

Fuzzy canola

J.K. (Jim) Daun

J.K. (Jim) Daun has been involved with canola/rapeseed for decades and told all about it in a lecture at the 102nd AOCS Annual Meeting & Expo, May 1–4, 2011, in Cincinnati, Ohio, USA. There, he became the 51st recipient of the Alton E. Bailey Award, given first by the AOCS North Central Section in 1959 and now granted by the USA Section.

In the late 1930s, rapeseed was about the only oilseed aside from flax that would grow on the northern Canadian prairies. Bert Craig, former head of the National Research Council's (NRC) Prairie Regional Laboratory and a father of the Canadian rapeseed industry, said: "The only trouble with the crop was the oil was no good and the meal was no good." Canada's entry into World War II in 1939, however, gave this unpromising crop a boost as the oil from this seed was needed because its high levels of erucic acid made it ideal as a lubricant for steam engines, not only on the railways but also in Canada's rapidly growing Navy.

The limited production during the war continued afterward, with product being processed at two retrofitted soybean plants in southern Manitoba and central Saskatchewan. Increases in production were slow but steady, and by 1970, almost 1 million metric tons were being produced. The oil was used in salad oils, shortenings, and margarines, but at just about that time, researchers, based on some early nutritional studies with rats, began to question whether high levels of erucic acid in edible oils were safe. In addition, rapeseed meal, although a good source of protein for animal feed, had high levels of glucosinolates—compounds that hydrolyze on ingestion to form antinutritional compounds—which hampered the use of rapeseed meal in animal rations.

During the 1950s and 1960s, researchers at Agriculture Canada (now Agriculture and Agri-Food Canada; AAFC) and NRC laboratories in Saskatoon worked on the rapeseed problem. NRC researchers, under the direction of Bert Craig, carried out pioneering work in the area of gas chromatography and developed methods for rapidly testing rapeseeds for erucic acid. They also developed reasonably rapid methods for determining glucosinolates. AAFC researchers, under the direction of Keith Downey, studied the genetics of erucic acid inheritance and found lines of rapeseed with low levels of erucic acid. A functional variety was released in 1968. At the same time, Jan Krzymanski, a visiting scientist from Poland at the Saskatoon laboratory, found a line of rapeseed in his collection that had low levels of glucosinolates.

Therefore, when erucic acid was recognized as being nutritionally undesirable at the International Rapeseed Congress held at Ste-Adèle, Québec, in 1970, researchers were ready to move to lines of low-erucic acid rapeseed (LEAR). This exciting period in the history of canola occurred just as I was starting my M.Sc. degree in the rapeseed research laboratory at the University of Manitoba.

The conversion to LEAR took place relatively smoothly, beginning in 1972 (Fig. 1). At the same time, a race was started to see who

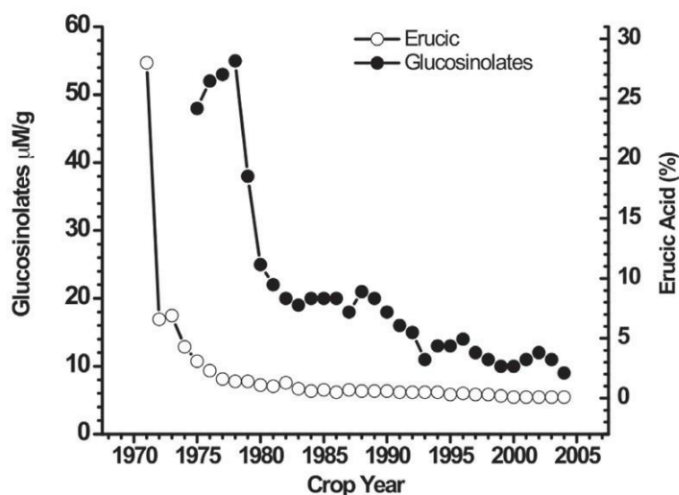


FIG. 1. Average levels of glucosinolates and erucic acid in Canadian canola and rapeseed crops, 1971–2010.

would produce the first agronomically suitable double-low rapeseed (i.e., low in both glucosinolates and erucic acid). Researchers at the University of Manitoba, under the direction of Baldur Stefansson, won the race in 1975 with the release and registration of the first double-low rapeseed, *Brassica napus* (Tower).

Since rapeseed cultivation in Canada at the time included approximately equal proportions of *B. napus* and *B. rapa*, it was not possible to complete the conversion to double-low until a double-low type of *B. rapa* was developed. In 1980, researchers from the AAFC laboratory in Saskatoon released the first double-low *B. rapa* variety (Candle), and the conversion to double-zero was completed by about 1982 (Fig. 1).

The Canadian oilseed industry then met and decided the commodity needed a new name, and came up with "canola." The name was copyright-protected because the industry did not want to repeat the problem that arose when the name Canbra was proposed for low-erucic acid rapeseed oil. Unfortunately, one of the Canadian processors changed its name to Canbra, making it difficult for other processors. Low-erucic acid oil is still sometimes referred to as canbra oil, especially in Europe.

