Comments of the International Olive Council (IOC)

on Doc CX/FO15/24/13

produced by Australia for the 24th session of the

Codex Committee on Fats and Oils (CCFO)

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INTRODUCTION

The Codex Alimentarius standard and the International Olive Council (IOC) standard both define quality and purity criteria for olive oils and olive pomace oils and stipulate methods for the assessment of those criteria. The aim of doing so is to safeguard the quality of olive oil, to prevent adulteration with other vegetable oils and to ensure compliance with the definitions of the different categories.

It is compulsory for IOC Members to apply the IOC standard and methods in their international trade, which accounts for 96% of world exports and 15% of world imports (excluding intra-European Union trade in both cases). Non-IOC member countries are also invited to adopt IOC standards and do so in some cases by incorporating them into their standards.

The **purity** criteria fixed in these international standards are used to detect adulteration on the basis of the differences in the composition of olive oils and the admixed oil. The effectiveness of each criterion depends on the kind and percentage of oil added to the olive oil.

The **quality** criteria set in the standards are designed to detect the adulteration of virgin olive oils with other lower-quality virgin olive oil, refined olive oils or olive pomace oils. In addition to physico–chemical testing, such detection is based on sensory analysis by a trained panel of experts to check for the presence of fruitiness (positive attribute) and specific negative attributes.

In the interests of fair, transparent and sustainable international trade, the IOC Members recommend full harmonisation of the Codex standard and methods with all the quality and purity criteria in the IOC standard and methods.

Owing to the fact that the IOC meets more frequently than CODEX, there are growing discrepancies between the standards of the two Organisations. The IOC Members therefore suggest working not only on two criteria, namely campesterol and delta-7-stigmastenol, but on all the criteria and methods. The IOC Executive Secretariat has circulated a relevant activity report which will be presented under agenda item 2 of the 24th session of the Codex Committee for Fats and Oils (CCFO).

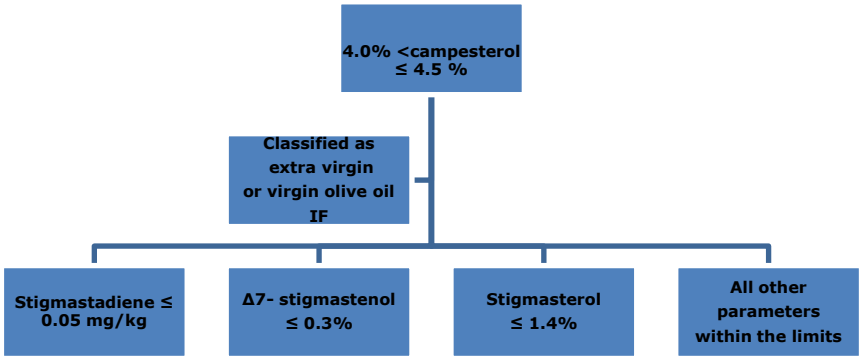
In addition, the IOC Members wish to voice some specific concerns prompted by document CX/FO15/24/13 produced by Australia.

GENERAL CONCERN RAISED BY THE AUSTRALIA CAMPESTEROL PROPOSAL

Campesterol is a useful purity criterion for the protection of olive oil authenticity. Its current limit (4% in both the Codex and IOC standards) was adopted after thorough studies based on real-life statistics supplied by all the olive oil producing countries.
In recent years, deviations from official limits have been observed in olive oils produced in certain countries, particularly non-traditional producing nations outside the Mediterranean region.

In response, the IOC conducted a three-year study on the composition of off-limit oils in order to try to find a solution allowing authentic oils to be classified in their real category. Deviations from the campesterol limit were examined in the study, which led the IOC chemistry experts[1] to propose the adoption of the following decision tree and its inclusion in the IOC standard in 2013:

In cases where extra virgin and virgin olive oils have a campesterol content between 4.0% and 4.5%, other parameters exist which ensure their authenticity. Hence, the decision tree for 4.0% < campesterol ≤ 4.5% could include stigmasterol ≤1.4%, stigmastadiene ≤0.05mg/kg and Δ7-stigmastenol ≤ 0.3 %, provided all the other purity criteria lie within the established limits.



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NB: The IOC limit for stigmastadiene has recently been changed from 0.10% to 0.05%

In 2013, Australia, assisted by some other countries (United States, New Zealand, Canada, etc), prepared a document proposing the revision of the campesterol limit in the CODEX STANDARD FOR OLIVE OILS AND OLIVE POMACE OILS as a solution to the deviations from the official campesterol limit.

The above-mentioned document proposed:

- Raising the limit for campesterol to ≤ 4.8%
- Raising the limit for stigmasterol to ≤ 1.9%

The same proposal has been submitted as Document CX/FO15/24/13 for discussion at the 24th session of the CODEX COMMITTEE ON FATS AND OILS in Malaysia, 9–13 February 2015.

