

ISOMERIC MONOUNSATURATED FATTY ACIDS IN EDIBLE FATS AND OILS  
WITH REFERENCE TO MYOCARDIAL LESIONS IN ANIMALS

---

By Frithjof W. Hougen and Erwin W. Wasowicz  
Department of Plant Science, University of Manitoba, Winnipeg, Canada

### INTRODUCTION

Kramer et al. (1) have suggested that  $\omega$ 7 positional isomers of monounsaturated fatty acids (MUFA's) present in rapeseed oil might be implicated in causing myocardial lesions in male rats. To throw further light on this question, we have compared rapeseed oils with several other edible fats and oils with respect to their contents of  $\omega$ 7 MUFA's. Detailed gas chromatographic analyses were made, with special attention to the quantitative determination of the  $\omega$ 7 isomers of the 16:1, 18:1, 20:1, and 22:1 fatty acids. When available, plant breeders' samples of known variety were used; otherwise, commercially produced samples were used. Several cultivars of rapeseed were included in the study. Also, samples from dietary fats and oils used in the nutritional studies of Kramer et al. (1) were analysed in the same way for comparison.

### EXPERIMENTAL

Oils were extracted from crushed or ground seed with hexane at room temperature. Fatty acid methyl esters were prepared from the fats and oils with sodium in methanol at room temperature according to Hougen and Bodo (2).

Two gas chromatographic columns were used: a wall coated open tubular column, stainless steel, coated with BDS polyester, and a support coated open tubular column, glass, coated with Silar 5CP on Silanox according to McKeag and Hougen (3). Correction factors were used for the quantitative estimation of the 18:1 $\omega$ 9/18:1 $\omega$ 7 ratios.

### RESULTS AND DISCUSSION

The fatty acid compositions for the tested samples are reported here only for the  $\omega$ 9 and  $\omega$ 7 isomers of the monounsaturated fatty acids (Table 1). Of eleven rapeseed cultivars examined, only four are included in the table, as representatives of the Brassica napus and campestris varieties with both high and low erucic acid.

The content of 18:1 $\omega$ 7 (vaccenic acid) in the high erucic rapeseed oils ranged from 0.7 to 2.3%, with  $\omega$ 9/ $\omega$ 7 ratios for 18:1 (oleic/vaccenic) ranging from 16.3 to 21.6. These ratios are similar to a ratio of 14 reported by Kuenmel (4) and a ratio of 16 reported by Ackman (5).

The content of vaccenic acid in the low erucic rapeseed oils (<5% 22:1) ranged from 3.0 to 3.4%, with  $\omega$ 9/ $\omega$ 7 ratios ranging from 17.9 to 19.8. Appelqvist (6) reported ratios of 7 or 8 for low erucic rapeseed oils, which infers a content of vaccenic acid about twice as high as obtained in the present work. While in our study the absolute amount of vaccenic acid varied with the oleic acid content, similar ratios of oleic to vaccenic acid were obtained for all the rapeseed oils.

Among twelve other species of fats and oils examined, olive oil and lard were outstanding in containing as much as 2.9 and 3.1% vaccenic acid, respectively, while the other ten species contained only from 0.2% (coconut) to 1.4% (soybean).