Canola was quickly accepted as a name for the new commodity, especially in Canada, Japan, the United States, and Australia. Europe was slower to develop both LEAR and double-zero varieties as it is not possible there to produce more than one cycle of the predominant winter type per year in breeding programs, whereas two or even three cycles of spring-type crops can be grown. There is still some resistance to adopting the designation "canola" in Europe.

What is canola?

But just what is canola, other than the second-most produced oilseed in the world?

I took the title for this talk from the mathematical term “fuzzy logic,” meaning reasoning that is approximate rather than precisely deduced. While this is not strictly applicable here, it is a useful analogy. Canola is complex and just what it is may, on occasion, be open to question.

The fuzziness starts right at the species level. While most oilseeds are drawn from a single species, both rapeseed and its offspring, canola, come from many species. Canola, at present, is restricted to two species—*B. napus* and *B. rapa*—although canola-quality *B. juncea* is in commercial production and there have been significant advances in the development of canola-quality *Sinapis alba* and *B. carinata*.

Information surrounding the name canola is also fuzzy. Wikipedia, in an otherwise useful article, states that the word “canola” was derived in 1978 from “Canadian oil, low acid.” This is untrue. The word canola has no hidden meaning except possibly “Canadian Oil.” The origin of the word obviously was influenced by “Mazola,” the ACH Foods brand name for corn (maize) oil. Canola was registered as a trademark in 1978 by the Western Canadian Oilseed Crushers’ Association. Control of the term was transferred in 1980 to the Rapeseed Association of Canada, which changed its name to the Canola Council of Canada the same year.

There is even fuzziness about the nutritional properties of canola oil and meal. Rapeseed oil with very high levels of erucic acid has been used as a food in Asia for at least 4,000 years and in Europe for at least 500 years. Concern about the nutritional action of erucic acid started with findings in the early 1950s by a Canadian scientist, Ken Carroll. After further concerns about erucic acid and heart health in 1970—coupled with the greatly increased use of rapeseed oil in Canada—the Canadian industry was able to move to low-erucic acid

lines quickly. The fuzziness continued with Health Canada’s ongoing concern about the safety of the new oil. The concerns were set to rest in the late 1970s when it was established that the line of rats studied was more to blame than the oil. This research was integral in the documentation presented to the US Food and Drug Administration (FDA) in order to gain Generally Recognized As Safe status for canola oil.

Once it was accepted in the United States, canola oil went on to become a nutritional star. The low level of saturated fat, coupled with a high level of oleic acid and a favorable ratio of linoleic to α -linolenic acid, led the American Heart Association and the American Dietetic Association to recommend canola oil as a healthful oil in the 1980s. In 2006, the FDA ruled that canola oil was eligible to bear a qualified health claim regarding its ability to reduce the risk of cardiovascular disease.

Despite this, the Internet continues to provide misleading information about the safety of canola oil. Snopes.com offers an email that has been circulating since 2001. Among the “facts” cited are:

- Rapeseed oil is poisonous to living things and is an excellent insect repellent.
- When rapeseed oil was removed from animal feed, scrapie and mad cow disease (bovine spongiform encephalopathy) disappeared.

The glucosinolate challenge

When the decision to remove glucosinolates from canola was made, scientists believed there were only a few aliphatic-based glucosinolates in the seed. The most predominant of these was progoitrin, whose

