EXHIBIT A

CROSNER LEGAL, P.C.
Craig W. Straub (SBN 249032)
craig@crosnerlegal.com
9440 Santa Monica Blvd. Suite 301
Beverly Hills, CA 90210
Tel: (866) 276-7637
Fax: (310) 510-6429

Attorneys for Plaintiff

ELECTRONICALLY
FILED
Superior Court of California,
County of San Francisco
08/13/2026
Clerk of the Court
BY: ERNALYN BURA
Deputy Clerk

SUPERIOR COURT OF THE STATE OF CALIFORNIA

COUNTY OF SAN FRANCISCO

DEBORAH BAUTISTA, individually, and on behalf of all others similarly situated,

Plaintiff,

v.

SNYDER'S-LANCE, INC., a North Carolina corporation,

Defendant.

Case No. **CGC-26-639884**

CLASS ACTION COMPLAINT FOR:

1. Violations of the Consumers Legal Remedies Act, Cal. Civ. Code §§ 1750, *et seq.*;
2. Violations of the Unfair Competition Law, Cal. Bus. & Prof. Code §§ 17200, *et seq.*; and
3. Breach of Express Warranty

Demand for Jury Trial

Plaintiff Deborah Bautista ("Plaintiff") brings this action individually and on behalf of all others similarly situated, by and through undersigned counsel, against Defendant Snyder's-Lance, Inc. ("Defendant"). Based upon personal knowledge as to herself and her own acts, and upon information and belief and the investigation of counsel as to all other matters, Plaintiff alleges as follows.

INTRODUCTION

1. Defendant prominently sells its Kettle® Brand Sea Salt with a Hint of Pink Peppercorn as "MADE WITH AVOCADO OIL" potato chips (the "Product"). The ingredient list reinforces that message by listing "avocado oil" as the sole oil ingredient.

CROSNER LEGAL, P.C.

2. The avocado oil representations are false and materially misleading. A July 2026 peer-reviewed and published study by researchers at the University of California, Davis tested two separately sourced lots of the Product. Both lots were compositionally inconsistent with authentic avocado oil across multiple independent fatty-acid and sterol markers. The observed pattern was instead consistent with substitution or dilution using other vegetable oils.

3. Avocado oil is a premium ingredient. Consumers seek it out because of its perceived nutritional qualities, taste, and avoidance of common seed oils, and products advertised as made with avocado oil command a premium over products made with ordinary vegetable oils. Defendant capitalized on those preferences while selling a Product whose oil fraction did not conform to authentic avocado oil.

4. Plaintiff, who purchased the Product in California, was deceived by Defendant's unlawful conduct and brings this action individually and on behalf of consumers to remedy Defendant's unlawful acts.

JURISDICTION AND VENUE

5. This Court has subject-matter jurisdiction under article VI, section 10 of the California Constitution. This action is an unlimited civil case.

6. This Court has personal jurisdiction over Defendant pursuant to California Code of Civil Procedure section 410.10 because Defendant purposefully markets, distributes, and sells the Product in California, including in San Francisco County, and Plaintiff's claims arise from that conduct.

7. Venue is proper in San Francisco County under California Civil Code section 1780(d) because Defendant does business in this County, including by marketing, distributing, and selling the Product here. Plaintiff also purchased the Product in this County and the transactions and injuries giving rise to her claims occurred here. Venue is additionally proper under California Code of Civil Procedure section 395.5 because Defendant's obligations and liability arose, and the alleged breach occurred, in this County.

PARTIES

8. Plaintiff Bautista is a resident of San Francisco County, California. Plaintiff purchased the Product approximately two or three times in 2026 from retail stores near her home in San Francisco. Before purchasing, she saw and relied on the prominent "AVOCADO OIL" representation on the front of the package and understood it to mean that the Product's declared edible oil was authentic avocado oil, not another vegetable oil substituted for or materially diluting avocado oil.

9. Plaintiff wanted chips made with avocado oil and considered the type of oil important to her purchasing decision. She paid a price premium attributable to the avocado-oil representation. Had Defendant disclosed that the Product's oil was not compositionally consistent with authentic avocado oil, Plaintiff would not have purchased it or would have paid less.

10. Plaintiff continues to desire potato chips made with authentic avocado oil and would purchase the Product again if she could rely on Defendant's labeling. Because Defendant continues to market the Product as "AVOCADO OIL" chips without disclosing the results described below or otherwise providing a reliable means to determine whether the oil is authentic, Plaintiff cannot know whether the representation is truthful and faces a real threat of future harm.

11. Defendant Snyder's-Lance, Inc. is a North Carolina corporation with its principal place of business at One Campbell Place, Camden, New Jersey. Defendant is an indirect wholly owned subsidiary of The Campbell's Company.

12. The Product's packaging states that it is "Distributed by Kettle Brand." "Kettle Brand" is an active assumed business name registered in Oregon. The registration identifies Snyder's-Lance as the authorized representative of record and lists One Campbell Place, Camden, New Jersey, which is the same address listed as Snyder's-Lance's principal office in the North Carolina Secretary of State's records. The Oregon registration was submitted by David A. Vincoff, who is identified in North Carolina's records as a Vice President of Snyder's-Lance.

13. The Campbell's Company's 2025 Annual Report identifies Kettle Brand potato chips as one of its "leadership brands" and states that The Campbell's Company, together with its consolidated subsidiaries, is a manufacturer and marketer of branded food products, including Kettle Brand potato chips.[1]

FACTUAL ALLEGATIONS

[1] *See* https://investor.thecampbellscompany.com/static-files/dd731f42-377f-4dc2-b2ef-54e72b6ba4c3

A. DEFENDANT'S AVOCADO-OIL REPRESENTATIONS

14. The front of the package prominently displays the words "AVOCADO OIL" and provides a picture of an avocado in close proximity.

15. The ingredient statement identifies "avocado oil" as the sole oil ingredient. It does not identify soybean, sunflower, canola, or any other vegetable oil, and it does not disclose that the avocado oil may be substituted or diluted.

16. These statements convey a clear and uniform message: the sole declared edible oil used in the Product is authentic avocado oil. The ingredient is not incidental to the Product's identity. "AVOCADO OIL" appears prominently in the Product name and on the principal display panel.

B. THE UC DAVIS STUDY

17. On July 11, 2026, Applied Food Research, a peer-reviewed scientific journal published by Elsevier B.V., published "Authenticity of avocado and olive oils used as ingredients in commercially processed foods" (Lopez-Alvarez, N., Li, X., Vizgordiski, B., & Wang, S.C. (2026). *Applied Food Research*, 6, Article 102389, https://doi.org/10.1016/j.afres.2026.102389) (the "UC Davis Study" or "Study").[2] The Study was conducted by researchers in the Department of Food Science and Technology at the University of California, Davis.

18. The Study evaluated, for the first time, the authenticity of avocado oil and olive oil used as the sole declared edible-oil ingredients in commercially processed foods, including chips. The researchers analyzed 74 commercial avocado- and olive-oil-labeled samples purchased in 2025 and 2026 from online retailers and California retail stores. They collected two separate lots of each product and analyzed each lot in duplicate.

19. For chips, the researchers extracted the oil using Soxhlet extraction and analyzed the recovered oil through fatty-acid methyl-ester profiling and sterol-composition analysis by

[2] A true and correct copy of the UC Davis Study, the accompanying identification of the studied products, and the relevant supplementary tables is attached hereto as **Exhibit A**.

gas chromatography with flame-ionization detection. The resulting profiles were evaluated against Codex Alimentarius standards intended to encompass natural variation caused by cultivar, geographic origin, maturity, and growing conditions.

20. The Study did not classify a sample as inconsistent merely because of a small or isolated deviation. It tolerated a deviation limited to a single marker that did not exceed 10% beyond the established compositional limit, treated certain marginal results as borderline, and classified samples as inconsistent only where multiple deviations or compositional patterns were inconsistent with authentic reference profiles.

21. The researchers also prepared model potato chips with authentic avocado oil and compared the oil before frying with oil recovered from the finished chips. Frying caused only minor changes in the relevant markers. The Study concluded that normal processing effects were insufficient to explain the significant deviations observed in inconsistent commercial products.

22. The Study tested two separately sourced lots of the Product as Samples 17 and 18, both purchased from California retailers. Both lots were analyzed in duplicate.

