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Rapeseed (syn. Canola) Revisited.

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For a few weeks in Springtime, parts of England's 'green and pleasant land' turns into a nauseous Day-Glo Yellow vista, as farmers submit us hapless country-lovers not only to hideous horizon-wide visual onslaught, but also to our annual toxic gassing from the sweet, cloying but underlyingly unpleasant volatiles from rapeseed flowers (*Brassica napus* L. ssp *oleifera*), coupled with a seasonal overload of rapeseed pollen. Although plant breeders have overcome the toxic nature of the original plant to some extent – which originally contained high level of aliphatic fatty acids, such as eicosenoic and (more especially) erucic acids - the high pollen levels, the high levels of insect-attracting nectar (especially hoverflies), and the disgusting volatile sulphur producing properties, are still present.

Honeybees (*Apis mellifera* L.) are apparently attracted mainly by the Rapeseed's flower's volatiles: particularly phenylacetaldehyde, linalool & (*E*,*E*)-farnesene (Blight *et al*. 1997), and the cabbage seed weevil *Ceutorhynchus assimilis* is attracted to its host plant, *Brassica napus*, by volatile isothiocyanates (Bartlet *et al*., 1993), perhaps including 3-butenyl, 4-pentenyl, and 2-phenylethyl isothiocyanates during certain development cyclic stages (Smart & Blight 2004) However several of us mere humanoids might react more adversely to unpleasant substances such as the phenylacetonitrile, isothiocyanates & the respiratory irritant dimethyl sulphide (McEwan & MacFarlane Smith 1998). According to the summary provided in the article introduction by Smolinska *et al* (1997) and the references therein, in tissues of the Brassicaceae, it appears that after tissue damage, myrosinase (thioglucoside glucohydrolase) hydrolyses the naturally occurring anionic glucosinolates present (which consist of beta-Dthioglucose and sulphonated oxime moieties), producing a number of end products including isothiocyanates, thiocyanate ion, nitriles, and epithionitriles according to the type of glucosinolates present and the exact hydrolysis conditions. As insect feeding deterrents, these products of myrosinase activity are more toxic than the glucosinolates themselves (Eckardt 2001). A search of the available literature has not revealed any detail whether the aroma volatiles produced by the rapeseed flowers involve similar processes in generating for

volatile sulphide compounds. For a few weeks at about this time of year, parts of England's 'green and pleasant land' turns into a nauseous Day-Glo yellow vista, as farmers submit us hapless country-lovers not only to hideous horizon-wide visual onslaught, but also to our annual toxic gassing of unpleasant volatiles from rapeseed flowers (*Brassica napus* spp. *oleifera*) coupled with a seasonal overload of rapeseed pollen.

Uses - bio-diesel & cosmetics.

When the UK crop matures, some of the fixed oil produced is sold for bio-diesel, mainly to Germany, according to an illustrated article in a recent Guardian supplement (Blythman 2007). Elsewhere, it is quoted that some 40-60% of European rapeseed production goes to bio-diesel production (Mudeva 2006); Apart from France, Poland is also among top rapeseed-oil producing countries, its' output being quoted as 1.49 million tons in 2004 (Krukowska 2004), although UK production is expected to top 2 million tons in 2008 (Blythman 2007). DEFRA have previously pointed out that 1 ton of rapeseed gives 0.38 tons of rape methyl ester (one possible bio-fuel, besides rape ethyl ester etc.). In other parts of the world, opposition to bio-fuels, especially bio-ethanol, has been vigorous (see Larouchepac 2006), but it hasn't stopped the Canadian Agriculture minister in 2006 announcing $11 million in funding initiatives for Canadian farmers in biofuels opportunities (N.B. already 40% of the rapeseed grown in Canada is GM, according to Teitel 2001).