The main concern of the IOC Members is that the proposed modification will weaken the possibility of fraud detection because the detection level of various seed oils will be higher than at present, as will be demonstrated farther on in these comments (see Tables). The IOC Members are likewise concerned that Document CX/FO15/24/13 gives no information on the extent of this problem in terms of volume. At the least, it should provide information for various years (because of the climate influence), itemised by country and olive variety, on the volume of virgin olive oils with a campesterol content of more than 4% (for example 4–4.5%, 4.5–4.8% and above 4.8%) and the total volume of virgin olive oil exported to world markets.

DETAILED CONCERNS RAISED BY THE AUSTRALIA CAMPESTEROL PROPOSAL

With the exception of olive oil, the most common vegetable oils have a high content of campesterol (corn, cotton, mustard, palm, palm kernel, peanut, rapeseed, safflower, sesame, soyabean, sunflower) and stigmasterol (except rapeseed and mustard).

Since protecting olive oil authenticity is the chief goal of any national legislator wishing to ensure fair trade in this product, it is crucial to compare the effectiveness of campesterol with that of stigmasterol in the detection of the fraudulent addition of high-campesterol oils to olive oil.

The percentage of seed oil detectable in olive oil on applying different limits (from 4.0% to 5.0% for campesterol and from 1.4% to 1.9% for stigmasterol) was calculated to ascertain how the fraud detection effectiveness of campesterol and stigmasterol would be affected if their limits were to be increased. The results of this exercise are reported in Tables 1 and 2. The various

adulteration detection levels were calculated on the basis of the limits fixed in the Codex standards for olive oils and olive pomace oils and for named vegetable oils.

Table 1. Approximate percentage of seed oil detectable in olive oil at different campesterol limits

	Campesterol limit applied							Value used for fraud detection	
Type of oil	4.0	4.5	4.6	4.7	4.8	4.9	5.0	CAMPESTEROL %	TOTAL STEROLS mg/kg
MUSTARD	0.8	1.2	1.3	1.4	1.4	1.5	1.6	28.0	8000
RAPESEED	1.3	1,7	1.9	2.0	2.1	2.2	2.3	30.0	5000
CORN	1.5	2.4	2.5	2.7	2.9	3.0	3.2	18.0	7000
SOYABEAN	4.0	6.2	6.6	7.0	7.5	7.9	8.3	16.0	3000
COTTON	5.0	7.6	8.2	8.8	9.4	10.1	10.7	10.0	5000
SESAME	5.0	7.6	8.2	8.8	9.4	10.1	10.7	10.0	5000
PEANUT	10.0	15.0	16.0	17.0	18.0	19.0	20.0	13.0	1500
SAFFLOWER	10.0	14.6	15.5	16.5	17.5	18.8	20.0	9.0	3000
PALM	14.0	20.0	21.0	22.0	23.0	24.0	25.0	20.0	600
SUNFLOWER	15.0	23.0	25.0	27.0	29.0	31.0	33.0	7.0	3000
PALM KERNEL	24.0	33.0	35.0	37.0	39.0	41.0	43.0	9.0	1000
OLIVE OIL								3.0	1500

The following conclusions are drawn from the data reported in Table 1:

- The campesterol limit of 4.0% is very sensitive in the detection of mustard, rapeseed and corn oils.
- Raising the campesterol limit from 4.0 to 5.0% almost **doubles** the percentage detection level of seed oils, thus reducing the efficiency of campesterol **by half**.

Table 2. Approximate percentage of seed oil detectable in olive oil at different stigmasterol limits

	Stigmasterol limit applied						Value used for fraud detection	
Type of oil	1.4	1.5	1.6	1.7	1.8	1.9	STIGMA STEROL %	TOTAL STEROLS mg/kg
SOYABEAN	1.1	1.5	1.8	2.2	2.6	3.0	15.0	3000
CORN	1.5	1.8	2.4	2.9	3.5	4.0	6.0	7000
SESAME	2.0	2.6	3.3	4.0	4.8	5.5	6.0	5000
SUNFLOWER	2.5	3.5	4.4	5.4	6.3	7.3	7.0	3000
COTTON	3.5	4.6	5.9	7.2	8.7	10.2	4.0	5000
PALM	3.5	4.6	5.7	6.8	7.9	9.0	14.0	1000
SAFFLOWER	4.0	5.4	6.8	8.4	9.9	11.5	5.0	3000
PEANUT	5.0	6.7	8.4	10.2	11.8	13.5	7.0	1500
PALM	6.6	8.6	10.7	12.7	14.6	16.5	12.0	600
MUSTARD	NO	NO	NO	NO	NO	NO	0.2	8000
RAPESEED	NO	NO	NO	NO	NO	NO	0.5	5000
OLIVE OIL							1,1	1500

The conclusions reached on the basis of the data given in Table 2 are as follows:

- The stigmasterol limit of 1.4% is very sensitive in the detection of soyabean, corn and sesame oils.
- Raising the stigmasterol limit from 1.4 to 1.9% almost **trebles** the percentage detection level of the seed oils, thus reducing the efficiency of campesterol by **one third.**

The data reported in the above two tables are summarised in Table 3.

