

A MESS OF RED POTTAGE

Max E. Tate, Dirk Enneking

The abundant *Vicia sativa* cultivar “blanche fleur” from Australia is perceived by markets to be a cheap protein rich pulse, but is it suitable for human consumption?

Esau sold his birthright to Jacob for a mess of red pottage, a dish thought to be the red lentil (*Lens culinaris* Medik.)¹. Taking today's price of US \$800 per tonne, this particular pulse must seem to be an attractive crop to many farmers. Unfortunately, red lentils are a rather poor yielding crop, so in the late 1980's when it was noted in Australia that the pinkish cotyledons of the “blanche fleur” cultivar of *Vicia sativa* L. bore a close resemblance to those of the red lentil after dehulling, it was but a short, step to the creation of a brand new food export market.

Work in Europe in the 1920's (summarised by Barulina²) established the virtual omnipresence of *V. sativa* as mimics in lentil crops. Flowers were eliminated as soon as they appeared because they are a different colour from *L. culinaris*. Lentil mimics still occur: proteins characteristic of seeds of a lentil-like vetch (*V. sativa*) have recently been detected as minor foreign matter in Manitoba lentil crops³. A European lentil-like vetch (*Vicia* var. *lentil sperma*) was of sufficient concern to the International Organization for Standardization (ISO, 1989), for it to propose test methods for its identification in 1989.

So an uninformed consumer may well be duped by lentil look-alike vetches. The somewhat spherical cotyledons of blanche fleur more closely resemble those of the common yellow split pea (*Pisum sativum*), than the flatter appearance of the lentil, but the colour (especially when coated with vegetable oil to enhance its attractiveness) bears a distinct resemblance to a paler form of red lentils. It is this mimicry of the of the red lentil which lies at the heart of the blanche fleur story.

The blanche fleur cultivar of *V. sativa* has been a useful stock feed and green manure crop in Australia since the early 1950's, growing readily in the mediterranean climate of southern Australia. But it is now perceived to be a valuable food-export cash crop for farmers: the latest export figures for the state of South Australia alone that the export trade has grown from a mere 50 tonnes of Blanche Fleur in the year 1988/89 to more than 9470 tonnes in the ten months from July 1991 to early May 1992. Of this latter figure 5600 tonnes were sold as split red vetch ("red legumes" or "red dhal"), which must be

destined for human consumption, (because the added cost of splitting (dehulling) would make it non-competitive in the stockfeed market).

There are at least nine reports in the literature of the toxic effects of feeding untreated *Vicia sativa* to one or more of the following: pigs, mules, horses, ducks, monkeys, turkey poults and chickens. Of particular note is the important neurotoxin study of Ressler *et al*⁴. These authors established that a 50% *Vicia sativa* diet fed to week-old chickens caused all the animals to die in less than one week; the observed toxicity could be quantitatively accounted for by the measured levels of L- β -cyanoalanine (0.1%) and its γ -L-glutamyl derivative (0.6%). In contrast to the acute toxicity to chickens, the rat experiments showed only a marked retardation in their growth rate. So we can say that although there is considerable species variability, under no circumstances can untreated *Vicia sativa* be considered to be suitable for human consumption.

Analytical studies at the Australian Grain Academy in Victoria have established that Blanche Fleur cultivar of *Vicia sativa* contains similar levels of β -Cyanoalanine (0.1%) and perhaps higher levels (1.1%) of the γ -Glutamyl derivative to those reported for *Vicia sativa* by Ressler *et al*⁴. So unless it is detoxified prior to eating, the split red vetch exported from South Australia alone, is sufficient to provide 56,000,000 x 100g servings each of which initially contains up to 1g of neurotoxins.

Alarming though the neurotoxin content of *V. sativa* is, the fact remains that people do not eat raw legumes, but process them by, for example, dehulling, soaking and cooking with or without straining at intermediate stages.

