

knowledge and information to both young and old. The statement that 'jobs in academia are significantly more attractive than in the past', is absolutely correct. However, the other side of the picture is that in many states like Madhya Pradesh, Uttar Pradesh, Rajasthan and Bihar, the state of higher education is pathetic. There is no or negligible recruitment in state universities and colleges for the past many decades. There is no replacement of retired teachers in the teaching departments. In some cases, ad hoc, part-time teachers with meagre salary are being enrolled. About four decades ago the state university services were better than those in the colleges. Now the university teachers have been deprived of many benefits, including retirement perks, etc.

Balaram's statement, 'The excitement of science and pleasure of research can only be communicated by exposing students at the earliest,' is a fact which cannot be explained in words. Unfortunately

what happened in India during the last many years is just the reverse. I shall enumerate a few causes. The experimental work in biology, i.e. in botany and zoology teaching classes has almost completely abandoned right from middle school to upper college level. At the undergraduate level, only a few experiments are being performed at the time of examination. In the postgraduate classes too, experiments are being performed mostly in practical record books only. One of the excuses for not providing the animal material for experimental purposes by school and college authorities is that the Government has banned the use of some living animal material for experimental and research work. This problem can be overcome by exploring alternative experimental animal models in which basic anatomical, morphological and physiological processes can be well demonstrated. Another reason is that the teachers have no knowledge of

acquiring, preserving or keeping living biological material in their institutions. The situation is not different in undergraduate medical education. Another reason for the decline of zoology/botany education in India is the starting of biotechnology and microbiology courses at the undergraduate level. This has caused more harm than benefit to biology education, as the student has to opt only botany or zoology along with biotechnology or microbiology. Thus we need to develop an 'inquiry-based instruction' system, for which teachers at schools and colleges need sufficient training, knowledge, expertise, zeal, enthusiasm and dedication to the cause of science.

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M. OVAIS

No. 7, Kausar Bungalows,  
Bhopal 462 001, India  
e-mail: drmovais@gmail.com

## Why waste citrus peel?

Juices extracted from citrus fruits are used in processing industries, but the peel and other waste materials are often thrown away. This not only creates environmental hazard, but also incurs cost of its disposal. Interestingly, if citrus wastes are used properly, they could serve in establishing other related industries.

Citrus peel yields citrus oil which serves a number of useful purposes. Several good methods are available for the extraction of citrus oil<sup>1</sup>. Grape fruit or orange peel yields naringin, also known as flavonone glycoside. Various food industries use this product in the preparation of bitter 'tonic' beverages, bitter chocolate, ice creams, etc.

Naringin works as a powerful antioxidant protecting the body from free radicals, thereby reducing the risk of cancer. It is also used in the treatment of gastric lesions and in the nutrition industry to increase uptake of supplements such as caffeine. In treating diabetics, it works as an aldose reductase inhibitor which inhibits the enzymes that turn glucose into other sugars, thus helping to fight retinal disease linked to diabetes. By enhancing lipid metabolism, it reduces the risk of atherosclerosis and other fat-related disorders. It can be used to obtain naringin dihydrochalcone, a com-

pound which is 300–1800 times sweeter than sugar.

Besides, citrus ethanol produced from citrus wastes is used as a fuel. Most ethanol is produced from corn which is cost effective. The food value of these crops is much higher than the fuel value. Evidently, alternate sources of production of ethanol like citrus wastes need exploration<sup>1</sup>.

Citrus oil and the extract obtained from citrus-fruit peel are antifungal and antibacterial in nature. It has been found effective against Gram-positive strains such as *Staphylococcus aureus*, *Bacillus subtilis* and Gram-negative strains such as *Escherichia coli*, *Klebsiella pneumoniae* and *Salmonella typhi*. Citrus peel is fungitoxic to *Aspergillus flavus* and *A. niger*.

Oil of citronella or the constituent, citronellal, is also used in mosquito coils. Several veterinary products for flea and tick control in domestic pets contain *d*-limonene (from citrus peels) as the active ingredient. Other uses include perimeter treatments of buildings against termites and the use of essential oils to repel cockroaches and flies<sup>2</sup>. Contact with orange oil kills termites by damaging their exoskeleton, causing loss of water and protein<sup>3</sup>. Another important use of plant essential oil constituents is

in the fumigation of beehives to manage economically important honey-bee parasites, the varroa mite (*Varroa jacobsoni*) and the tracheal mite (*Acarapis woodi*)<sup>4–7</sup>.

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D. P. ABROL

Division of Entomology,  
Sher-E-Kashmir University of  
Agricultural Sciences and Technology,  
Faculty of Agriculture,  
Main Campus, Chatha,  
Jammu 180 009, India  
e-mail: dharam\_abrol@rediffmail.com