Table 3. Comparison of the percentage of seed oil detectable in olive oil on applying different campesterol and stigmasterol limits

	Limit applied for					Value used for fraud detection		
	CAMPESTEROL			STIGMA-STEROL		CAMPE-STEROL %	STIGMA-STEROL %	TOTAL STEROLS mg/kg
Type of oil	4.0	4.5	4.8	1.4	1.9			
MUSTARD	0.8	1.2	1.4	NO	NO	28.0	0.2	8000
RAPESEED	1.3	1.7	2.1	NO	NO	30.0	0.5	5000
CORN	1.5	2.4	2.9	1.5	4.0	18.0	6.0	7000
SOYABEAN	4.0	6.2	7.5	1.1	3.0	16.0	15.0	3000
COTTON	5.0	7.6	9.4	3.5	10.2	10.0	4.0	5000
SESAME	5.0	7.6	9.4	2.0	5.5	10.0	6.0	5000
PEANUT	10.0	15.0	18.0	5.0	13.5	13.0	7.0	1500
SAFFLOWER	10.0	14.6	17.5	4.0	11.5	9.0	5.0	3000
PALM	14.0	20.0	23.0	6.6	16.5	20.0	12.0	600
SUNFLOWER	15.0	23.0	29.0	2.5	7.3	7.0	7.0	3000
PALM KERNEL	24.0	33.0	39.0	3.5	9.0	9.0	14.0	1000
OLIVE OIL						3.0	1.1	1500

Table 4 has been compiled from the data provided in Table 3 to show the effectiveness of stigmasterol in fraud detection on applying limits of 1.4% and 1.9%.

Table 4. Evaluation of the effectiveness of the stigmasterol parameter in fraud detection

	Equally or more effective than campesterol (limit ≤4.0%) in the detection of vegetable oils		% of seed oil detectable in olive oil is lower than that determined by the campesterol parameter (limit 4.8%)		% of seed oil detectable in olive oil is below 5.0%	
Type of oil	Stigmasterol ≤1.4%	Stigmasterol ≤1.9%	Stigmasterol ≤1.4%	Stigmasterol ≤1.9%	Stigmasterol ≤1.4%	Stigmasterol ≤1.9%
MUSTARD	NO	NO	NO	NO	NO	NO
RAPESEED	NO	NO	NO	NO	NO	NO
CORN	YES	NO	YES	NO	YES	YES
SOYABEAN	YES	YES	YES	YES	YES	YES
COTTON	YES	NO	YES	NO	YES	NO
SESAME	YES	NO	YES	YES	YES	NO
PEANUT	YES	NO	YES	YES	YES	NO
SAFFLOWER	YES	NO	YES	YES	YES	NO
PALM	YES	NO	YES	YES	NO	NO
SUNFLOWER	YES	YES	YES	YES	YES	NO
PALM KERNEL	YES	YES	YES	YES	YES	NO

In the light of the above findings, the conclusion reached is that stigmasterol is a much more effective parameter for the detection of olive oil fraud at a limit of 1.4% than at 1.9% because:

- At a limit of 1.4%, the stigmasterol parameter could be used instead of campesterol (limit 4.0%) for the detection of all other vegetable oils (corn, cotton, palm, palm kernel, peanut, safflower, sesame, soyabean and sunflower) except rapeseed and mustardseed.
- At a limit of 1.9%, the stigmasterol parameter could be used instead of campesterol (limit 4.0%) solely for the detection of soyabean, sunflower and palm kernel oil. Hence, **the application of a stigmasterol limit of 1.9% increases the margin for olive oil adulteration with corn, cotton, palm, peanut, safflower and sesame oil.**
- At a limit of 1.4%, the stigmasterol parameter is useless for the detection of olive oil adulteration with rapeseed and mustardseed oil when the campesterol limit is 4.8%.
- At a limit of 1.9%, the stigmasterol parameter is useless for the detection of olive oil adulteration with corn, cotton, rapeseed and mustardseed oils when the campesterol limit is 4.8%.
- Detection levels when applying the stigmasterol parameter at a limit of 1.4% are satisfactory (below 5.0%) for the detection of all other vegetable oils (corn, cotton, palm kernel, peanut, safflower, sesame, soyabean and sunflower) except palm, rapeseed and mustardseed.