TABLE 1  
MONOUNSATURATED FATTY ACID ISOMERS IN EDIBLE FATS AND OILS<sup>a</sup>

Sample	16:1		18:1		20:1		22:1		Total ω7
	ω9 <sup>b</sup>	ω7	ω9	ω7	ω9	ω7	ω9	ω7	
Rape, <u>B.napus</u>									
Target	0.03	0.1	18.4	1.1	11.5	1.2	40.9	0.6	3.0
Tower	0.03	0.1	60.8	3.1	1.3	0	0.01	0	3.2
Rape, <u>B.campestris</u>									
Polar	0.03	0.1	19.3	1.4	10.3	0.8	35.6	0.6	2.9
Span	0.02	0.1	53.1	3.0	3.0	0.2	3.6	0.1	3.4
Coconut	0	0.09	10.0	0.23	0.07	0	0	0	0.3
Corn	0.02	0.4	26.4	0.7	0.23	0	0	0	1.1
Cottonseed	0	0.45	14.8	0.7	0.27	0	0	0	1.2
Olive	0.09	0.7	70.6	2.9	0.29	0.2	0	0	3.8
Palm	0.09	0.1	37.1	0.71	0.04	0	0	0	0.8
Peanut	0.02	0.02	37.5	0.49	1.9	0	0.16	0	0.5
Safflower	0.01	0.1	12.9	0.6	0.18	0	0	0	0.7
Sesame	0.01	0.03	38.6	1.0	0.18	0	0	0	1.0
Soybean	0	0.06	22.5	1.4	0.12	0	0	0	1.5
Sunflower	0	0.02	15.4	0.51	0.20	0	0	0	0.5
Lard	0.26	2.21	41.5	3.1	0.79	0.02	0	0	5.3
Tallow	0.35	2.13	34.8	0.6	0.07	0	0	0	2.7

<sup>a</sup>As percent of the total fatty acids

<sup>b</sup>Number of carbon atoms from methyl end to double bond.

The  $\omega$ 7 isomers of 16:1, 20:1, and 22:1 were generally absent, or present only in very small amounts. The  $\omega$ 7 isomer of 16:1 (palmitoleic acid) predominated over the  $\omega$ 9 isomer in all the samples. The amount of palmitoleic acid, however, was very small in most samples, except in olive oil, lard, and tallow, which contained somewhat higher amounts of this isomer.

When adding together the  $\omega$ 7 isomers of 16:1, 18:1, 20:1 and 22:1 for each sample (Table 1), the total  $\omega$ 7 content was higher for olive oil and lard than for the rapeseed oils. It thus appears highly improbable that the  $\omega$ 7 isomers in rapeseed oil can be a contribution factor in the formation of myocardial lesions in male rats, since rats fed lard (7) or olive oil (1) with the higher  $\omega$ 7 content had a significantly lower incidence of heart lesions than rats fed rapeseed oils.

Several dietary fats and oil samples used in rat (1, 7) and pig (8) feeding trials were similarly analyzed. The fatty acid compositions of these commercially obtained samples were similar to those given in Table 1, except that the sample of olive oil contained somewhat less vaccenic acid, i.e., 2.1% as compared to 2.9% in Table 1. These results, nevertheless, corroborated the above conclusion that the  $\omega$ 7 isomers in rapeseed oil most probably are not a cause of myocardial lesions in male rats.

#### ACKNOWLEDGEMENT

The authors wish to thank Dr. J.K.G. Kramer, Agriculture Canada, Ottawa, for supplying dietary fats and oil samples and for criticism of the manuscript, and the Rapeseed Association of Canada for financial support.

#### REFERENCES

1. Kramer, J.K.G., H.W. Hulan, S. Mahadevan, F.D. Sauer, and A.H. Corner, 1975. *Lipids* 10: 511.
2. Hougen, F.W., and V. Bodo, 1973. *J. Amer. Oil Chem. Soc.* 50: 230.
3. McKeag, R.G., and F.W. Hougen, 1977. *J. Chromatogr.* 136: 308.
4. Kuemmel, D.F., 1964. *J. Amer. Oil Chem. Soc.* 41: 667.
5. Ackman, R.G., 1966. *J. Amer. Oil Chem. Soc.* 43: 483.
6. Appelqvist, L.-Å. in "Rapeseed", Edited by L.-Å. Appelqvist and R. Ohlson, Elsevier Pub. Co., New York, Chapter 7, 1972.
7. Hulan, H.W., J.K.G. Kramer, S. Mahadevan, F.D. Sauer, and A.H. Corner, 1976. *Lipids* 11: 9.
8. Friend, D.W., J.K.G. Kramer, and A.H. Corner, 1976. *Can. J. Anim. Sci.* 56: 361.