

Supporting information for

Hue parameter fluorescence identification of edible oils with a smartphone

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1 Materials and methods

1.1 Oil samples

The edible oils were all purchased from local stores around Gothenburg. Details about the oil samples can be found in table S1

Table S1. Edible oil sample information and sampling order.

Sample#	Abbreviation	Brand / Type	Price SEK*/L	Origin
1	EVOO 1	COOP Classico / Extra virgin Olive oil	80	Spain
2	EVOO 2	Eldorado / Extra virgin Olive oil	49	Spain
3	Olive mix	ICA / Olive oil mix, 70% Refined, 30% Extra virgin	65	Spain
4	Rapeseed EV 1	ICA / Rapeseed oil, cold pressed	56	Sweden
5	Rapeseed	ICA / Rapeseed oil, refined	19	Belgium
6	Sunflower 1	Eldorado / Sunflower oil, refined	17	Ukraine
7	Fishoil 1.1	Eskimo 3 Pure / Fishoil, cold pressed	900	EU
8	Fishoil 1.2	Eskimo 3 Pure / Fishoil, cold pressed	900	EU
9	EVOO 3.1	Primadonna Bio organic / Extra virgin Olive oil	90	EU
10	Sunflower 2	Zeta / Sunflower oil, refined	30	Italy
11	Sesame	Blue Dragon / Sesame oil	280	Malaysia
12	Corn	Vita D'Or / Corn oil, refined	23	Belgium
13	Walnut	Deluxe / Walnut oil	160	France/USA
14	EVOO 4	La Campagna / Extra virgin olive oil	57	Spain
15	EVOO 5	Zeta original / Extra virgin Olive oil	108	EU (Italy)
16	Rapeseed EV 2	Eko GO / Rapeseed, cold pressed	66	Sweden
17	Rapeseed EV 3	Gunnarshögs Gård / Eco cold pressed rapeseed oil	78	Sweden
18	Avocado EV 1.1	Olivado / Extra virgin avocado oil	352	New Zealand
19	EVOO 6.1	Fontana original / Extra virgin Olive oil	94	Greece
20	EVOO 3.2	Primadonna Bio organic / Extra virgin Olive oil	90	EU
21	EVOO 7	Primadonna / Extra virgin Olive oil	45	Spain
22	Avocado EV 1.2	Olivado / Extra virgin avocado oil	352	New Zealand
23	Linseed	Kung Markatta / linseed, cold pressed	312	Sweden
24	EVOO 6.2	Fontana original / Extra virgin Olive oil	94	Greece

* 100 SEK = 11.51 US\$ = 9.53 EURO (2018-04-30)

1.2 Instrumentation

Smartphone: Samsung Galaxy S4 mini

3in1 Pocket Flashlight Torch LED Pen USB Rechargeable Light 500LM Lamp (with 405 nm LED included)

Serstech 100 Indicator (Handheld Raman instrument)

1.3 HSV colorspace

HSV (Hue, Saturation, Value) is a commonly used cylindrical color-space in digital imaging. Where hue (H) corresponds to the CCDs “spectral” color tone represented as angular values from 0 to 1 (circular part of the cylinder). Saturation (S) represents maximum difference between the RGB channels (cylinder radius) and value (V, sometimes referred to as Brightness, B) is the maximum channel value (cylinder height). The equations for HSV colour-space:

The equations for HSV colour-space:

$$H = (((G - B) / (\max - \min) + 0) / 6 ; \quad \text{If } R = \max$$

$$H = (((B - R) / (\max - \min) + 2) / 6 ; \quad \text{If } G = \max$$

$$H = (((R - G) / (\max - \min) + 4) / 6 ; \quad \text{If } B = \max$$

$$S = (\max - \min) / \max$$

$$V = \max$$

1.4 ImageJ analysis

After smartphone acquisition images were sent to a computer with NIH’s open image analysis software ImageJ installed. The following steps are executed for each sample image:

- 1) Open image
- 2) Change: Image Type to HSB stack (Optional: Save as)
- 3) Choose: Image Look-up-Table Spectrum (Optional: Save as)
- 4) Analyze – Histogram (Optional: Save as)

2 Results

2.1 General discussion

All oil samples that had a “twin” sample of same brand and type, but acquired from different stores, geographical places and times, all were very close in hue values (0.2, 0.2, 0.4 and 0.7 in absolute values) which was roughly within one standard deviation. This is providing credibility to manufacturer reproducibility (and total management) of these samples, as well as additional proof-of-concept for the present study.