23. The fatty-acid composition of each lot deviated from the Codex ranges for authentic avocado oil on multiple markers, as follows:

Fatty Acid Marker	Codex Range	Sample 17	Sample 18
Palmitic acid (C16:0)	11.0%–26.0%	12.4% (within range)	8.5% (below range)
Palmitoleic acid (C16:1)	4.0%–17.1%	1.0% (below range)	1.3% (below range)
Stearic acid (C18:0)	0.1%–1.3%	3.0% (above range)	2.5% (above range)

24. The sterol composition of both lots likewise deviated from the Codex range on multiple markers:

Sterol Marker	Codex Range	Sample 17	Sample 18
Campesterol	4.0%–8.3%	3.9% (marginally below range)	10.0% (above range)
Stigmasterol	0.3%–2.0%	1.7% (within range)	6.6% (above range)
Clerosterol	1.0%–2.5%	1.2% (within range)	0.3% (below range)
β-sitosterol	79.0%–93.4%	77.6% (marginally below range)	65.3% (below range)
Delta-7-avenasterol	ND–1.5%	0.6% (within range)	2.5% (above range)
Delta-7-stigmastenol	ND–1.5%	6.1% (above range)	8.2% (above range)

25. The lots also contained cis-vaccenic acid at the following levels:

Marker	Sample 17	Sample 18	Study's "Consistent" Products (mean)	Study's "Inconsistent" Products (mean)
Cis-vaccenic acid (C18:1 n-7)	2.4%	1.6%	5.3% ± 1.0%	1.7% ± 0.5%

26. The Study found a statistically significant difference in cis-vaccenic acid levels between avocado-oil-labeled products classified as compositionally consistent and inconsistent. Sample 18 was consistent with the 1%–2% range the Study described for inconsistent samples, while Sample 17 was substantially below the 5.3% mean reported for consistent samples and closer to the 1.7% mean reported for inconsistent samples.

27. The concordance of multiple independent fatty-acid and sterol markers, including delta-7-stigmastenol, which reached approximately 4.1 and 5.5 times the Codex ceiling in Samples 17 and 18, respectively, supports the inference that the Product's oil was compositionally inconsistent with authentic avocado oil and instead reflected substitution with or material dilution by another vegetable oil. The Product's labeling did not disclose any blended-oil formulation.

C. Materiality, Reliance, and Injury

28. The identity of the cooking oil is material to reasonable consumers. Avocado oil is marketed and perceived as a premium oil with desirable nutritional and taste attributes. Consumers also choose avocado-oil products to avoid common seed oils. Defendant's own placement of "AVOCADO OIL" prominently in the Product name and on the front panel confirms its materiality.

29. Products labeled as containing avocado oil generally command higher prices than products made with ordinary vegetable oils. The Study likewise observed that avocado-oil-labeled processed foods generally commanded a price premium over vegetable-oil counterparts.

30. Defendant knew or should have known the identity and authenticity of the Product's primary cooking oil through supplier specifications, certificates of analysis, purchase records, formulation records, quality-control testing, and routine diligence. Defendant nevertheless represented without qualification that the Product contained avocado oil as its sole edible oil.

31. Plaintiff and Class members saw and relied on the uniform avocado-oil representations in purchasing the Product. They received a product worth less than represented and paid money they otherwise would not have paid, or paid a price premium, causing economic injury.

CLASS ACTION ALLEGATIONS

32. Plaintiff brings this action as a class action pursuant to California Code of Civil Procedure section 382 on behalf of the following class:

> All persons who purchased the Product for personal, family, or household use in California during the applicable statute of limitations period through the date class notice is disseminated.

33. Excluded from the Class are: (i) Defendant and its officers, directors, and employees; (ii) any person who files a valid and timely request for exclusion; (iii) judicial officers and their immediate family members and associated court staff assigned to the case; and (iv) individuals who received a full refund of the Product from Defendant.

34. Plaintiff reserves the right to amend or otherwise alter the class definition presented to the Court at the appropriate time, or to propose or eliminate subclasses, in response to facts learned through discovery, legal arguments advanced by Defendant, or otherwise.

35. The Class is appropriate for certification because Plaintiff can prove the elements of the claims on a classwide basis using the same evidence as would be used to prove those elements in individual actions alleging the same claims.

36. Numerosity: Class Members are so numerous that joinder of all members is impracticable. Plaintiff believes that there are thousands of consumers who are Class Members described above who have been damaged by Defendant's deceptive and misleading practices.

37. Commonality: Common questions predominate, including whether the Product's oil was authentic avocado oil; whether Defendant's "AVOCADO OIL" representations and ingredient list were false or misleading; whether Defendant knew or should have known of the issue; whether the representations were material to reasonable consumers; and whether Defendant violated the express warranty laws, the UCL, and the CLRA.

38. Typicality: Plaintiff's claims are typical because she purchased the same Product bearing the same material representations, relied on those representations, and suffered the same type of economic injury as other Class members.

39. Adequacy: Plaintiff will fairly and adequately protect the Class. She has no interests antagonistic to the Class and has retained counsel experienced in consumer-protection and class-action litigation.

40. A class action is superior to individual actions because individual losses are comparatively small, common issues predominate, and concentrating the litigation in one forum promotes efficiency and consistent results.

41. Defendant has acted or refused to act on grounds generally applicable to the Class, making final injunctive relief appropriate for the Class as a whole.

FIRST CLAIM FOR RELIEF

Violation of California's Consumers Legal Remedies Act

Cal. Civ. Code §§ 1750, *et seq.*

42. Plaintiff realleges and incorporates by reference all allegations contained in this complaint, as though fully set forth herein.

43. Plaintiff brings this claim under the CLRA individually and on behalf of the Class against Defendant.

44. At all times relevant hereto, Plaintiff and the members of the Class were "consumer[s]," as defined in California Civil Code section 1761(d).

45. At all relevant times, Defendant was a "person," as defined in California Civil Code section 1761(c).

46. At all relevant times, the Product manufactured, marketed, advertised, and sold by Defendant constituted a "good," as defined in California Civil Code section 1761(a).

47. The purchases of the Product by Plaintiff and the members of the Class were and are "transactions" within the meaning of California Civil Code section 1761(e).

48. Defendant violated Civil Code section 1770, including subdivisions (a)(5), (a)(7), and (a)(9), by representing that the Product had characteristics, ingredients, benefits, and

qualities it did not have; representing that it was of a particular standard or quality when it was not; and advertising it with the intent not to sell it as advertised.

49. Defendant's violations were material and caused Plaintiff and Class members to suffer damage because they would not have purchased the Product or would have paid less if the truth had been disclosed.

50. Plaintiff seeks injunctive relief under Civil Code section 1780(a)(2). Plaintiff provided Defendant with notice pursuant to Civil Code section 1782(a) by certified mail, return receipt requested, on August 4, 2026. If Defendant does not provide an appropriate correction within the statutory period, Plaintiff will amend this Complaint to seek damages under the CLRA.

51. Pursuant to section 1780(d) of the CLRA, below is an affidavit showing that this action was commenced in a proper forum.

SECOND CLAIM FOR RELIEF

Violation of California's Unfair Competition Law

Cal. Bus. & Prof. Code §§ 17200, *et seq.*

52. Plaintiff realleges and incorporates by reference all allegations contained in this complaint, as though fully set forth herein.

53. Plaintiff brings this claim under the UCL individually and on behalf of the Class against Defendant.

54. Defendant engaged in unlawful, unfair, and fraudulent business acts and practices by marketing and selling the Product as containing avocado oil as its sole edible oil when the Product's oil was not compositionally consistent with authentic avocado oil and was instead consistent with substitution or material dilution by another vegetable oil.

55. The conduct is unlawful because it violates, among other laws, the FAL, the CLRA, and California's warranty law.

56. The conduct is fraudulent because it is likely to deceive reasonable consumers.

57. The conduct is unfair because the harm to consumers is substantial, not outweighed by countervailing benefits, and not reasonably avoidable, and because it offends established public policies requiring truthful food labeling.

58. Defendant committed "unfair" business acts or practices by marketing and selling the Product as containing avocado oil as its sole edible oil when the Product's oil was compositionally inconsistent with authentic avocado oil and consistent with substitution or material dilution using another vegetable oil.

59. This conduct caused substantial injury to consumers that was not outweighed by any countervailing benefit and that consumers could not reasonably have avoided.

60. There is no societal benefit from deceptive advertising. Plaintiff and the other Class members paid for a Product that is not as advertised by Defendant. Further, Defendant failed to disclose a material fact (that the Product's oil was compositionally inconsistent with authentic avocado oil and consistent with substitution or material dilution) of which it had exclusive knowledge.

61. While Plaintiff and the other Class members were harmed, Defendant was unjustly enriched by its misrepresentations and material omissions. As a result, Defendant's conduct is "unfair," as it offended an established public policy. There were reasonably available alternatives to further Defendant's legitimate business interests, other than the conduct described herein.

62. Defendant committed "fraudulent" business acts or practices by prominently representing that the Product contained avocado oil as its sole edible oil. These representations were likely to deceive reasonable consumers because the Product's oil was compositionally inconsistent with authentic avocado oil and consistent with substitution or material dilution using another vegetable oil.

63. Defendant's wrongful business practices and violations of the UCL are ongoing.

64. Plaintiff lost money or property as a result of Defendant's conduct because she would not have purchased the Product or would have paid less absent the misrepresentations.

65. Plaintiff seeks restitution, injunctive relief, reasonable attorneys' fees and costs where authorized, and all other relief available under the UCL.

