## Letter to the Editor

Sir,

It has been many years since Ackman and Sipos (1) proposed the concept of using a theoretical relative response factor for the conversion of raw to corrected peak areas when analyzing fatty acid methyl esters (FAME) by gas chromatography. This means that the factor is determined not by analysis of a standard sample but by calculation of the theoretical relative response from a consideration of the amount of carbon in the FAME that is bonded to one or more hydrogen atoms relative to the amount bonded in 18:0. Despite the time-lapse between the proposition of the concept and its probable logic, we believe that the practice is not yet commonly adopted. Considering work we have published in recent years on measures to optimize the accuracy of FAME analysis (2-8), which culminated in the summary paper that appeared in *JAOCS* (9), we believe that a sufficient number and range of fatty acids have been shown to comply with theory that it may reasonably be presumed that the concept is valid for all FAME that are commonly encountered in edible oils. For this reason, it was recommended (9) that the proper way to optimize accuracy is to use the theoretical relative response factor for conversion of raw to corrected peak areas and to ensure that chemical and instrumental parameters are optimized according to defined recommendations so as to eliminate errors from these sources. The purposes of this letter are (i) To collect in one table the theoretical relative response factors of a number of FAME that are commonly encountered in practice, calculated according to these principles, so they will be readily available for those wishing to investigate the concepts discussed in the summary paper (9) (Table 1). (ii) To propose that the terms "theoretical relative response factor" (TRF) and "empirical correction factor" (ECF) be introduced and used to differentiate between the two methods available for converting raw to corrected peak areas. The term "TRF" should be employed when the factor used is calculated according to the theoretical concept of Ackman and Sipos (1) and the techniques and equipment are optimized according to the concepts developed by Craske and Bannon (9). The term "ECF" should be employed when the technique of standardization is the traditional method, whereby a standard sample is analyzed and correction factors are determined from the results obtained. In the latter case, the factor will comprise both the theoretical relative response factor and a factor whose magnitude will depend on the extent to which the equipment has not been optimized, perhaps because the nature of the analysis is such that it is not practical to optimize according to theoretical principles. These concepts have been discussed in detail (9). It may be noted that, to date, we have not investigated the applicability of TRF to FAME that contain any polar substituents in the fatty acid chain. Therefore, we suggest that the concept not be used for FAME of this type unless they are shown also to conform to theory.

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### REFERENCES

1. Ackman, R.G., and J.C. Sipos, *J. Am. Oil Chem Soc. 41*:377 (1964).
2. Albertyn, D.E., C.D. Bannon, J.D. Craske, Ngo Trong Hai, K.L. O'Rourke and C. Szonyi, *J. Chromatogr. 247*:47 (1982).

TABLE 1

**Theoretical Relative Responses for Fatty Acid Methyl Esters**

| FAME | TRF | FAME | TRF | FAME | TRF | FAME | TRF |
|---|---|---|---|---|---|---|---|
| 4:0 | 1.5396 | 14:1 | 1.0354 | 18:2 | 0.9865 | 22:1 | 0.9664 |
| 5:0 | 1.4009 | 15:0 | 1.0308 | 18:3 | 0.9797 | 22:2 | 0.9609 |
| 6:0 | 1.3084 | 15:1 | 1.0227 | 18:4 | 0.9730 | 22:3 | 0.9554 |
| 7:0 | 1.2423 | 16:0 | 1.0193 | 19:0 | 0.9919 | 22:4 | 0.9499 |
| 8:0 | 1.1927 | 16:1 | 1.0117 | 20:0 | 0.9846 | 22:5 | 0.9443 |
| 9:0 | 1.1542 | 16:2 | 1.0041 | 20:1 | 0.9785 | 22:6 | 0.9388 |
| 10:0 | 1.1233 | 16:3 | 0.9965 | 20:2 | 0.9724 | 23:0 | 0.9665 |
| 11:0 | 1.0981 | 16:4 | 0.9889 | 20:3 | 0.9663 | 24:0 | 0.9614 |
| 12:0 | 1.0771 | 17:0 | 1.0091 | 20:4 | 0.9603 | 24:1 | 0.9564 |
| 12:1 | 1.0670 | 17:1 | 1.0019 | 20:5 | 0.9452 | | |
| 13:0 | 1.0593 | 18:0 | 1.0000 | 21:0 | 0.9780 | | |
| 14:0 | 1.0440 | 18:1 | 0.9932 | 22:0 | 0.9720 | | |