Supplementing diesel is apparently in line with the EU commitment to increasing the share of bio-fuelled transport to 10% (Kroeger, 2007), although this has bought criticism from many environmental NGO's who say the policy will do more harm than good (Anon 2007). Some of these criticisms have been aired in the UK national press, such as the fact that land, which should be primarily set aside for food production, is being raffled off to appease the modern great God: the motor car. In a slightly different area, George Monbiot has criticized the UK government for not disqualifying palm-oil (which he maintains will actually worsen greenhouse gas discharges) from EU-driven bio-fuel targets (Monbiot 2006). True, a public consultation exercise on the bio-fuels policy topic was conducted by the EC (EC 2006), but as usual, the EC was more concerned with policy than practicality, and failed to ask views on the pertinent issues.

In Canada, low erucic acid (< 2%), low glucosinolate (<30 micromoles/g air-dried oil-free meal) GM rapeseed bred for herbicide resistance is called Canola (Canada – oil). Resistance to GM canola cropping seems to be lower in Canada – elsewhere worries about corn contamination from GM material & associated public liability issues, quite apart from high consumer resistance, have been reported (GMWatch 2004). However pro-GM lobbyists continue to exert pressure in countries like Australia (NCF 2006).

Low erucic acid rapeseed oil is used in cooking & margarine production, and in the preparation of salad dressings. The oil is used as a lubricant as well as an ingredient for bio-fuels as discussed; the oil free press-cake is high in protein and

is used in the animal feed industry. A small amount of rapeseed oil is used in cosmetics, especially in soap-making, as a carrier for fragrances in 100% 'natural' perfumes, and as a diluent for candle fragrances, in lamp oils etc. However, even if from a non-GM source, considering rapeseed oil's negative eco-associations as set out below (nitrate leaching, crop spraying requirements etc.), any usage of the oil as a fragrance diluent is restricted to the 'natural' perfumes category, and for obvious reasons claims cannot be extended to 'organic' perfumes.

Rapeseed oil production – the negative aspects.

Although rapeseed *Brassica napus* L. is native to Europe and has been cultivated since Neolithic times, committing a large area of agricultural land to growing rapeseed is a new development, and has a downside. Some of the issues here include:

1. *The increased use of harmful crop sprays*. Rapeseed is prone to widespread attack from a variety of insect & microbiological predators. An average crop might receive the following sprayings: 3 of herbicides, 2 of fungicides & 2 of insecticides per growing season (Office of National Statistics through Blythman 2007). Insecticides commonly used include glufosinate ammonium & the hormone disruptor vinclozolin.

2. *Possible eco-damage*. Rapeseed crop production is associated with higher demands for nitrogen & sulphur-based fertiliser application, and excessive nitrate leaching into water sources is associated with rapeseed cultivation, causing localised environmental problems. In addition, decaying rapeseed vegetation (in common with other Brassica spp.) is known to put thiocyanate into the soil (Brown & Morra 1993), & soils treated with defatted rapeseed meal were determined to yield 6µg/g of thiocyanate (Brown et al 1991), although please note that a determined chemical value for thiocyanate, & and its total bioavailability, may differ. Microbiological degradation over several days will offer the principle detoxification route for thiocyanate (Brown & Morra 1993). However the Canadian Canola Board indicates that breeders of Canola varieties have reduced the glucosinolate contents in rapeseed meal (where the bitter taste of glucosinolates acts as a feeding deterrent). Already they claim Canadian Canola meal has only an average 16µg/mol total glucosinolates (and some years it has been lower than this), compared with traditional meal which contains 120-160µg/mol. Judging by the nitrile or isothiocyanate volatiles coming from flowering rapeseed fields in the UK, this sort of technology hasn't yet spared UK citizens from their annual gassing.