THIRD CLAIM FOR RELIEF

Breach of Express Warranty

66. Plaintiff realleges and incorporates by reference all allegations contained in this complaint, as though fully set forth herein.

67. Plaintiff brings this claim individually and on behalf of the Class against Defendant.

68. Defendant's prominent "AVOCADO OIL" representation and ingredient statement identifying avocado oil as the Product's sole edible oil were affirmations of fact and descriptions of the goods that became part of the basis of the bargain.

69. The Product did not conform to those affirmations and descriptions because its oil was not compositionally consistent with authentic avocado oil and was consistent with substitution or material dilution with another vegetable oil.

70. Plaintiff and Class members purchased the Product in reliance on the warranties and suffered damages in an amount to be proven, including the purchase price and/or price premium attributable to the false representations.

71. Plaintiff mailed Defendant with pre-suit notice of the breach and an opportunity to cure by letter dated August 4, 2026.

REQUEST FOR RELIEF

Plaintiff, individually, and on behalf of all others similarly situated, requests relief as follows:

72. Declaring that this action is a proper class action, certifying the Class defined herein, appointing Plaintiff as Class Representative, and appointing the undersigned counsel as Class Counsel;

73. Ordering restitution of all money Defendant obtained from Plaintiff and the Class as a result of Defendant's unlawful, unfair, and fraudulent business practices;

74. Awarding injunctive relief as permitted by law or equity, including enjoining Defendant from continuing the unlawful practices alleged herein and requiring Defendant to undertake a corrective advertising campaign;

75. Awarding Plaintiff and the Class damages in an amount to be determined at trial and distinct from any restitution awarded;

76. Awarding Plaintiff and the Class reasonable attorneys' fees and costs as permitted by law;

77. Awarding pre- and post-judgment interest on all amounts awarded; and

78. Awarding such other and further relief as the Court deems just and proper.

JURY DEMAND

79. Plaintiff hereby demands a trial by jury.

Dated: August 13, 2026

CROSNER LEGAL, P.C.

By: */s/ Craig W. Straub*

Craig W. Straub (SBN 249032)
craig@crosnerlegal.com
9440 Santa Monica Blvd. Suite 301
Beverly Hills, CA 90210
Tel: (866) 276-7637
Fax: (310) 510-6429
Attorneys for Plaintiff

Affidavit Pursuant to Civil Code Section 1780(d)

I, Craig W. Straub, declare as follows: I am an attorney duly licensed to practice before all of the courts of the State of California. I am counsel of record for Plaintiff. This declaration is made pursuant to § 1780(d) of the California Consumers Legal Remedies Act. Defendant has done, and is doing, business in California, including in this county. Such business includes the marketing, promotion, distribution, and sale of the Product within the State of California. I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct. Executed August 13, 2026 at San Diego, California.

Dated: August 13, 2026

CROSNER LEGAL, P.C.

By: */s/ Craig W. Straub*

Craig W. Straub (SBN 249032)
craig@crosnerlegal.com
9440 Santa Monica Blvd. Suite 301
Beverly Hills, CA 90210
Tel: (866) 276-7637
Fax: (310) 510-6429

Attorneys for Plaintiff

Exhibit A

Applied Food Research 6 (2026) 102389

Contents lists available at ScienceDirect

Applied Food Research

journal homepage: www.elsevier.com/locate/afres

Authenticity of avocado and olive oils used as ingredients in commercially processed foods

Natalie Lopez-Alvarez [a], Xueqi Li [a,1], Benjamin Vizgordiski [a,1], Selina C. Wang [a,b,*]

[a] Department of Food Science and Technology, University of California Davis, Davis, CA, 95616, USA
[b] University of California Agriculture and Natural Resources, Davis, CA, 95616, USA

ARTICLE INFO

Keywords:
Avocado oil
Olive oil
Authenticity
Processed foods
Fatty acids
Sterols

ABSTRACT

Avocado oil and olive oil are increasingly incorporated into processed foods as premium ingredients, reflecting consumer interest in their perceived health attributes and preference relative to vegetable oils. To date, most studies have focused on bottled oils sold directly to consumers, whereas oils used as ingredients in processed foods have received little analytical attention. This study evaluated the authenticity of avocado oil and olive oil used as ingredients in commercially processed foods, oils extracted from 74 commercial chips, mayonnaise, and salad dressings labeled as containing avocado oil or olive oil were evaluated using established compositional markers, including fatty acids and sterols. Eighty-nine percent of avocado oil–labeled products exhibited compositional patterns inconsistent with authentic avocado oil, characterized by reduced palmitic acid, palmitoleic acid, cis-vaccenic acid, beta-sitosterol, and clerosterol, and elevated stearic acid, campesterol, stigmasterol, delta-7-stigmastenol and delta-7-avenasterol. These findings suggest that ingredient-level oil claims may represent an underexamined source of economic adulteration in processed foods.

1. Introduction

Avocado oil and olive oil are recognized as premium edible oils and are increasingly incorporated into processed foods such as snack products, mayonnaise, and salad dressings. Both oils are derived from fruit tissues and are rich in monounsaturated fatty acids, particularly oleic acid, and are valued for their nutritional properties. Their use is often motivated by consumer interest in perceived nutritional benefits and marketing strategies that differentiate products from those formulated primarily with seed oils. As a result, ingredient statements highlighting avocado oil or olive oil have become more common across a range of processed food categories.

Concerns regarding the authenticity of high-value edible oils are well documented, particularly for bottled olive oil (Baeten et al., 1996; Frankel, 2010; Laroussi-Mezghani et al., 2015) and, more recently, avocado oil (Aras & Rohman, 2025). Numerous studies have demonstrated that products marketed as avocado oil may be partially or wholly substituted with lower-cost vegetable oils or refined oils, resulting in mislabeling and economic adulteration (Green & Wang, 2020; Green & Wang, 2023). In response, a range of analytical approaches based on fatty acid composition, sterol profiles, and other minor components have been developed and applied to assess oil authenticity and support regulatory oversight (A. Fernando et al., 2025; Green & Wang, 2022; Green & Wang, 2023; Hashempour-baltork et al., 2024; Marín-Obispo et al., 2025; Pérez-Calabuig et al., 2023; Rydlewski et al., 2020; Tang et al., 2021; Tang et al., 2024; Wu et al., 2024).

In contrast to bottled oils sold directly to consumers, considerably less attention has been paid to the authenticity of edible oils used as ingredients in processed foods (Grundy et al., 2025). Unlike bottled oils, which can be analyzed directly, oils used as ingredients in processed foods must first be recovered from complex food matrices prior to authenticity assessment. When oils are incorporated into complex food matrices, they are often present with other ingredients and may be subjected to thermal processing, emulsification, or blending (García González et al., 2018; Ramadan, 2015; Ujong et al., 2023). These factors can complicate both analytical assessment and regulatory enforcement, and may reduce transparency regarding the composition of the oil fraction relative to labeled ingredient claims.

Labeling regulations generally require that ingredients be declared by common or usual name (U.S. Food and Drug Administration, 2013); however, the extent to which labeled oils reflect the actual composition of the lipid fraction in finished goods remains largely unknown (Moore

* Corresponding author.
E-mail address: scwang@ucdavis.edu (S.C. Wang).
[1] Both authors contributed equally to this work

https://doi.org/10.1016/j.afres.2026.102389
Received 19 April 2026; Received in revised form 9 July 2026; Accepted 10 July 2026
Available online 11 July 2026
2772-5022/© 2026 The Author(s). Published by Elsevier B.V. This is an open access article under the CC BY-NC license (http://creativecommons.org/licenses/by-nc/4.0/).

et al., 2012; Yao & Rodriguez-Saona, 2020). It remains unclear whether products labeled as containing avocado oil or olive oil are formulated primarily with these oils or whether they contain lipid fractions inconsistent with the labeled oil claims. This represents a potential gap in current food control efforts, as consumers may reasonably interpret front-of-package oil claims as signals of meaningful product differentiation. Prior research demonstrates that ingredient-based claims and "free-from" labels can generate halo effects, shaping perceptions of healthiness and sustainability beyond what is objectively warranted (Lozano-Castellón et al., 2022; Priven et al., 2015). As front-of-package marketing increasingly emphasizes premium oils, understanding whether labeled oils meaningfully represent the lipid fraction is essential for consumer transparency.

To our knowledge, this is the first study to systematically evaluate the authenticity of avocado oil and olive oil used as the sole declared edible oil ingredients in commercially processed foods while also examining the effects of representative food-processing operations on authenticity markers. The objective of this study was to evaluate the authenticity of avocado oil and olive oil used as the sole declared edible oil ingredients in commercial processed foods. Oils extracted from chips, mayonnaise, and salad dressings were analyzed using established fatty acid and sterol compositional markers to assess ingredient-level authenticity and determine whether the lipid composition was consistent with the labeled oil claims. This study aims to provide data relevant to ingredient-level oil authenticity and to inform future discussions on labeling accuracy and analytical verification in processed foods.

