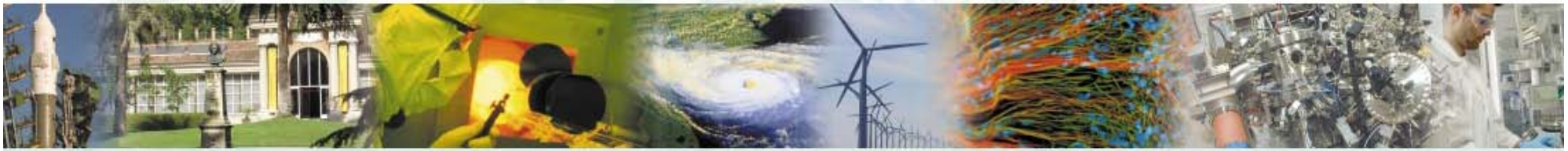

New Method To Determine Fatty Acid Alkyl Esters In Olive Oils And The Use As A New Quality Parameter

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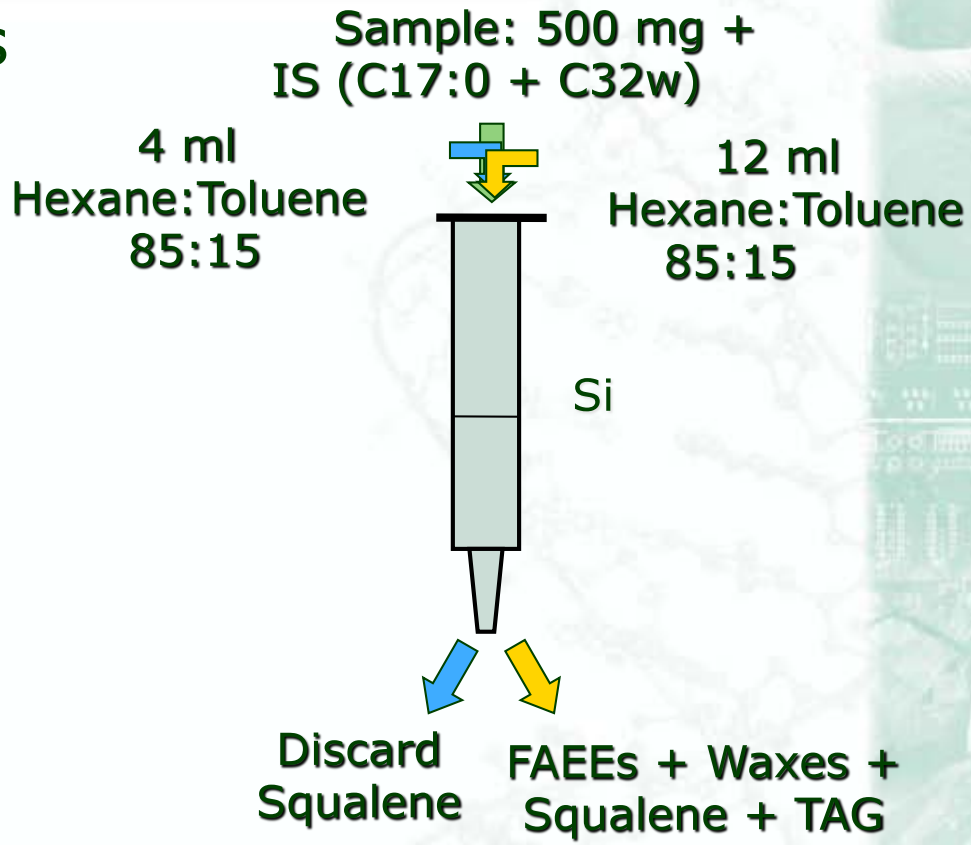
Introduction

- FAAEs are natural compounds present in OO formed by esterification of free fatty acids with short chain alcohols (FAEEs + FAMEs).
- In EVOO concentration of FAAEs are low.
- The ratio FAEEs/FAMEs in EVOO are also low.
- Low quality VOO have higher concentration of FAAEs and concentration of FAEEs > FAMEs.
- FAEEs can be used as a quality parameter.