The analytical data from Victoria suggest that up to 90% of these water soluble toxins can be removed by the age-old detoxification practice of leaching, which involves soaking the dehulled vetch and discarding the washings. In a separate experiment, approximately 30-50% was removed by cooking. Nevertheless it is as well to point out that the cooking experiments measured the analytical loss of the measured toxins, not whether there was loss of biological toxicity *in toto*. In this respect, the work of Harper and Arscott⁵ established that extensive autoclaving (8h at 15psi) of *Vicia sativa* was necessary to substantially reduce the toxicity to chickens.

Before the identification of the neurotoxin content, the sporadic use of white-seeded varieties of *V. sativa* as a pulse for human consumption has been reported^{6,7} and P. Hanelt (I.P.K. Gatersleben; personal communication) suggests that its consumption is still extant in the province of Ratcha in West-Georgia (C.I.S.). However Hegi⁷ mentioned that "sour lentil" (*V. sativa*) samples were confiscated by police in Berlin during World War 1 and Danckwortt⁸ tabulated *V. sativa* as a poisonous vetch. Nevertheless, there does not appear to be any mention in this period of any unequivocal case of human poisoning that could be attributed to *V. sativa*.

The United Nations FAO has a Food quality and Consumer Protection Group based in Rome and were apparently unaware of the widespread sale or human consumption of blanche fleur when we contacted them. A member of the group wrote that it was their view that in pulse eating countries most toxins would be lost during the common culinary practice of soaking and discarding the washings. To us, the important point seems to be whether or not the blanche fleur is likely to be treated as if it were red lentils. Red lentils frequently have only sufficient water added to produce the final desired consistency, thereby retaining as much of the minerals and vitamins as possible. With a red lentil-mimic such as blanche fleur this practice would inevitably result in higher consumption of the neurotoxins. With the almost ubiquitous presence of water soluble (and in many cases thermostable) toxins in nearly all legumes, the practice of leaching by soaking is easy to recommend and practice, but in many regions of the world water is a scarce and valuable commodity.

Thus it would seem that in practice there is very little international monitoring of new commodities supplied for human consumption and there is great reliance on self-regulation by exporting countries. Presumably this is based on the premise that if mistakes are made, it is the exporter's hip pocket nerve and credibility which suffers most- but in this particular case, there seems to be much less concern for the health of the consumer.

Lentils or vetch?

Is there any evidence that blanche fleur has been labelled as red lentils? In the past it has, as is documented in a letter to *the South Australian Stock Journal* dated 26th March 1992. The Victorian Brokerage firm which negotiated the sales of the split red vetch to various buyers stated: " The first two shipments, a total of 400 tonnes were branded at the request of the overseas buyers as split red lentils, but described on the phytosanitary certificates as split vetch. All shipments since have been branded either split legumes or split red dhal."

It is obvious from this statement that not all the blame for this situation must rest with the exporter. Furthermore, the lack of background knowledge of this particular company is clearly evident in the additional comment on a prior derogatory article: " Your statement regarding neurotoxicity is without foundation. This is supported by the repeat orders we are now receiving from all our overseas buyers who have had almost three months to evaluate the quality of the product."

The department of primary industries and energy controls AQIS, the Australian Quarantine Inspection Service, which issues the all-important Phytosanitary Certificate to the exporters. It was a consequence of a request to us late last year by a concerned South Australian exporter of blanche fleur, that we commenced a qualitative paper electrophoretic investigation, which clearly indicated the presence of the unusual and characteristic blue ninhydrin spot of β -cyanoalanine in a sample of Blanche Fleur at a level similar to that in other *Vicia sativa* cultivars.

Much to our surprise, the exporter informed us in late in February this year that contrary to our report of the presence of neurotoxins in Blanche Fleur, AQIS had issued a circular dated Feb. 11th 1992 entitled " False Trade Description - Export of *Vicia sativa* described as Lentils" in which it was stated: "Many varieties of vetch contain toxic amino acids such as β -cyanoalanine making them unsuitable for human consumption. The recently released variety blanche fleur is suitable for human consumption and in its split form has a similar colour , shape and size as lentil. However, consumer acceptance of this vetch as an alternative food source has been slow."