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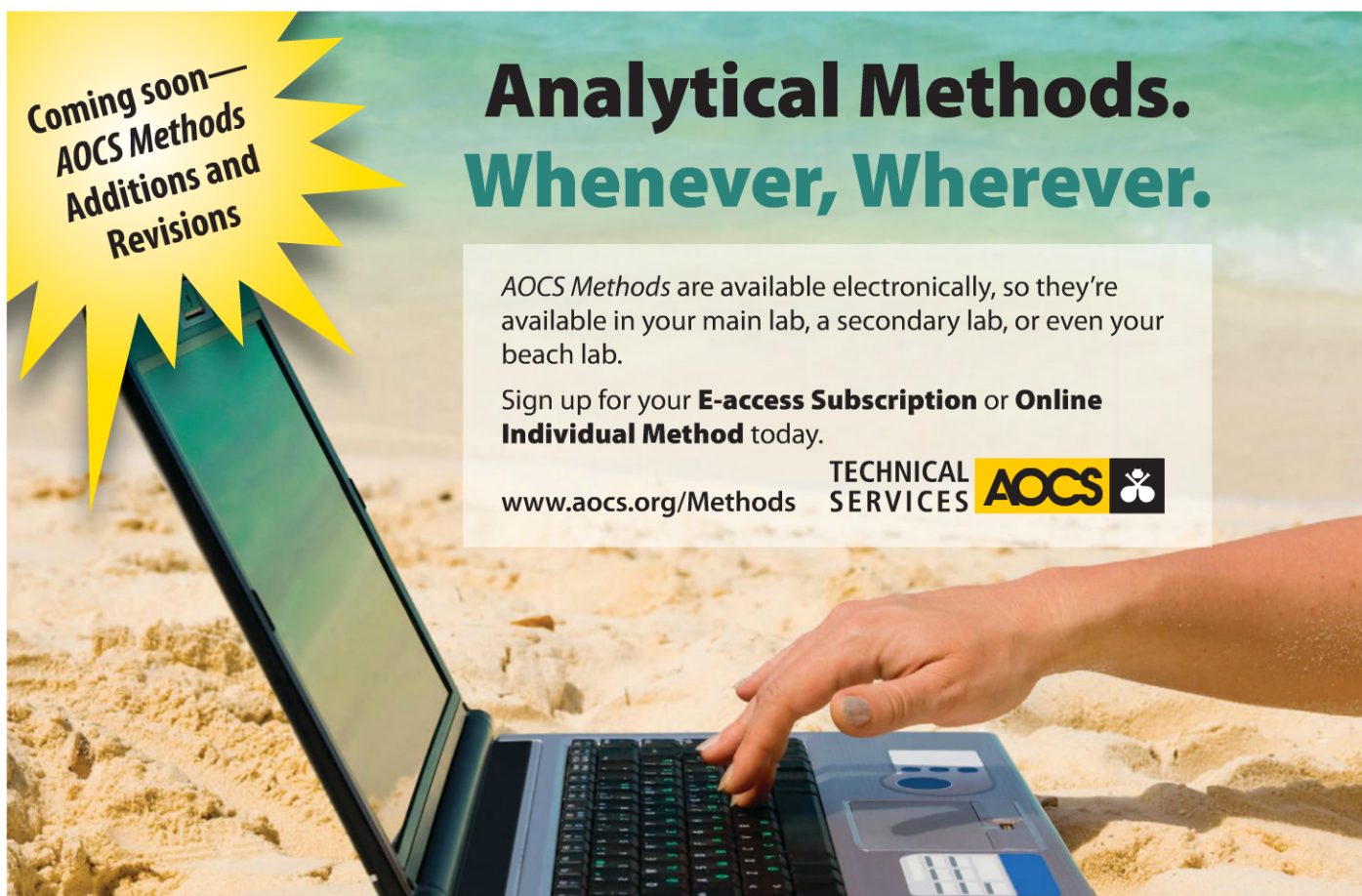
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One of the more exciting periods of my career came in late 1976, when I was contacted by the then Rapeseed Association of Canada to comment on and then confirm reports from Hilmer Sørensen in Denmark that there was a new glucosinolate found in rapeseeds, this time with an indolyl R-group. By using thin-layer chromatography techniques from my Ph.D. work, I was able to detect some indolyl-containing glucosinolate bands from extracts of double-zero rapeseed. This was also confirmed by my colleague, Ian MacGregor, working in Saskatoon. These indolyl glucosinolates were a problem since their quantitative analysis was difficult using the techniques commonly available at the time. They accounted for about 10 micromoles of glucosinolates beyond the 30 micromoles given in the legal definition in Canadian food legislation. The fuzziness of the glucosinolate situation increased when it was discovered that this particular set of glucosinolates appears to have health benefits.

Even the definition of canola suffered from fuzziness. I was asked by the Rapeseed Association early in 1978 to comment on the proposed definition of canola. This definition read in part that canola "shall be the seed of the species *Brassica napus* or *Brassica campestris*, the oil component of which seed contains less than 5% erucic acid and the solid component of which seed contains less than 3 milligrams of glucosinolate per gram of solid (GLC Method-MacGregor)."

I immediately saw the problem with the definition of glucosinolates. First of all, the 3 milligrams referred not to glucosinolates but to glucosinolate hydrolysis products, and second, the "GLC Method-MacGregor" didn't exist in a published form. It was an in-house method used by the breeding program in Saskatoon.

The proposed definition was discussed in detail at an international workshop on rapeseed analysis held in Winnipeg in 1980. As a result of these discussions, the definition was modified in 1982 to read "... the solid component of which seed contains less than 30 micromoles of any one or any mixture of 3-butenyl glucosinolates, 4-pentenyl glucosinolate, 2-hydroxy-3-butenyl glucosinolate, and 2-hydroxy-4-pentenyl glucosinolate per gram of air dry, oil free solid (GLC Method of the Canadian Grain Commission [CGC])."

The new definition had the advantage of naming the glucosinolates to be considered in the definition; it measured them as micromoles, removing any error due to molecular weight differences, and also referred to a method that the CGC had published in collaboration with MacGregor and after ring-testing in Canadian laboratories.

Even the fatty acid profile is fuzzy. Currently in Canada, four varieties with different fatty acid profiles are in production. None of these can be readily differentiated on delivery, and it is necessary that at least the HEAR crops be grown under identity-preserved or closed-loop contracts.

In conclusion, I would like to reiterate that canola and rapeseed have many forms and compositions, each of which has its strong points and uses. The multiple uses of the oil and meal are valuable, but since the seed cannot easily be visually differentiated, there is a problem with keeping the seed segregated. Nonetheless, canola has become the second-leading oilseed in the world based on these very multiple-use capabilities, and it will continue to provide consumers with exactly the type of oil they need.

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