3. *The GM issue*. Monsanto has been amongst those companies producing transgenic rapeseed varieties, modified to be resistant to RoundUp (known in Australia as RoundUp Ready canola). You may remember Monsanto previously hit the headlines when it prosecuted a Canadian farmer, who, it was claimed had allegedly infringed their property rights (wind-blown (?) GM rapeseed plants had appeared on his land). The judge, to the outrage of GM protesters, found for Monsanto (Teitel 2001), and although the case was later reviewed, the court still

found for Monsanto (BBC 2004). The EC halted new approvals for GMO's in 1998 due to intense consumer opposition, but the US filed a complaint at the WTO in 2003, supported by Argentina & Canada. The US action has been widely seen by EU consumers as bullying, and since the FDA has been involved in international GMO promotion, Cropwatch now sees this organization not as a reliable independent health authority, but as an authority hopelessly tainted by political influence.

In 2004 the EU introduced labeling & traceability procedures for GMO's, but meanwhile the US has proved to be the leading source of global GM contamination. For example between 2001 & 2004 hundreds of tons of maize contaminated with Sygenta's unapproved transgenic variety Bt10 were distributed world-wide and entered the global food chain, without the US authorities 'noticing' for these four years…

The EC authorised Monsanto in August 2005, in a totally undemocratic move, to be allowed to grow the GM rapeseed variety GT73 in Europe for 10 years, going against the wishes of the EU member states, 13 out of 25 of whom had voted against the proposal. The EU Commissioners seem, for unknown reasons, keen to promote GM technology throughout Europe, and are out of touch with the opinions of the majority of EU citizens who maintain a strong anti-GM stance. A more recent evaluation of the safety of GM canola, including the explaining away of increase in liver weights of rats fed GT73 canola, is to be found at FD Govt. Au. (2007).

The European Commission just recently authorized the Bayer Chemical Company to be allowed grow three GM rapeseed varieties in Europe for the next 10 years, modified to resist glufosinate ammonium. And so it goes on…. The financial might & influence of big industry wins out against the wishes of the people.

4. *Allergic Reactions*

According to my non-scientifically based observations (i.e. talking to some UK GP's), rapeseed pollen causes untold seasonal respiratory misery for a proportion of the (rural?) UK population, but this fact is apparently disputed by oilseed organizations. The scientific press shows little clear direction on the issue either – just a handful of articles, both for (e.g. Focke *et al*. 1998; Hemmer *et al.* 1997) and against (e.g. Guylling 2006) an allergic association. Previously Parrat et al. (1995) had shown in a Scottish study that allergic reactions were not directly related to airborne pollen levels, although Welch et al. (2000) ruled out cross-reactivity with grass pollen. Soutar *et al*. (1994) investigating 1000 people from the Aberdeen area had suggested the prevalence of symptoms was small and could be caused by chemicals from the crop chemicals. Similarly Murphy (1999) had concluded that rapeseed allergenicity only had a minimal impact on health. An article by Butcher *et al*. (1994) looked for possible aeroallergens/irritants & identified 22 volatiles from rapeseed flowers.

More recent studies paint a more illuminating picture, however. Children with IgE-mediated allergy to foods often show reactions to rape seeds in skin prick tests (pathways unknown). Puumalaein *et al*. (2005) have shown that 2S albumins (seed storage proteins) may be responsible for the rapeseed food allergy, and investigations characterising these proteins being investigated by Palomeres *et al*. (2002). More recently, Fiorina *et al*. (2003) employed an in situ aerobiologic test to detect the presence of a rapeseed allergen, where routine tests had failed, and Hermanides *et al*. (2006) describe cases of occupational allergy to *Brassica* pollens.

It seems then that science has yet to recognize the UK people's anecdotal experiences of eye & upper respiratory irritation from rapeseed volatiles or pollen and offer some proper explanations. Or is there a conspiracy of silence? An excellent thread from 1996 on the Gentech archive (Gentech 1996) shows examples of academic unawareness (failing to find what published studies there are), UK ministerial indifference (no evidence, but this is revealed to be an empty defence which simply reflects a lack of authoritative studies) and a surprising dearth of North American & Canadian anecdotal symptom reporting, in contrast to the UK experience. The Gentech article also provides 14 references related to allergenicity of rapeseed/rapeseed products – which had proved so hard for some authorities to find (err, no change there then!).