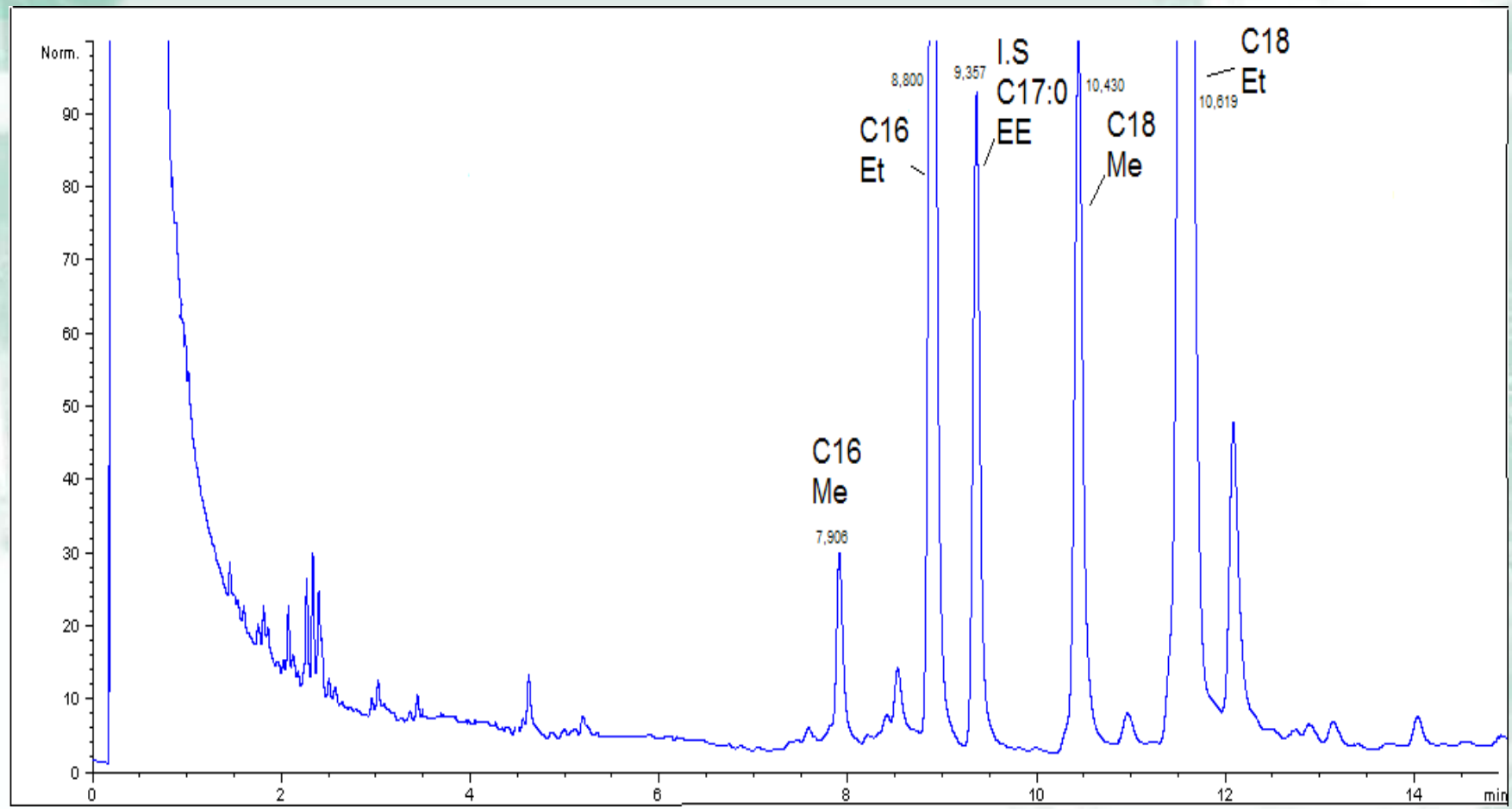
Pérez-Camino et al. J. Agric. Food Chem., 2008, 56, 6740-6744

Analytical Method

- Isolation of the FAAEs fraction with Si-SPE.