2. Materials and methods

2.1. Sample collection

Three food categories that have become increasingly prevalent in the U.S. market were selected: chips, mayonnaise, and salad dressings. These categories were included because avocado oil and olive oil are frequently promoted as premium ingredients in each category, while also representing distinct food matrices and processing conditions. Chips represent thermally processed fried products, mayonnaise represents an emulsified system, and salad dressings represent liquid emulsified formulations. Evaluating multiple product categories allowed assessment of oil authenticity across different commercial applications. Within each category, products were selected based on consumer popularity and market availability. Only products that declared a single oil (e.g. avocado oil or olive oil) in the ingredient statement and did not list additional edible oils were included in the study. Three vegetable oil chip products and three vegetable oil mayonnaise products were also collected as compositional comparators; however, because these products did not claim to contain avocado or olive oil as the sole oil source, they were not included in authenticity classification analyses.

Samples were purchased in 2025 and 2026 from online sources and retail stores in California and stored unopened in the laboratory until analysis. Two separate lots of each product were collected and analyzed, and each lot was analyzed in duplicate. Product information, including declared oil type, ingredient list, retail price, and collection location, is provided in Supplementary Table 1. The brands included in the study are listed in Supplementary Table 2. Lot numbers were recorded and are available from the corresponding author upon request.

2.2. Oil extraction

Fat extraction of mayonnaise and salad dressing was performed according to Lagunes-Galvez et al. (2002) with some modifications. Approximately 20 g of mayonnaise or salad dressing were portioned in 50 mL falcon tubes and frozen at -20°C for 24 h. Samples were thawed at room temperature for two hours. The thawed samples were centrifuged at 15,000 x g for 10 min (Sorvall Legend X1; Thermo Scientific, Newington, CT, USA), resulting in an oil layer separating from the other ingredients.

Chips were prepared for oil extraction according to Kadamne and Proctor (2010). Approximately 30 g of chips were blended in a food processor (DLC-2A Mini-Prep Plus; Cuisinart, East Windsor, NJ, USA). Approximately 10 g of crushed chips were weighed and placed in Sartorius cellulose extraction thimbles (33 mm x 130 mm). Fat extraction was performed by the Soxhlet method using Buchi E-800 Universal Extractor (Buchi Corporation, New Castle, USA). The fat was extracted for 25 cycles using n-hexane at 69°C. The residual hexane was further evaporated under the "Drying Step" on Buchi E-800 and left to dry completely in a fume hood until no hexane remained to acquire the extracted fat for subsequent analysis.

2.3. Chemical analysis

2.3.1. Fatty acid profile

Fatty acid methyl esters (FAMEs) were prepared according to the IOC official method (COI/T.20/Doc. No 33/Rev.1, International Olive Council, 2017) with modifications. Briefly, in a 12 mL amber vial, approximately 0.03 g of oil was mixed with 3 mL of HPLC grade hexane. 200 µL of 2 mol L^{-1} methanolic potassium hydroxide solution was added and was vortexed for 30 seconds. The solution was left to stratify until the upper layer was clear and was subsequently filtered with a 0.45 µm PTFE filter for analysis.

FAMEs were analyzed using a gas chromatograph equipped with a flame ionization detector (GC-FID) (Agilent 7890A; Agilent Technologies, Wilmington, DE, USA). Separation was achieved using a DB-FastFAME capillary column (90 m × 250 µm × 0.25 µm, Agilent, Santa Clara, CA, USA). Helium was used as the carrier gas at a constant flow rate of 1.9 mL min^{-1}. The injector temperature was set at 260°C with a split ratio of 30:1 while the detector temperature was set at 260°C. Hydrogen, air, and nitrogen (make-up gas) flows were set at 40, 400, and 25 mL min^{-1}, respectively. The oven temperature program was as follows: initial temperature 75°C for 1 min; ramp at 35°C min^{-1} to 200°C and hold for 14 min; ramp at 2.5°C min^{-1} to 210°C and hold for 5 min; ramp at 12 °C min^{-1} to 230°C and hold for 10 min. The total run time was 47.4 min.

FAMEs were identified by comparison of retention times with a 37-component FAME standard mixture (Supelco, PA, USA). Quantification was performed using peak area normalization and results were expressed as the relative percentage of total identified FAMEs.

2.3.2. Sterol profile

Sterols samples were prepared following the method by Thompson & Merola (1993). 85% aqueous potassium hydroxide and 3% ethanoic pyrogallol were prepared fresh the day of analysis. Approximately 0.2 g of oil sample was pipetted into a 50 mL plastic tube along with 20 µL of the internal standard 5α-Cholestan-3β-ol in ethyl acetate 0.2% w/v). 8 mL of the 3% pyrogallol solution was added along with 0.5 mL of 85% KOH and gently swirled to incorporate. The tubes were shaken in a water-shaker bath (Precision SWB 15; Thermo Scientific, Newington, CT, USA) at 80°C for 20 min and cooled under tap water. 12 mL of deionized water was added to each tube along with 20 mL cyclohexane and manually shaken for 30 seconds. The solution was left to stratify until the organic layer was clear. The organic layer was transferred to glass tubes and dried under nitrogen flow with gentle heating of 35°C to aid evaporation (BT1606; BT Lab Systems, St Louis, MO, USA). The residue was redissolved in 400 µL of derivatization reagent (pyridine/BSTFA with 1% TMCS, 1:1, v/v).

Sterol composition was determined by an Agilent 7890A GC-FID on an Agilent DB-5HT capillary column (30 m × 0.25 mm × 0.1 µm). Helium was used as the carrier gas under constant-flow mode at 1.2 mL min^{-1}. The injector temperature was set at 280°C in split mode (split ratio 30:1). The oven temperature was maintained isothermally at 260°C for 50 min with a post-run temperature at 300°C. The FID temperature was 300°C, using the same hydrogen, air, and nitrogen flow

rates as described for the FAMEs GC analysis.

Sterol composition was identified by comparing retention times with those of authentic standards analyzed under identical conditions. 5α-Cholestan-3β-ol and cholesterol were purchased from Sigma-Aldrich (St. Louis, MO, USA) and stigmasterol, brassicasterol, Δ5-avenasterol, and Δ7-avenasterol were purchased from Toronto Research Chemicals (Toronto, ON, Canada). Quantification was performed using the internal standard based on peak area ratios and expressed in percentage. Cholesterol was excluded from total sterol normalization because it originates from egg rather than oil (Kuang et al., 2018).

2.4. Authenticity criteria

Fatty acid and sterol compositions of avocado oil are known to vary according to cultivar, geographic origin, maturity, and growing conditions (Hausch et al., 2020; Manaf et al., 2019; Ramos-Aguilar et al., 2021; Rodríguez-Sánchez et al., 2025; Tan et al., 2017; Wu et al., 2024). However, because the origin and varietal composition of avocado oil used as an ingredient in processed foods are not disclosed on product labels, these factors could not be incorporated into the present analysis. Therefore, authenticity classification was based on Codex Alimentarius Standard for Named Vegetable Oils and Olive Oil and Olive Pomace Oils (CXS 210-1999; CXS 33-1981*)* which are intended to encompass expected natural variability (Codex Alimentarius Commission, 2024a, 2024b).

To account for analytical uncertainty, biological variability, and potential processing influences, minor deviations were tolerated in the classification criteria. Deviations limited to a single fatty acid or sterol marker and not exceeding 10% beyond established compositional limits were not considered sufficient to classify a sample as inconsistent and were therefore considered consistent. A sample was considered borderline when no more than two fatty acid or sterol markers marginally exceeded the 10% allowance and lacked concordant deviations across other markers indicative of a non-authentic profile. When a sample was fully consistent in either fatty acids or sterols and borderline in the other, it was considered consistent with authentic oil. Samples that have multiple deviations or patterns inconsistent with authentic reference profiles were classified as inconsistent.

2.5. Preparation of model chips and mayonnaise

2.5.1. Model chips preparation

Two retail avocado oils (Marianne's Avocado Oil, packaged in the US from globally sourced materials; Sprouts Farmers Market, product of Mexico and/or Spain) and two retail extra virgin olive oil (California Olive Ranch Extra Virgin Olive Oil, product of California; Sprouts Farmers Market, product of Spain) were used as reference oils for preparation of model products.

Model avocado oil chips samples were prepared and fried according to Zhang et al. (2018). Russet potatoes were purchased from a local grocery store. Potatoes were washed, peeled, and sliced into 1.5 mm thick slices using a mandoline slicer (Vekaya, Hangzhou, China). Sliced potatoes were blanched in boiling water for two min and dried with paper towels to remove surface moisture. Two hundred and fifty mL of pure avocado oil was heated in a 3-qt stainless steel saucepan until 180°C. Eighty grams of blanched potatoes were fried for 7 min, and the excess oil was drained onto paper towels. This process was performed in duplicate. A portion of the avocado oil was analyzed directly prior to frying (pre-frying oil). After frying, the oil absorbed into the potato chips was recovered using the extraction procedure described in Section 2.2 and analyzed (post-frying oil). This process was performed in duplicate.