Concluding Remarks.

The persistence of public belief that rapeseed cultivation causes widespread seasonal respiratory distress has been remarked upon by Blythman (2007), who maintains (paraphrasing his words) that in the absence of a clear case of causation, maybe we should own up to the fact that in the UK, we simply don't like the stuff. I, for one, am quite willing to own up to that fact. However it is more likely that better investigative science will conclusively reveal a causative mechanism for the allergy syndrome, forcing a reversal of the current 'in-denial' attitudes of oilseed boards, plant breeders & agricultural officials.

Postscript.

After this article was largely complete, we discovered a website devoted to the rapeseed allergy syndrome - please visit it at http://www.oilseedrape.org.uk/.

References.

Anon (2007) "Brussels biofuels push met with skepticism." – see http://www.euractiv.com/en/environment/brussels-biofuels-push-metscepticism/article-160789

Bartlet, E., Blight, M.M., Hick, A.J., and Williams, I.H. (1993). "The responses of the cabbage seed weevil (Ceutorhynchus assimilis) to the odor of oilseed rape (*Brassica napus*) and to some volatile isothiocyanates. *Entomol. Exp. Appl*. **68**, 295–302.

BBC (2004) see http://news.bbc.co.uk/1/hi/business/3736591.stm

Blight M.M Le Métayer M., Delègue M-H.P., Pickett J.A., Marion-Poll F. & Lester J. Wadhams L.J. (2004) "Identification of Floral Volatiles Involved in Recognition of Oilseed Rape Flowers, Brassica napus by Honeybees, *Apis mellifera*" *Journal of Chemical Ecology* **23**(7), 1715-172.

Blythman J. (2007) "Seeds of Discontent." The Guardian G2 19.04.07 pp4-8. See also:

http://environment.guardian.co.uk/energy/story/0,,2060538,00.html?gusrc=rss&feed=1

Brown P.D., Morra M.J., McCaffrey J.R., Auld D.L. & Williams III L. (1991) "Allelochemicals produced during glucosinolate degradation in soil." *J. Chem.Ecology* **17**(10), 2021-2034.

Brown P.D. & Morra M.J. (1993) "Fate of Ionic thiocyanate (SCN-) in Soil" *J. Agric. Food Chem*. 1003, 41, 978-982.

Butcher R.D., MacFarlane-Smith W., Robertson G.W., Griffiths D.W. (1994) "The identification of potential aeroallergen/irritant(s) from oilseed rape (Brassica napus spp. oleifera): volatile organic compounds emitted during flowering progression." *Clin Exp Allergy*. **24**(12), 1105-14.

EC (2006) http://ec.europa.eu/energy/res/legislation/biofuels_consultation_en.htm

FD Govt Au - see "GM Canola safety assessment" at http://www.foodstandards.gov.au/newsroom/factsheets/factsheets2004/gmcanolasafetyassess2498.cfm

Eckardt N.A. (2001) "Some like It with nitriles: A nitrile-specifying protein linked to herbivore feeding behavior in *Arabidopsis*" *Plant Cell* **13**, 2565-2568

Fiorina A., Scordamaglia A., Guerra L. & Passalacqua G.(2003) "Aerobiologic diagnosis of brassicaceae-induced asthma" *Allergy* **58** (8), 829–830.

Focke M., Hemmer W., Hayek B., Gotz M. & Jarisch R. (1998) "Identification of allergens in oilseed rape (Brassica napus) pollen." Int Arch Allergy Immunol. 117(2), 105-12

Gentech (1996): see archive at http://www.gene.ch/gentech/1999/May-Jun/msg00001.html

GMWatch (2004) – see http://www.gmwatch.org/archive2.asp?arcid=3166

Gylling H. (2006) "Rapeseed oil does not cause allergic reactions." *Allergy* **61**(7), 895
.
Hemmer W., Focke M., Wantke F., Jager S., Gotz M. & Jarisch R. (1997) "Oilseed rape pollen is a potentially relevant allergen." *Clin Exp Allergy* **27**(2), 156-61.