Chromatographic Analysis



Fatty Acid
Alkyl Esters

Diterpenic
Esters

Sterol esters +
Triterpenic Alcohols

FAAEs in Genuine EVOO

- In 50 samples analysed of genuine EVOO of different varieties and origins.
- The average concentration of FAAEs is 35,9 mg/kg.
- The higher concentration of FAAEs was 103 mg/kg.
- All oils were also analysed by the IG organoleptic panel: classification EVOO.

FAAEs in Genuine EVOO

Oils	FAMEs	FAEEs	Σ FAAEs	Ratio	Panel
Arbequina 2	20	16	36	0,8	EV
Arbequina 3	19	14	33	0,7	EV
Arbequina 4	9	5	14	0,5	EV
Arbequina 5	27	3	30	0,1	EV
Arbequina 6	11	25	36	2,3	EV
Picual 2	42	31	73	0,7	EV
Picual 3	22	5	27	0,2	EV
Picual 4	15	25	40	1,4	EV
Picual 5	18	19	37	1,0	EV
Picual 6	4	3	7	1,0	EV
Carolea	13	6	19	0,5	EV
Hojiblanca 2	15	9	24	0,6	EV
Hojiblanca 3	7	42	49	5,8	EV
Hojiblanca 4	10	18	28	1,7	EV
Blanqueta	29	25	54	0,9	EV
Chamlali	16	17	33	1,1	EV
Koroneiki	11	18	19	0,7	EV
Picholine Marrocaine	40	32	72	0,8	EV
Cornicabra 2	42	21	63	0,5	EV
Turkish Oil	45	9	54	0,2	EV
Blended Oil	3	2	5	0,7	EV
Spanish Oil	15	24	39	1,7	EV
Italian Oil	50	53	**103**	1,1	EV
Californian Oil	2	1	**3**	0,7	EV

FAAEs in Genuine EVOO

Oils	FAMEs	FAEEs	Σ FAAEs	Ratio	Panel
Blended Oil 4	18	29	47	1,6	EV
Blended Oil 5	11	28	39	2,6	EV
Blended Oil 6	14	39	53	2,7	EV
Blended Oil 7	29	42	71	1,5	EV
Blended Oil 8	17	34	51	2,0	EV
Blended Oil 9	24	38	62	1,6	EV
Blended Oil 10	24	49	73	2,0	EV
Blended Oil 11	3	2	**5**	0,7	EV
Blended Oil 12	12	20	32	1,7	EV
Blended Oil 13	13	24	37	1,8	EV
Blended Oil 14	12	18	30	1,5	EV
Blended Oil 15	3	3	6	1,2	EV
Blended Oil 16	6	34	40	5,3	EV
Blended Oil 17	4	13	17	3,5	EV
Blended Oil 18	41	49	**90**	1,2	EV
Blended Oil 19	10	15	25	1,6	EV
Blended Oil 20	3	4	7	1,7	EV
Blended Oil 21	3	14	17	4,7	EV
Blended Oil 22	2	4	6	1,6	EV
Blended Oil 23	2	4	6	2,1	EV
Blended Oil 24	5	8	13	1,7	EV
Blended Oil 25	11	18	29	1,6	EV
Blended Oil 26	34	40	74	1,2	EV
Blended Oil 27	7	15	22	2,0	EV
Blended Oil 28	3	8	11	2,1	EV

Limit for FAAEs in EVOO

- 96% of the EVOO have less than 75 mg/kg.
- Oils with more than 75 mg/kg have FAEEs/FAMEs ratio < 1,5.
- Limits for EVOO:

Σ FAAEs $\leq$ 75 mg/kg ➔ EVOO

75 < Σ FAAEs $\leq$ 150 mg/kg , Ratio FAEEs/FAMEs $\leq$ 1,5 ➔ EVOO

75 < Σ FAAEs $\leq$ 150 mg/kg , Ratio FAEEs/FAMEs > 1,5 ➔ No EVOO

Σ FAAEs > 150 mg/kg ➔ No EVOO

FAAEs in Low Quality VOO

- Low quality VOO with sensory defects have high amounts of FAAEs.
- Oils with musty, muddy, fusty, winey and other defects have been analyzed.

Oils	FAMEs	FAEEs	Σ FAAEs	Ratio	Panel
Fusty	777	1853	2630	2,4	L
Winey	62	430	492	7,0	L
Muddy	161	1178	1339	7,3	L
Musty	358	723	1081	2,0	L
Rancid	50	88	138	1,8	L
Frozen Olives	7	11	18	1,7	EV

FAAEs in Low Quality VOO

- Oils with enzymatic or fermentative defects: fusty, muddy, musty or winey have high content FAAEs in particular FAEEs.
- The increase in the content in FAEEs imply higher ratios.
- Other defects: Rancid and frozen olives do not produce significative amounts of FAAEs.

Blind Samples

Oils	FAMEs	FAEEs	Σ FAAEs	Ratio	Classification Criteria	
					Σ FAAEs	Panel
Verdial 1	37	91	128	2,5	No EV	V
Hojiblanca 5	51	93	144	1,8	No EV	V
Manzanilla 4	39	100	139	2,6	No EV	V
Arbequina 7	33	63	96	1,9	No EV	V
Arbequina 8	24	38	62	1,6	EV	EV
Cornicabra 3	74	89	163	1,2	No EV	V
Blind 29	97	135	232	1,4	No EV	V
Blind 30	57	79	136	1,4	**EV**	**V**
Blind 31	47	141	188	3,0	No EV	V
Blind 32	97	135	232	1,4	No EV	V
Blind 33	32	91	123	2,9	No EV	V
Blind 34	71	309	380	4,6	No EV	L
Blind 35	4	6	10	1,3	EV	EV
Blind 36	27	44	71	1,7	**EV**	**V**
Blind 37	27	49	76	1,9	No EV	V
Blind 38	168	822	990	4,9	No EV	V
Blind 39	26	46	72	1,8	**EV**	**L**
Blind 40	21	42	63	2,0	**EV**	**V**
Blind 41	45	49	94	1,1	EV	EV
Blind 42	46	79	125	1,7	No EV	L

Blind Samples

Oils	FAMEs	FAEEs	Σ FAAEs	Ratio	Classification Criteria	
					Σ FAAEs	Panel
Blind 43	22	47	69	2,1	EV	EV
Blind 44	92	463	555	5,0	No EV	V
Blind 45	27	74	101	2,7	No EV	V
Blind 46	18	43	61	2,5	**EV**	**L**
Blind 47	33	111	144	3,4	No EV	V
IOC Col. Mars 08	9	18	27	2,0	EV	EV
IOC Col. Mars 08	166	252	418	1,5	No EV	L
IOC Col. Mars 08	5	18	23	3,4	**EV**	**V**
IOC Col. Mars 08	4	16	20	4,3	**EV**	**V**
Blind 52	13	24	37	1,8	EV	EV
Blind 53	33	171	204	5,2	No EV	L

FAAEs as Quality Parameter

- Oils with high contents of FAAEs are classified non EVOO either by the criteria and the Panel test.
- There are oils classified EVOO by FAAEs and non EVOO by Panel test.
- The opposite never occurs.
- FAAEs as quality parameter is necessary condition but not enough for detecting non EVOO.
- In the same analysis waxes can be determined.