Olive oil potato chips were prepared in a similar manner. Two hundred and fifty mL of pure extra virgin olive oil was heated to 160°C to avoid excessive thermal degradation. Eighty grams of blanched potatoes were fried for 8 min. A portion of the olive oil was analyzed directly before frying, and post-frying oil was recovered from the fried chips using the extraction procedure described in Section 2.2.

White corn tortillas, containing no added fat, were purchased from a local grocery store. Tortillas were sliced into quarters. Sixty grams of tortilla was fried in 180 mL pure avocado oil at 180°C for 4 min. Post-frying oil was recovered from the tortilla chips using the extraction procedure described in Section 2.2.

2.5.2. Model mayonnaise preparation

Model avocado oil mayonnaise was prepared using pure avocado oil to evaluate potential compositional changes during emulsification and storage. Formulations consisted of whole eggs (18%), vinegar (6%), and oil (76%), following a standardized laboratory-scale procedure according to Metri-Ojeda et al. (2023). Whole eggs and avocado oil were combined using an immersion blender (KHB1231, KitchenAid, Benton Harbor, MI) with continuous mixing to form a stable emulsion. Once an emulsion was achieved, vinegar was added and mixed again to incorporate. Final products were stored in glass jars at 4°C prior to analysis. Oil was subsequently re-extracted using the method described in Section 2.2 to assess whether emulsification or short-term storage altered fatty acid or sterol composition. Model olive oil mayonnaise was prepared the same with using pure extra virgin olive oil.

2.6. Statistical analysis

All analytical measurements were performed in duplicate, unless noted otherwise. Results are reported as mean ± standard deviation.

Selected fatty acids and sterols of avocado oil- or olive oil-contained products were compared across three product categories (chips, mayonnaise, and salad dressings). Scatter dot plots were generated in R (R Foundation for Statistical Computing, Vienna, Austria) using Visual Studio Code, displaying individual observations with category medians indicated by dashed lines and shaded regions for the corresponding Codex Alimentarius compositional ranges for authentic oils.

Principal component analysis (PCA) was performed to assess variation in selected fatty acids and sterols among the samples mentioned in 2.1; vegetable oil (VO) comparator samples were included as references. Variables were centered and scaled to unit variance prior to analysis. PCA was conducted in R using Visual Studio Code. Biplots of the first two principal components were generated to display sample scores and variable loadings simultaneously. Samples were colored by oil category, and 95% confidence ellipses were overlaid for avocado oil- and olive oil-containing samples.

Cis-vaccenic acid (C18:1 (n-7)) levels in avocado oil-labeled products were compared between samples classified as compositionally consistent or inconsistent. Individual observations were visualized using a scatter dot plot generated in R with group medians indicated by dashed lines. Differences between groups were evaluated using the non-parametric Wilcoxon rank-sum test due to unequal sample size and non-normal data distribution. Statistical significance was set at $p < 0.05$.

3. Results and discussion

3.1. Authenticity by product category and declared oil type

Classification was based on an integrated interpretation of fatty acid and sterol markers. Samples were considered consistent when both fatty acid and sterol profiles met the compositional criteria defined in Section 2.4; summary results are presented in Table 1. Among avocado oil–labeled products, 93% of chip samples were classified as inconsistent with authentic avocado oil based on combined fatty acid and sterol criteria. Similarly, 71% of mayonnaise samples and 100% of salad dressing samples were classified as inconsistent. These findings indicate that labeled claims of premium oils in processed foods do not consistently align with the chemical composition of the oil fraction. In contrast, 90% of olive oil–labeled chip products and 100% of olive oil–labeled salad dressings and mayonnaise were classified as consistent

Table 1
Authenticity classification results based on fatty acid and sterols criteria described in Section 2.4.

Product category	Declared oil	N	Consistent (N, %)	Inconsistent (N, %)	Price range ($/oz product)
Chips	Avocado	28	2 (7%)	26 (93%)	0.30-2.00
	Olive	10	9 (90%)	1 (10%)	0.43-1.70
Dressings	Avocado	12	0 (0%)	12 (100%)	0.60-1.12
	Olive	6	6 (100%)	0 (0%)	0.42-1.12
Mayonnaise	Avocado	14	4 (29%)	10 (71%)	0.30-1.63
	Olive	4	4 (100%)	0 (0%)	0.53-1.07

with authentic olive oil. Overall, the rate of inconsistency observed for avocado oil–labeled products was substantially higher than that observed for olive oil–labeled products.

For the two avocado oil chip products classified as consistent, two different production lots were collected to assess lot-to-lot variability. In both cases, only one lot met the criteria for consistency, whereas the second lot was considered inconsistent. These findings indicate measurable lot-to-lot variation and highlight the importance of batch-level verification when assessing ingredient authenticity in processed foods as a company may be sourcing from multiple suppliers for the same ingredient.

One of the studied brands offered both avocado oil and olive oil potato chip products. Neither of the two avocado oil potato chip products tested was consistent with Codex standards, whereas one of the two olive oil potato chip products was consistent. This suggests that formulation practices and ingredient sourcing may differ even within the same brand and product category. At the same time, this may also reflect the comparatively higher compliance and authenticity of olive oil sources relative to avocado oil, as olive oil standards are more established and regulatory oversight and enforcement are considerably more developed than for avocado oil.

Retail prices showed consistent premiums for products labeled as containing avocado oil or olive oil relative to vegetable oil counterparts (Table 1 and Table S1). Chips labeled with avocado oil ranged from $0.30–2.00 per ounce, compared with $0.43–1.70 for olive oil chips and $0.44–0.62 for vegetable oil chips. Avocado oil mayonnaise ranged from $0.30–1.63 per ounce, compared with $0.53–1.07 for olive oil mayonnaise and $0.24–0.75 for vegetable oil mayonnaise. Salad dressings labeled with avocado oil ranged from $0.60–1.12 per ounce, while olive oil dressings ranged from $0.42–1.12 per ounce. Products labeled with avocado oil or olive oil generally commanded higher retail prices than comparable products formulated with vegetable oils.

The two avocado oil chip products classified as consistent were priced at $0.63 and $0.83 per ounce, near or below the average price of all avocado oil chip products in the study. The four consistent avocado oil mayonnaise products were priced at $1.63 per ounce, higher than other avocado oil mayonnaise products studied. Overall, these findings indicate that although products labeled with avocado oil generally commanded a price premium over vegetable oil counterparts, retail price alone was not a reliable indicator of ingredient authenticity and consumers cannot rely on price alone as an indicator of authenticity.

Ingredient-level adulteration may present distinct regulatory challenges. In finished foods, oils are embedded within multi-ingredient systems and may be present at varying inclusion levels. All products included in this study declared only a single edible oil in the ingredient statement and did not disclose blended oil formulations. Thus, consumers would reasonably expect the named oil, particularly when emphasized through front-of-package claims such as “made with 100% avocado oil” to be the primary lipid source of the product. Although third-party verification and certification programs for foods and consumer products exist (e.g., Seed Oil Free Alliance), only two of the olive oil–labeled dressing samples analyzed in this study carried such certification at the time of purchase.

3.2. Fatty acid and sterol compositional characteristics of consistent and inconsistent samples

Detailed fatty acid and sterol profiles of oils extracted from commercial products are summarized in Tables S3 and S4. Figs. 1 and 2 show the distribution of key fatty acids and sterols in oils extracted from commercial products labeled as containing avocado oil or olive oil.

Low levels of palmitic acid (C16:0) and palmitoleic acid (C16:1), together with elevated stearic acid (C18:0), are not characteristic of authentic avocado oil. Rather, this pattern is more consistent with substitution or dilution using vegetable oils. Most avocado oil chips and mayonnaise samples, and all avocado oil salad dressings, fell outside the Codex standard ranges for C16:0, C16:1 and C18:0 (shaded regions in Fig. 1a and Supplementary Table S3). These fatty acids were selected because they are included in the Codex standards and exhibited the greatest differences between products classified as consistent and inconsistent with authentic avocado oil compositional ranges; however, classification was based on the complete fatty acid and sterol profiles rather than these markers alone. In contrast, olive oil chips, mayonnaise and salad dressings were consistently within the Codex standard ranges for the same fatty acids (Fig. 1b and Supplementary Table S3), indicating substantially better compliance among the olive oil–labeled products evaluated.

Sterol composition also showed substantial inconsistencies among avocado oil–labeled products. Most samples had campesterol, stigmasterol and Δ7-avenasterol levels outside the Codex standard ranges (shaded regions in Fig. 2a and Supplementary Table S4). Elevated campesterol, stigmasterol and Δ7-avenasterol are consistent with substitution or dilution with vegetable oils. These sterol deviations support the fatty acid findings and indicate widespread compositional inconsistency among the avocado oil–labeled products evaluated.