Atomic Weights: carbon, 12.011; hydrogen, 1.0079; oxygen, 15.9994. (*Handbook of Chemistry & Physics*, 64th edn., 1983-1984, The Chemical Rubber Publishing Co., Cleveland, OH) Factors are relative to 18:0, which has a factor of 1.0000 by definition. Factors for the following FAME have been verified experimentally: 4:0, 6:0, 8:0, 10:0, 12:0, 14:0, 16:0, 17:0, 20:0, C9-18:1, C9,C12-18:2, C9,C12,C15-18:3, C5,C8,C11,C14-20:4, C4,C7,C10,C13,C16,C19-22:6. Only one factor is given for all positional and geometric isomers and for branched chain FAME, as the factors are dependent only on the content of carbon to which hydrogen is bonded.

3. Bannon, C.D., J.D. Craske, Ngo Trong Hai, N.L. Harper and K.L. O'Rourke, *Ibid. 247*:63.
4. Bannon, C.D., G.J. Breen, J.D. Craske, Ngo Trong Hai, N.L. Harper and K.L. O'Rourke, *Ibid. 247*:71 (1982).
5. Bannon, C.D., J.D. Craske and A.E. Hilliker, *J. Am. Oil Chem. Soc. 62*:1501 (1985).
6. Bannon, C.D., J.D. Craske and A.E. Hilliker, *Ibid. 63*:105 (1986).
7. Bannon, C.D., J.D. Craske, D.L. Felder, I.J. Garland and L.M. Norman, *J. Chromatogr. 407*:231 (1987).
8. Craske, J.D., C.D. Bannon and L.M. Norman, *J. Am. Oil Chem. Soc. 65*:262 (1988).
9. Craske, J.D., and C.D. Bannon, *Ibid. 64*:1413 (1987).

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## ERRATUM

The wrong figure appeared with the caption for Figure 1 of "β-Carotene Adsorption on Acid-Activated Montmorillonite," which appeared on page 776 of the May issue of *JAOCS*. The figure, with the correct caption, is reproduced below. The paper was written by N. Sarier and Ç. Güler, Ege University, Faculty of Science, Chemistry Department, Izmir, Turkey.

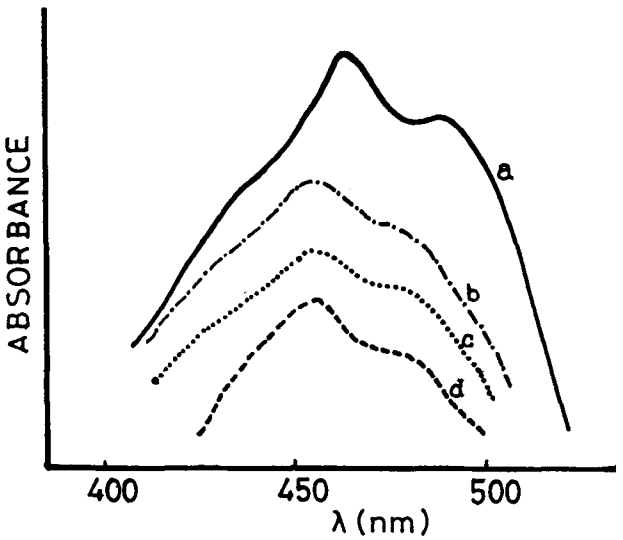


**FIG. 1. Absorption spectrum of (a) β-carotene in benzene before adsorption, supernatant solution of β-carotene after adsorption at (b) 30 C, (c) 35 C, (d) 40 C.**