it refer to the cataclysmic drying up of the Saraswati; or to the demise of the Harappan civilization (which is reliably known to have occurred around 2000 BC). These two events must therefore have occurred many generations before the contemporaneous portions of the *Rig Veda* begin. The Saraswati is, in the *Rig Veda*, essentially a holy river, rather than a mighty one.

It is certain that the puny, rainfed Ghaggar of the present time, popularly identified with the ancient Saraswati, once flowed right down to the Rann of Kutch. Since geomorphological evidence on when the river shrank is subject to a margin of error running into several thousand years, it is tempting to speculate that the Saraswati must have been in full form when the mature Harappan site of Dholavira (today hopelessly bogged down in the formidable Rann) was constructed; around 2500 BC. This would have given the site easy access to the sea, and to upstream sites like Kalibangan in Rajasthan and Banawali in Haryana; and, of course, an assured supply of water. As a corollary, the abandoning of the three sites about 500 years later, would have coincided with the cataclysmic change in the Saraswati. The supply of water at the three sites would have had to be much more plentiful than it is today for the Harappans to even think of constructing such large cities there. Besides, one must remember that without easy and reliable means of water transport, it is very unlikely that such a commonality of culture could have developed across Harappan cities situated thousands of kilometres apart from one another.

The 'spot where the Saraswati mingleth with the sea' is mentioned as one of the *tirthas* which pilgrims were supposed to visit in ancient times (travelling north from Prabhasa – Somanath? – to the ancient junction of the Saraswati with the sea, south to Dvaravati – Dwaraka – and then, perhaps after a brief sea journey, up the course of the Indus river: *Tirthayatra Parv* of the *Mahabharat*, Sec. 82). The Saraswati probably shrank more than 4000 years ago; but reverence for this ancient and sacred spot would have survived in popular memory.

Mainstream historians dismiss the *Puranas* (and other popular literature such as the *Mahabharat*) as consisting mostly of mythology and claptrap. But a classic written by F. Eden Pargiter in 1922, drew the attention of sceptical scholars to the great difference in content and style between the king lists of the *Puranas* and the rest of their more fanciful material; to the remarkable consistency between king lists taken from a large number of different *Puranas*; and to the way that the genealogies of as many as a dozen different dynasties of ancient India mesh so well with one another in space and time.

Pargiter, an ICS man of the old school, after a careful, critical and painstaking study of the *Puranas* lasting more than thirty years, was able to document the genealogies of these ruling houses of ancient India for about 120 generations before Mahapadma Nanda and his sons (the predecessors of Chandragupta Maurya) came along and 'enjoyed the earth for a hundred years'. This stupendous achievement made it possible, for the first time, to slot Puranic history into the Gregorian calendar, thanks to the fact that the latter has a firm date for Alexander's invasion of India – 326 BC. Pargiter's study made it possible to put together a connected account of early Indian history right from the most ancient times; it was no longer necessary to stop at the Buddha in the 6th century BC. No doubt we still do not have exact dates for earlier events; because we have no way of knowing how long each generation of the king lists ruled. But at