Sterol composition of the olive oil–labeled samples also showed deviations from Codex standards. Multiple chip samples had campesterol, brassicasterol and apparent β-sitosterol levels outside of the Codex limits (Fig. 2b and Supplementary Table S4). Because brassicasterol is not characteristic of authentic olive oil and is commonly associated with canola oil, its presence above trace levels is particularly indicative of potential substitution or blending (Gül & Seker, 2006). However, if canola oil was an adulterant, a concurrent reduction in C16:0, C16:1, and C18:0 would be expected (Christopoulou et al., 2004), which was not observed (Fig. 1b).

Similar to avocado oil, campesterol is a critical regulatory marker for olive oil authenticity. It has long been recognized as a reliable marker to distinguish olive oil from vegetable oils, which typically contain substantially higher campesterol levels (Codex STAN 33-1981, Codex Alimentarius Commission, 2024b; Srigley et al., 2016; COI/T.15/NC No 3/Rev. 21, International Olive Council, 2025). Olive pomace oil, derived from olive residues and subsequently refined, may exhibit modest alterations in sterol distribution, including slightly elevated levels of brassicasterol. According to the label, two olive oil mayonnaise products were formulated with a blend of olive pomace oil and extra virgin olive oil. These samples showed higher levels of brassicasterol compared with the 100% extra virgin olive oil mayonnaise counterpart from the same brand. However, the sterol profiles of the blended samples did not exhibit the markedly elevated campesterol or brassicasterol levels characteristic of vegetable oils (Codex STAN 33-1981, Codex Alimentarius Commission, 2024b).

3.3. Multivariate and targeted discrimination analyses

3.3.1. Principal component analysis of fatty acid and sterol profiles

Principal component analysis (PCA) of fatty acid and sterol profiles demonstrated clear separation between samples classified as consistent and inconsistent with their labeled oil claims (Figs. 3 and 4). For the selected fatty acids (Fig. 3), PC1 explained 37.5% of the total variance and PC2 explained 28.4%. These fatty acids were selected because they

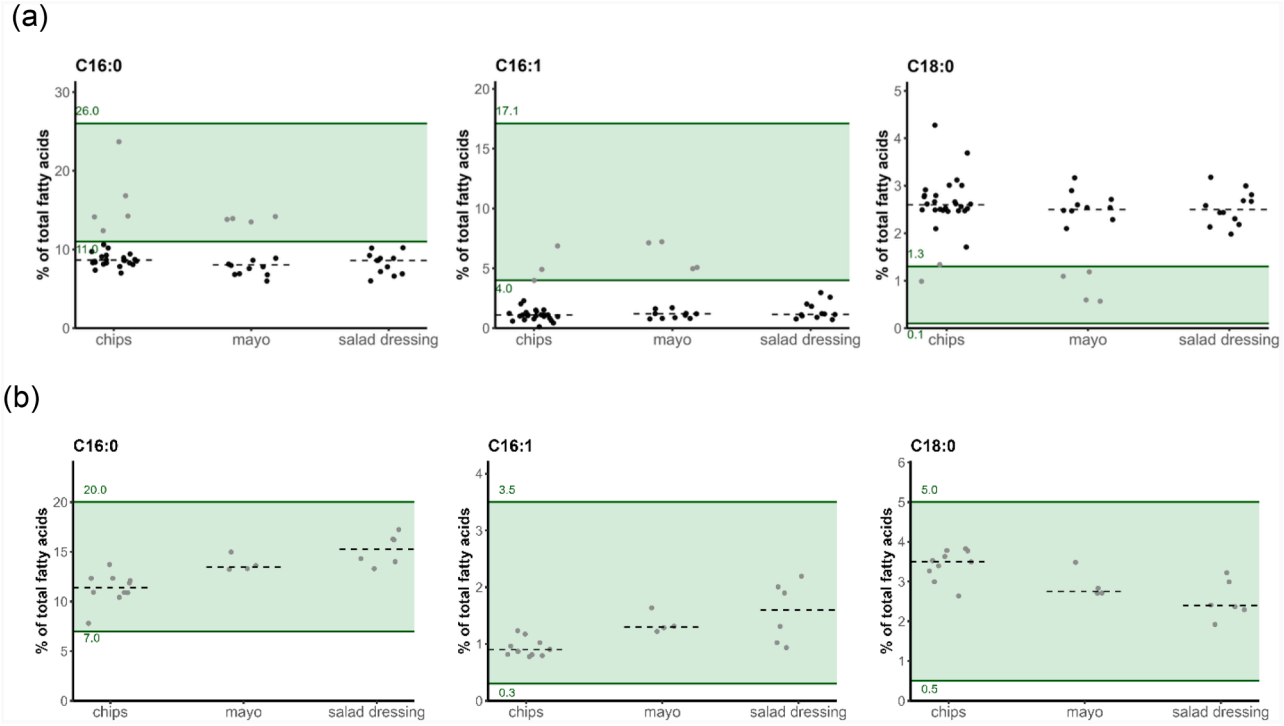

Fig. 1. Distribution of representative Codex-regulated fatty acids (palmitic acid C16:0, palmitoleic acid C16:1 and stearic acid C18:0) in oils extracted from commercial products labeled as containing (a) avocado oil (b) olive oil. Points represent individual products (grey = within the specified compositional criterion; black = outside); horizontal bars indicate medians; shaded regions indicate the corresponding Codex Alimentarius compositional ranges for authentic oils.

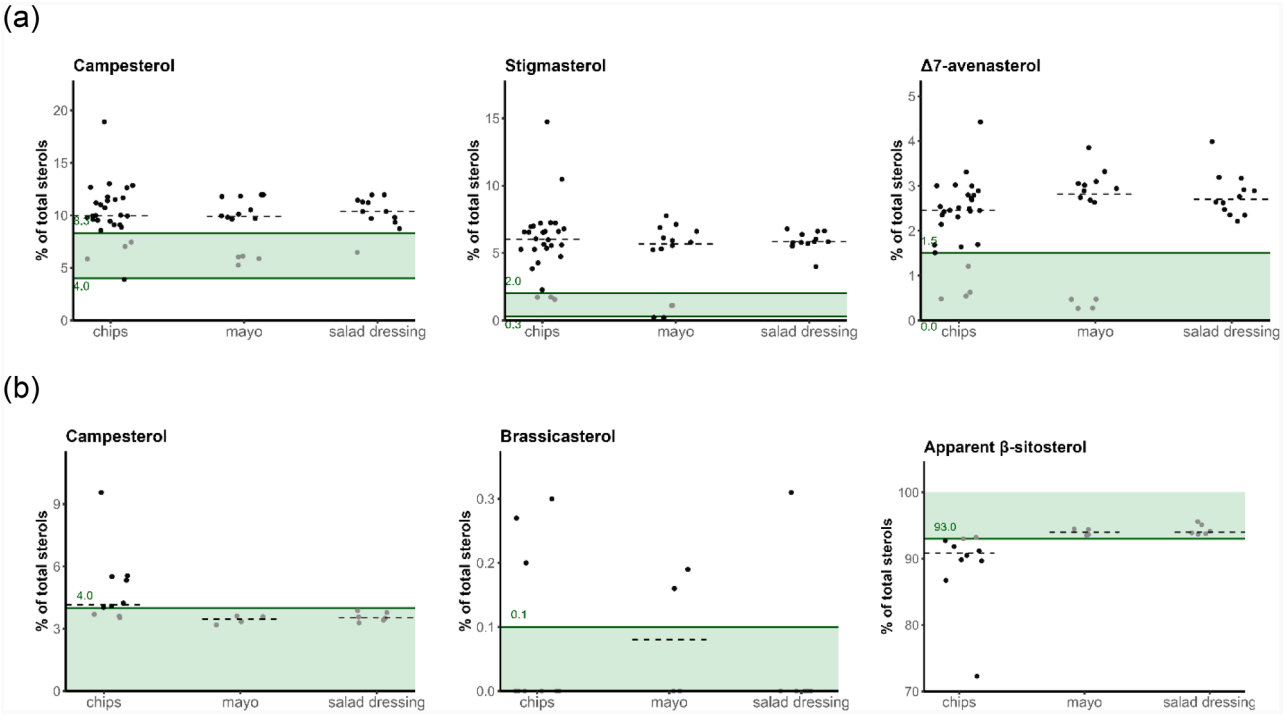

Fig. 2. Distribution of key sterols (campesterol, stigmasterol and Δ7-avenasterol; campesterol, brassicasterol and apparent β-sitosterol) in oils extracted from commercial products labeled as containing (a) avocado oil, (b) olive oil, respectively. Points represent individual products (grey = within the specified compositional criterion; black = outside); horizontal bars indicate medians; shaded green regions indicate the corresponding Codex Alimentarius compositional ranges for authentic oils.

exhibited the greatest differences between products classified as consistent and inconsistent and contributed strongly to PCA separation. PC1 was primarily associated with C16:0, C16:1, C18:1 (n-7), and C18:0, whereas PC2 was mainly influenced by C18:1, C18:2, and C18:3. Olive oil (OO) samples showed tighter clustering with a smaller confidence ellipse, with most samples positively correlated with C18:1, consistent