- ❖ Detection levels when applying the stigmasterol parameter at a limit of 1.9% are satisfactory (below 5.0%) solely for corn and soyabean oil.

The only weakness of the 1.4% stigmasterol limit is that it is not effective in the detection of rapeseed and mustardseed oil. Table 5 below therefore presents the parameters and percentage of detectable seed oil in olive oil on applying other parameters in addition to campesterol (limit 4.0%) and stigmasterol (limit 1.4%).

Table 5. Most effective parameters for the detection of high-campesterol seed oils in olive oil

Type of oil	Percentage of seed oil detectable oil in olive oil on applying		Other very effective parameters in fraud detection (d.l. = detection level)
	Campesterol (limit 4.0%)	Stigmasterol (limit 1.4%)	
Corn	≈1.5%	≈1.5%	Ap. β-sito (d.l. 1.5%) ΔECN42 (d.l. 1.0%)
Cotton	≈5.0%	≈3.5%	ΔECN42 (d.l. 1.0%)
Palm	≈14.0%	≈6.6%	Myristic (d.l. 1.0%)
Palm kernel	≈24.0%	≈3.5%	Myristic (d.l. 0.1%)
Peanut	≈10.0%	≈5.0%	Behenic (d.l. 3.0%)
Safflower	≈10.0%	≈4.0%	Ap. β-sito (d.l. 1.0%) ΔECN42 (d.l. 1.0%)
Sesame	≈5.0%	≈2.0%	Ap. β-sito (d.l. 1.0%) ΔECN42 (d.l. 1.5%)
Soyabean	≈4.0%	≈1.1%	Ap. β-sito (d.l. 2.0%) ΔECN42 (d.l. 1.0%)
Sunflower	≈15.0%	≈2.5%	Δ7-stigmastenol (d.l. 0.5%) Ap. β-sito (d.l. 2.0%) ΔECN42 (d.l. 1.0%)
Rapeseed	≈1.3%	Not suitable	Ap. β-sito (d.l. 1.0%) Brassicasterol (d.l. 0.1%)
Mustardseed	≈0.8%	Not suitable	Ap. β-sito (d.l. 1.0%) Campesterol ≤5.0 (d.l. 1.5%)

In view of the above, it is concluded that:

- √ some other parameters are equally or more effective than campesterol (limit 4.0%) for the detection of rapeseed and mustardseed oil.

CONCLUSIONS

The adoption of a limit of 1.9% for stigmasterol and 4.8% for campesterol would have the following consequences:

- **It would increase the margin for olive oil adulteration compared with the current situation where the specified campesterol limit is 4.0%**
- **Stigmasterol would be useless for the detection of olive oil adulteration with corn, cotton, rapeseed and mustardseed oil**
- **The detection of most seed oils would be unsatisfactory because the detection levels are only below 5.0% in the cases of corn and soyabean oil**

These consequences do not take into consideration the potential new problems associated with a stigmasterol limit of 1.9%, which might lead to further cases of off-limit oils produced from certain varieties in certain countries.

The IOC member countries recommend studying and discussing the Argentinian technical proposal within the IOC in view of the fact that this international institution has already investigated this issue and has reached a series of conclusions based on the testing results for samples supplied by the producing countries which led to the adoption of decision trees included in the IOC standard since 2013 upon a proposal of the official group of IOC chemistry experts (see list given in footnote 1, page 3).

In addition, the IOC member countries propose that Codex initiate new work to fully harmonize its standard with the IOC standard (in particular decision trees for campesterol, delta-7-stigmastenol, revised limits for stigmastadiene, myristic acid, waxes, median of the defect, new limits for ethyl esters and 2-glyceryl monopalmitate including the methods for measuring those criteria as referred in Codex document CX/FO INFO on activities of international organizations relevant to the work of CCFO).

With this in mind, they cordially invite the countries concerned to attend or continue to attend as observers at the meetings of the IOC chemistry experts (Brazil, Canada and the United States already do so and Australia has done so in the past) and to participate in an electronic working group in order to examine this matter and to present a solid proposal to the CCFO in 2017.

Sources:

. Codex standard for olive oils and olive pomace oils

. Codex standards for named vegetable oils

. IOC standard for olive oils and olive pomace oils (COI/T.15/NC No 3/Rev.8, February 2015)
http://www.internationaloliveoil.org/estaticos/view/222-standards

. “Comparison of the effectiveness of the campesterol to the stigmasterol in the detection of fraud of olive oil with oils exhibited high campesterol content”, written by IOC chemistry expert E. Christopoulou, January 2015.
. IOC study on authentic olive oils displaying off-limit parameters: campesterol, delta-7-stigmastenol: http://www.internationaloliveoil.org/documents/index/353-chemistry/1606-ioc-studies/