Hermanides H.K., Lahey-de Boer A.M., Zuidmeer L., Guikers C., van Ree R., & Knulst A.C. (2006) "*Brassica oleracea* pollen, a new source of occupational allergens." *Allergy* **61**(4), 498-502.

Kroeger A. (2007) "Denmark Seeks bio-fuel solutions." http://news.bbc.co.uk/2/hi/europe/6539379.stm

Krukowska E. (ed) (2004) "Polish bio-diesel output seen surging on law change." – see http://www.planetark.org/dailynewsstory.cfm/newsid/35623/newsDate/14-Mar-2006/story.htm

Larouchepac (2006) – see http://www.state.sd.us/puc/commission/dockets/electric/2005/el05-022/hearing/pubicmeetingexhbitneson2.pdf

McEwan M., Macfarlane Smith W.H. (1998) "Identification of volatile organic compounds emitted in the field by oilseed rape (*Brassica napus* ssp. *oleifera*) over the growing season." *Clinical Exptl Allergy* **28**(3), 332.

Monbiot G. (2006) – see http://www.monbiot.com/archives/2005/12/06/worsethan-fossil-fuel

Mudeva A. (2006) "Food Industry calls for bio-diesel alternatives." – see http://www.planetark.com/dailynewsstory.cfm?newsid=35885&newsdate=04-Apr-2006

Murphy D.J. (1999) "Is rapeseed really an allergenic plant? Popular myths versus scientific realities." *Immunology Today* **20** (11), 511-514.

NCF (2006) – Network of Concerned Farmers “Australia gains GM-free premiums for Canola” – see http://www.non-gmfarmerscom/news_details.asp?ID=2821

Palomares O., Monsalve R.I., Rodríguez R. & Villalba M. (2002) "Recombinant pronapin precursor produced in Pichia pastoris displays structural and immunologic equivalent properties to its mature product isolated from rapeseed." *Eur. J. Biochem*. **269**, 2538-2545.

Parratt D., Macfarlane Smith W.H., Thomson G., Cameron L.A. & Butcher R.D. (1995) "Evidence that oilseed rape (Brassica napus ssp. oleifera) causes respiratory illness in rural dwellers." *Scott Med J.* **40**(3), 74-6.

Puumalainen T.J., Poikonen S., Kotovuori A., Vaali K., Kalkkinen N., Reunala T., Turjanmaa K, Timo Palosuo T. "Napins, 2S albumins, are major allergens in oilseed rape and turnip rape." *Journal of Allergy and Clinical Immunology* **117**(2),426-432.

Smart L.E. & Blight M.M. (2004) "Field discrimination of Oilseed Rape, *Brassica napus* Volatiles by Cabbage Seed Weevil, *Ceutorhynchus assimilis* " *Journal of Chemical Ecology* **23**(11), 2555-2567.

Smolinska U., Morra M.J., Knudsen G.R. & Brown P.D. (1997) "Toxicity of glucosinolate degradation products from Brassica napus seed meal toward *Aphanomyces euteiches* f. sp. *pisi*" *Biological Control* **67**(1), 77-82.

Soutar A., Harker C., Seaton A., Brooke M. & Marr I. (1994) "Oilseed rape and seasonal symptoms: epidemiological and environmental studies." *Thorax* **49**(4), 352-6.

Teitel M. (2001). “There you go again, Monsanto.” – see http://www.genewatch.org/genewatch/articles/14-4monsanto.html

Welch J., Jones M.G., Cullinan P., Coates O.A., & Newman Taylor A.J. (2000) "Sensitization to oilseed rape is not due to cross-reactivity with grass pollen." *Clin Exp Allergy*. **30**(3), 370-5.