Our initial reaction was to be thankful for the commonsense of consumers. But we then repeated and confirmed our earlier observations. The responsible minister was immediately notified of our concern on 25 February and again on 5 March, to which we received a reply on 25 March. The relevant section reads as follows:

"I am informed that you have raised your concerns with AQIS about the possible levels of β -cyanoalanine in the cultivar blanche fleur. I have also been informed that AQIS, in response to your facsimile, has informed the Grains Council, exporters and AQIS inspection staff that it is not possible to provide affirmation that the cultivar is fit for human consumption.

It will be a matter for the industry to establish to the satisfaction of competent authorities such as the National Food Authority that the levels of β -cyanoalanine in this or other cultivars render them fit for human consumption. AQIS would the take appropriate action on this advice."

Exporters have assured us that once the shipment leaves the wharf it can be sold and resold many times over and hence the initial phytosanitary health certificate destination bears little relationship to where it ultimately is consumed. Nonetheless for what it is worth the split Blanche Fleur from South Australia in 1991/1992 was initially consigned to Saudi Arabia, United Arab Emirates, Dubai, Oman, Jordan, and Egypt. The whole vetch was consigned to Portugal,Italy,Spain,South Africa, Austria and USA. It should be remembered that reexport from the middle East to India, Pakistan and Sri Lanka and other countries is highly likely.

What more can be done?

In the first instance the consumers and the scientific community at large can be made aware that red vetch *Vicia sativa* is definitely not the edible red lentil *Lens culinaris* and that is the main purpose of article. Second, the common practice of soaking pulses and discarding the washings substantially reduces the toxin level and this should be encouraged. Third, cultivars with negligible neurotoxin content can be selected by plant breeders, despite the probable decrease in yields that would result from insect or avian predation.

For those who wish to distinguish between these two look-alike pulses, the simple week-old chicken bioassay outlined by the Ressler work would provide an inexpensive third world alternative to HPLC analysis or the Canadian protein electrophoretic procedure, and would thus be feasible for use in poorer countries.

Even on the scale of Australian exports, there have been no reports of acute toxicity among consumers. It is therefore probable that any untoward consequences must either have gone unrecognised or are close to symptomless. Nevertheless the Ressler *et al.*'s observations on growth retardation by feeding *Vicia sativa* to immature rats provide a warning that one particular potential usage, namely as part of a free midday meal for school children in Sri Lanka which was briefly suggested in a market-research report for the Australian Grain Legumes Committee should be forbidden. And the introduction into famine relief programmes should also be proscribed.

In a protein-deficient world it is possible that suitably leached or genetically altered and thereby detoxified cultivars of *Vicia sativa* may come to be important as human food, just as other initially undesirable crops have been modified for human consumption either by post harvest processing (soyabeans) or by genetic improvement (rape seed). Meanwhile, in the absence of any satisfactory data on the toxicology of β -Cyanoalanine and its γ -glutamyl derivative, everyone should be on their guard for the appearance of deleterious effects from the rising human consumption of the blanche fleur cultivar of *V. sativa* marketed as "red vetch", "red legumes" or "red dhal".

Max. Tate and Dirk. Enneking are in the Department of Plant Science, Waite Agricultural Research Institute, University of Adelaide, Glen Osmond, South Australia, Australia 5064.

1. De Candolle, A. *Origin of Cultivated Plants* 2nd edn (London, Keegan Paul, Trench, 1886 p.322)
2. Barulina, H. *Trudy prikl. Bot. Genet. Selek.*(suppl.) **40**, 302-3 (1930).
3. Cooke L.A., Marchylo, B.A. *Plant Varieties and Seeds*, **5**, 1-11(1992)
4. Ressler C., Nigam, S.N & Giza, Y.-H. *J. Am. Chem. Soc.*, **91**, 2758-2765(1969)
5. Harper, J.A. & Arscott, G.H. *Poult. Sci.* **41** 1968-1974 (1962).
6. Tabulated Information on Subtropical Grain Legumes p.297-305 (FAO Plant Production and Protection Division, Rome 1959).
7. Hegi, G., *Die Illustrierte Flora Mittel-Europas 1550-1551* (Lehmann, Munich, 1925).
8. Danckwortt, P.W. *Zeitschr. f. Untersuchung d. Lebensmittel* **69**: 458-463(1935)