2.2 Average hue values and standard deviations of the oil samples

Table S2. Mean hue values and standard deviations of the edible oil samples (calculated from the six replicates of each oil shown in figure 3), presented in decreasing hue order.

Sample	Mean	STD
EVOO 7	242.1	1.5
EVOO 5	240.8	0.8
EVOO 3.2	240.2	0.6
EVOO 6.2	239.8	0.8
EVOO 6.1	239.6	0.8
EVOO 3.1	239.5	1.0
EVOO 4	239.5	0.7
EVOO 1	239.0	0.6
EVOO 2	238.9	0.9
Olive mix	232.7	1.3
Avocado EV 1.2	232.7	0.7
Avocado EV 1.1	232.3	1.3
Rapeseed EV 2	222.1	5.9
Rapeseed EV 1	220.8	7.5
Sunflower 2	172.2	0.8
Sunflower 1	161.4	1.4
Rapeseed	152.2	1.0
Corn	142.9	0.8
Walnut	136.8	0.7
Sesame	105.8	5.1
Linseed	104.9	14.4
Rapeseed EV 3	102.8	8.8
Fishoil 1.2	98.9	2.8
Fishoil 1.1	98.7	6.5

2.2 Sample RGB images of the 24 oils

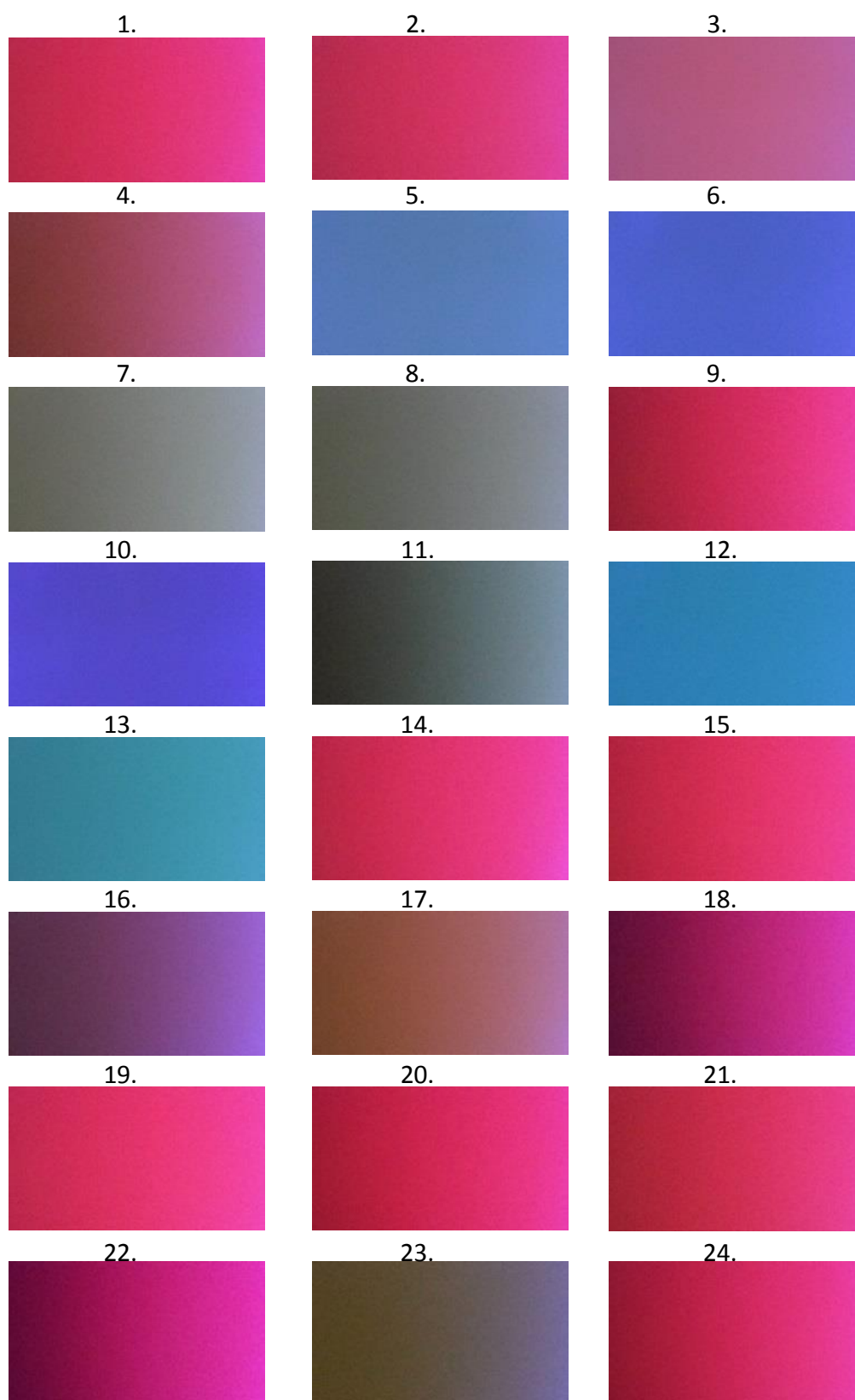


Fig. S1 Sample RGB images of the first replicate of the 24 edible oils. Numbers correspond to sample numbers in Table S1 and actual sample order.

2.3 Sample hue (LUT spectrum) images of the 24 oils

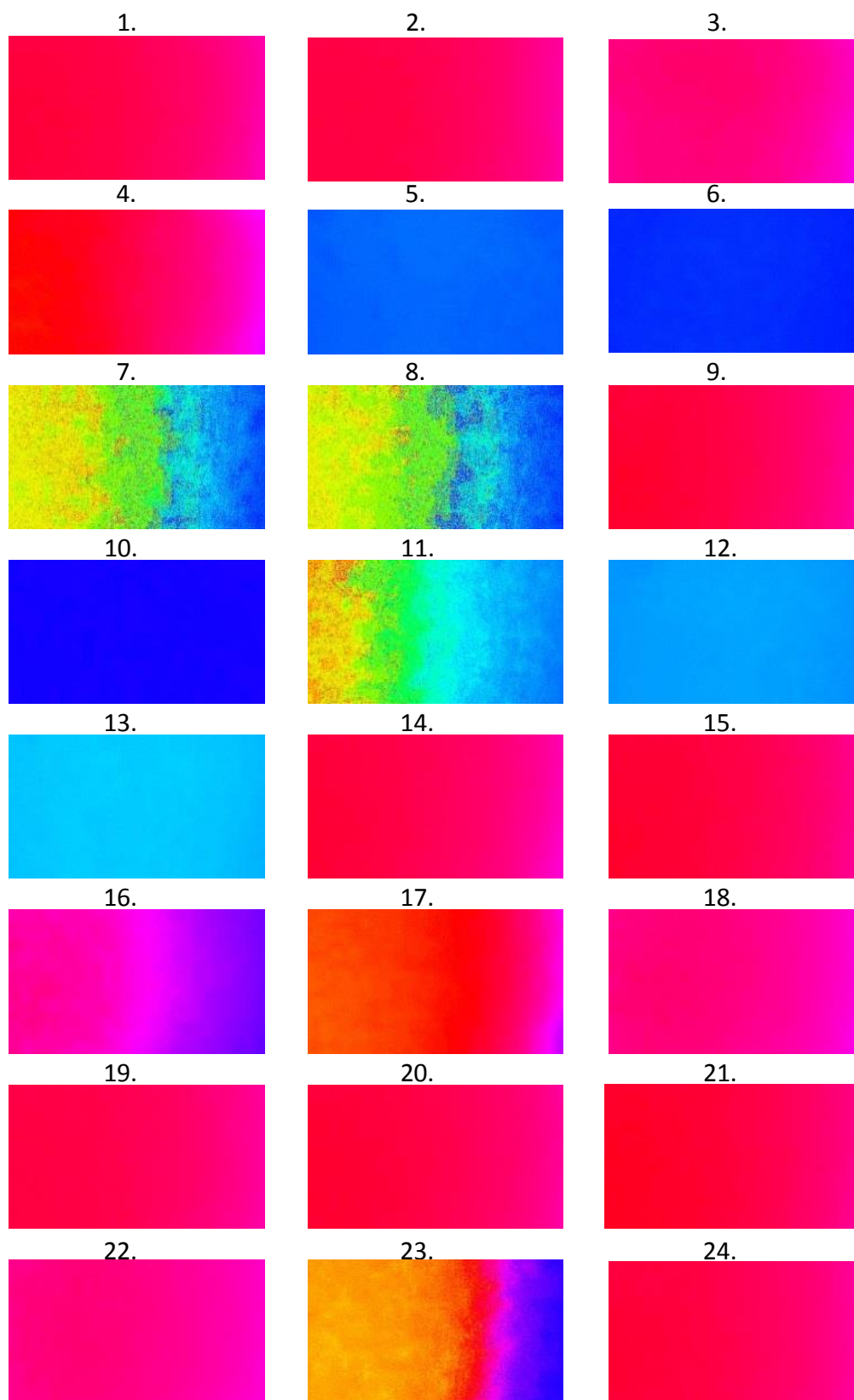


Fig. S2 Sample Hue spectrum images of the first replicate of the 24 edible oils. Numbers correspond to sample numbers in Table S1 and actual sample order.