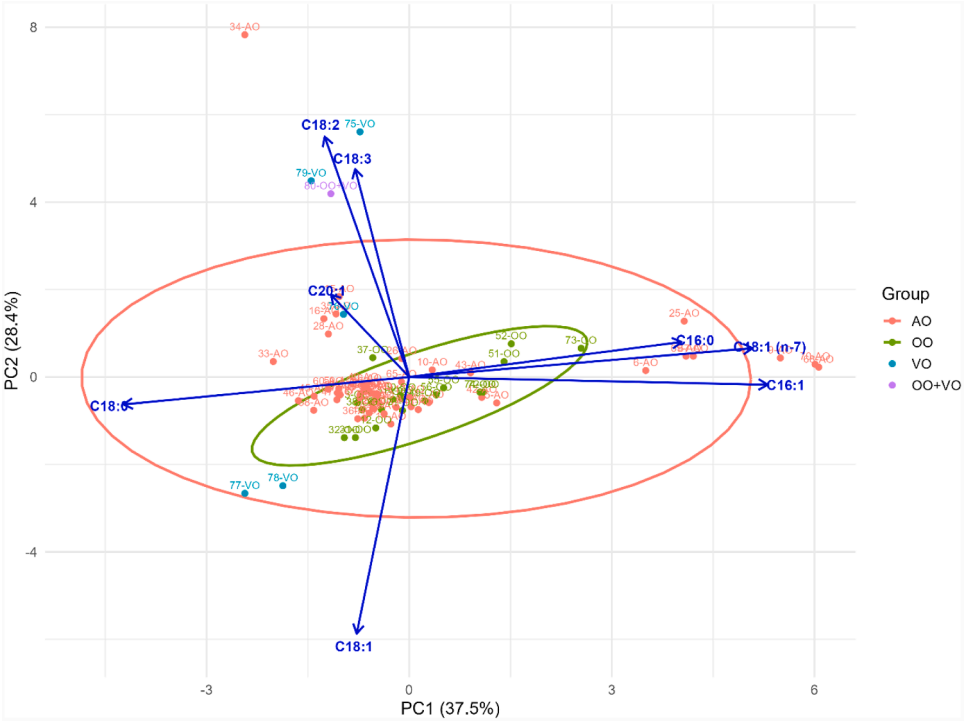

Fig. 3. PCA of selected fatty acids. AO: avocado oil-containing samples; OO: olive oil-containing samples; VO: vegetable oil-containing samples; OO+VO: sample containing vegetable oil blend with olive oil as the first ingredient.

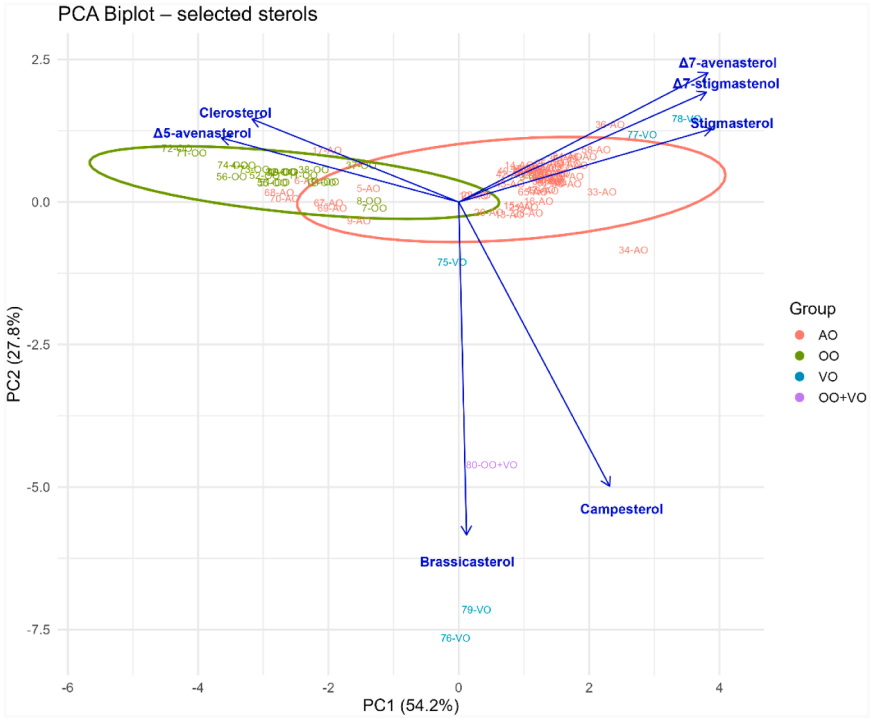

Fig. 4. PCA of selected sterols. AO: avocado oil-containing samples; OO: olive oil-containing samples; VO: vegetable oil-containing samples; OO+VO: sample containing vegetable oil blend with olive oil as the first ingredient.

with typical olive oil composition. In contrast, avocado oil (AO) samples had a broader confidence ellipse, reflecting greater variability. Samples 6-AO, 9-AO, 25-AO, 67-AO, 68-AO, 69-AO, and 70-AO were positively associated with C16:1 and C18:1 (n-7), consistent with fatty acid profiles of authentic avocado oil. Sample 34-AO was clearly separated from the AO cluster; its fatty acid profile, characterized by high C18:2 (52.5%) and C18:3 (6.5%) and low C18:1 (24.8%), is consistent with soybean oil composition. Many avocado oil–labeled samples clustered near samples 76-VO (containing canola, corn, soybean, and/or sunflower oil), suggesting that the fatty acid profiles of those products are more consistent with polyunsaturated vegetable oil compositions than with authentic avocado oil.

Selected sterols explained 82.0% of the total variance (PC1: 54.2% and PC2: 27.8%) in Fig. 4. PC1 was primarily associated with clerosterol, Δ5-avenasterol and stigmasterol, whereas PC2 was mainly influenced by brassicasterol and campesterol. OO samples were generally positioned along the direction of Δ5-avenasterol and clerosterol loadings, reflecting higher relative contributions of these sterols, whereas AO samples were more broadly distributed along PC1, indicating greater compositional variability. Samples 5-AO, 6-AO, 9-AO, 17-AO, 67-AO, 68-AO, 69-AO, and 70-AO were positively correlated with Δ5-avenasterol, a sterol typically present at higher levels in avocado oil than in common vegetable oils, supporting their alignment with authentic avocado oil profiles based on sterols. Sample 34-AO, which was clearly separated from the main avocado oil fatty acid cluster in Fig. 3, was again unique in Fig. 4, indicating a sterol composition that differs substantially from the other avocado oil–labeled samples. The consistent separation of Sample 34-AO in both fatty acid and sterol PCA suggests that its lipid composition differs from most of the oil used in AO-labeled products. Its fatty acid and sterol profiles are consistent with soybean oil rather than avocado oil. Avocado oil with 100% substitution of soybean oil was documented in an earlier study (Green & Wang, 2020).

Samples located in the direction of brassicasterol and campesterol loadings exhibited sterol patterns more consistent with vegetable oil characteristics. Samples 76-VO and 79-VO, which listed canola oil as the primary ingredient, showed strong correlations with brassicasterol, a characteristic sterol marker of canola oil. Sample 80-OO+VO also demonstrated strong associations with brassicasterol and campesterol despite olive oil being listed as the first ingredient, suggesting that vegetable oil may be the primary lipid component rather than olive oil.

3.3.2. Targeted evaluation of cis-vaccenic acid C18:1 (n-7) as a discriminatory marker for avocado oil

C18:1 (n-7) levels differed between consistent and inconsistent avocado oil–labeled products (Fig. 5). Oils extracted from samples classified as consistent had values clustering around 4-6% range. In contrast, inconsistent samples showed substantially lower levels, between 1-2%, aligning with typical vegetable oil profiles. Mean C18:1 (n-7) content was 5.3 ± 1.0% in consistent samples compared with 1.7 ± 0.5% in inconsistent samples ($p < 0.001$). C18:1 (n-7) is characteristically elevated in avocado oil relative to most common vegetable oils (Green & Wang, 2022), the clear separation observed here supports its strong discriminatory capacity as a targeted marker for distinguishing authentic avocado oil from products containing vegetable oils.

3.4. Processing-induced changes in fatty acid and sterol composition

Key fatty acids and sterols in oils recovered from laboratory-prepared chips and mayonnaise are presented in Tables 2–4, with complete compositional profiles provided in Table S5. Under laboratory-scale frying (160–180°C, ≤8 min) and emulsification conditions, minor changes relative to the original oils were observed.

For avocado oil subjected to frying (Table 2), absolute changes in major fatty acids were less than 0.6%. Notably, C18:1 (n-7), a key discriminatory marker for avocado oil authenticity (Fig. 5), decreased by only 0.1% following frying in both potato and tortilla chips. C16:0, C16:1 and C18:0 that differentiated consistent and inconsistent samples

Table 2
Selected fatty acids and sterols (%) of avocado oil before frying and after recovery from laboratory-prepared avocado oil potato (AP) and tortilla (AT) chips.