2.3 Sample hue (LUT spectrum) histograms of the 24 oils

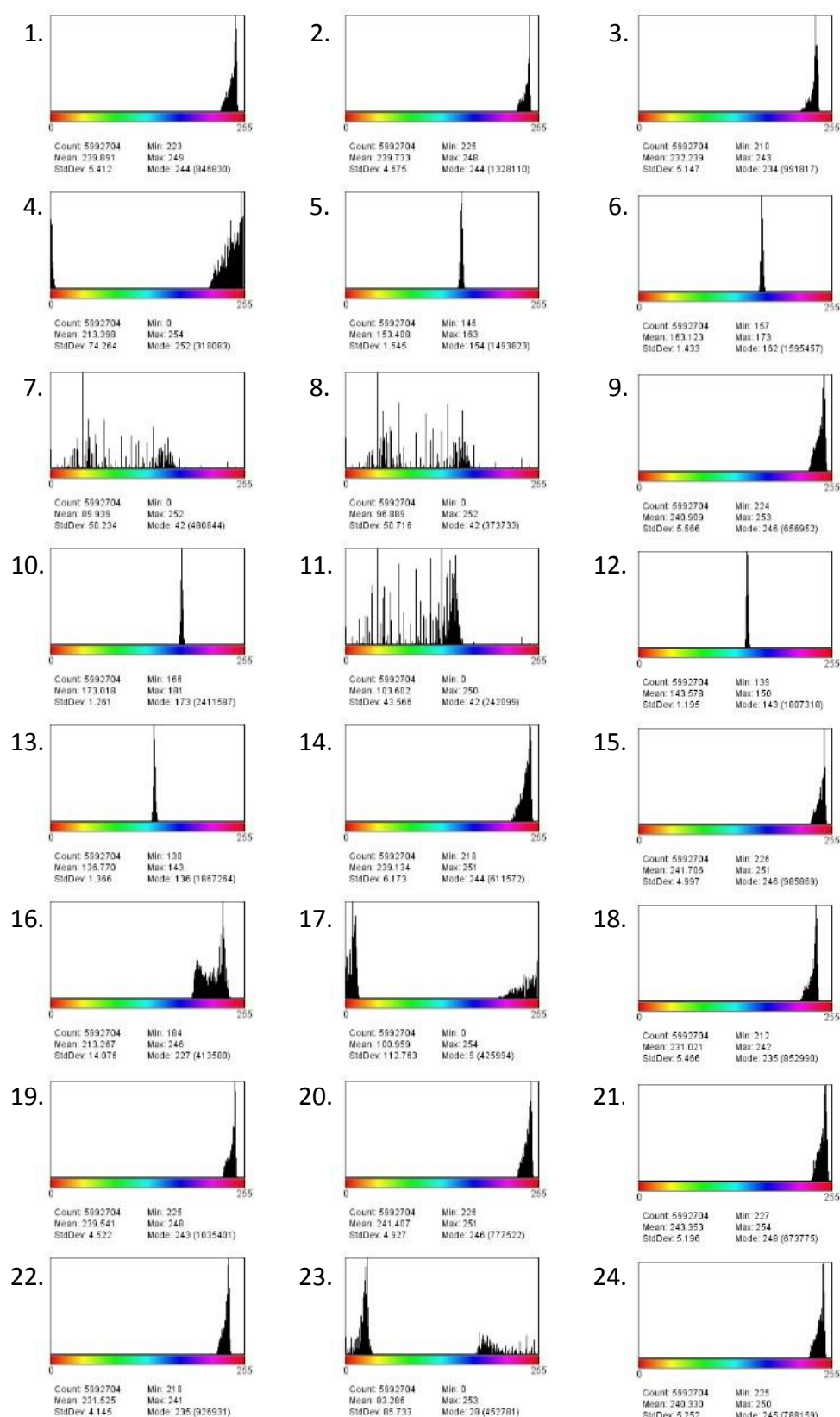


Fig. S3 Sample Hue spectrum histograms of the first replicate of the 24 edible oils. Numbers correspond to sample numbers in Table S1 and actual sample order.