Marker	Codex limit	Pre-frying	AP	Δ (AP)	AT	Δ (AT)
C16:0	11.0-26.0	19.3 ± 0.0	19.5 ± 0.0	0.2	19.5 ± 0.1	0.2
C16:1	4.0-17.1	7.1 ± 0.0	7.1 ± 0.0	0.0	7.0 ± 0.0	-0.1
C18:0	0.1-1.3	1.0 ± 0.0	1.0 ± 0.0	0.0	1.0 ± 0.0	0.0
C18:1	42.0-75.0	58.5 ± 0.0	58.3 ± 0.0	-0.2	57.9 ± 0.2	-0.6
C18:1 (n-7)	NA	4.2 ± 0.0	4.1 ± 0.0	-0.1	4.1 ± 0.0	-0.1
C18:2	7.8-19.0	12.1 ± 0.0	12.0 ± 0.0	-0.1	12.7 ± 0.3	0.6
C18:3	0.5-2.1	1.3 ± 0.0	1.4 ± 0.0	0.1	1.3 ± 0.0	0.0
Brassicasterol	ND-0.5	0.3 ± 0.0	0.3 ± 0.0	0.0	0.3 ± 0.0	0.0
Campesterol	4.0-8.3	7.8 ± 0.0	7.6 ± 0.0	-0.2	8.0 ± 0.1	0.2
Stigmasterol	0.3-2.0	0.9 ± 0.0	1.0 ± 0.0	0.1	1.1 ± 0.1	0.2
Clerosterol	1.0-2.5	1.3 ± 0.0	1.5 ± 0.1	0.2	1.6 ± 0.0	0.3
β-sitosterol	79.0-93.4	79.4 ± 0.1	77.8 ± 0.2	-1.6	77.7 ± 0.3	-1.7
Δ5-avenasterol	2.0-8.0	5.6 ± 0.0	6.3 ± 0.1	0.7	5.2 ± 0.1	-0.4
Δ5,24-stigmastadienol	NA	3.2 ± 0.1	4.1 ± 0.1	0.9	4.0 ± 0.1	0.8
Δ7-avenasterol	ND-1.5	0.5 ± 0.0	0.5 ± 0.0	0.0	0.5 ± 0.0	0.0

Values are expressed as the relative percentage of total fatty acids or total sterols (mean ± SD). Δ represents absolute percentage point change (post − pre-frying). NA denotes fatty acid or sterol is not in the current Codex standards. C16:0, palmitic acid; C16:1, palmitoleic acid; C18:0, stearic acid; C18:1, oleic acid; C18:1(n-7), cis-vaccenic acid; C18:2, linoleic acid; C18:3, α-linolenic acid.

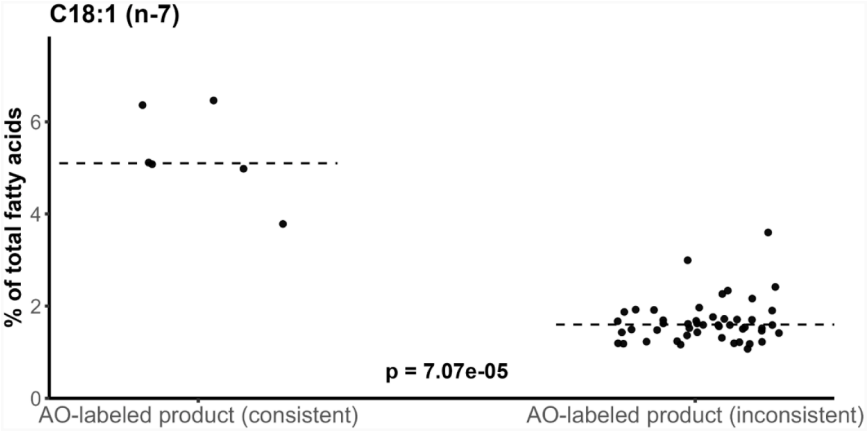

Fig. 5. Cis-vaccenic acid C18:1(n-7) content (% of total fatty acids) in oils extracted from avocado oil–labeled products classified as consistent or inconsistent. Each point represents an individual product. Dashed lines indicate group medians.

Case 3:26-cv-10580-TSH Document 1-1 Filed 09/16/26 Page 25 of 34

Table 3
Selected fatty acids and sterols (%) of olive oil before frying and after recovery from laboratory-prepared olive oil potato chips (OP).

Marker	Codex limit	Pre-frying	OP	Δ
C16:0	7.0-20.0	11.8 ± 0.0	11.9 ± 0.0	0.1
C16:1	0.3-3.5	1.1 ± 0.0	1.1 ± 0.0	0.0
C18:0	0.5-5.0	3.7 ± 0.0	3.7 ± 0.0	0.0
C18:1	53.0-85.0	73.8 ± 0.0	74.0 ± 0.1	0.2
C18:1 (n-7)	NA	2.3 ± 0.0	2.3 ± 0.0	0.0
C18:2	2.5-21.0	7.6 ± 0.0	7.6 ± 0.0	0.0
C18:3	≤ 1.0	0.7 ± 0.0	0.8 ± 0.0	0.1
Brassicasterol	≤ 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0
Campesterol	≤ 4.0	3.0 ± 0.4	3.3 ± 0.0	0.3
Stigmasterol	< campesterol	0.9 ± 0.0	1.5 ± 0.0	0.6
β-sitosterol	NA	85.7 ± 0.3	81.4 ± 0.2	-4.3
Δ5-avenasterol	NA	8.5 ± 0.1	11.7 ± 0.2	3.2
Δ7-stigmastenol	≤ 0.5	0.0 ± 0.0	0.0 ± 0.0	0.0
Apparent β-sitosterol	≥ 93.0	95.1 ± 0.4	94.4 ± 0.0	-0.7

Values are expressed as the relative percentage of total fatty acids or total sterols (mean ± SD). Δ represents absolute percentage point change (post − pre-frying). NA denotes fatty acid or sterol is not in the current Codex standards. C16:0, palmitic acid; C16:1, palmitoleic acid; C18:0, stearic acid; C18:1, oleic acid; C18:1(n-7), cis-vaccenic acid; C18:2, linoleic acid; C18:3, α-linolenic acid.

Table 4
Selected fatty acids and sterols (%) of avocado oil before emulsification and after recovery from laboratory-prepared avocado oil mayonnaise (AM).

Marker	Codex limit	Pre-emulsification	AM	Δ
C16:0	11.0-26.0	17.3 ± 0.0	17.0 ± 0.0	-0.3
C16:1	4.0-17.1	6.5 ± 0.0	6.4 ± 0.1	-0.1
C18:0	0.1-1.3	1.0 ± 0.0	1.1 ± 0.0	0.1
C18:1	42.0-75.0	59.2 ± 0.0	59.4 ± 0.1	0.2
C18:1 (n-7)	NA	4.8 ± 0.0	4.8 ± 0.0	0.0
C18:2	7.8-19.0	14.5 ± 0.0	14.7 ± 0.1	0.2
C18:3	0.5-2.1	0.9 ± 0.0	0.9 ± 0.0	0.0
Brassicasterol	ND-0.5	0.2 ± 0.0	0.1 ± 0.0	-0.1
Campesterol	4.0-8.3	7.1 ± 0.0	7.2 ± 0.0	0.1
Stigmasterol	0.3-2.0	1.0 ± 0.0	0.9 ± 0.0	-0.1
Clerosterol	1.0-2.5	1.2 ± 0.0	1.2 ± 0.0	0.0
β-sitosterol	79.0-93.4	83.5 ± 0.1	83.0 ± 0.2	-0.5
Δ5-avenasterol	2.0-8.0	4.1 ± 0.0	4.2 ± 0.0	0.1
Δ5,24-stigmastadienol	NA	1.2 ± 0.0	1.7 ± 0.1	0.5
Δ7-avenasterol	ND-1.5	0.5 ± 0.0	0.6 ± 0.1	0.1

Values are expressed as the relative percentage of total fatty acids or total sterols (mean ± SD). Δ represents absolute percentage point change (post − pre-emulsification). NA denotes fatty acid or sterol is not in the current Codex standards. C16:0, palmitic acid; C16:1, palmitoleic acid; C18:0, stearic acid; C18:1, oleic acid; C18:1(n-7), cis-vaccenic acid; C18:2, linoleic acid; C18:3, α-linolenic acid.

(Fig. 1a) did not change more than 0.2%. Most sterols showed only minor changes, with the largest decrease observed for β-sitosterol (−1.6 for potato chips and −1.7% for tortilla chips). This trend is consistent with previous reports indicating that β-sitosterol is particularly susceptible to heat-induced degradation during thermal processing (Salta et al., 2008). Δ7-avenasterol, a sterol for which many of the inconsistent avocado oil-labeled chips exceeded the Codex limit, remained unchanged during the frying process.

For olive oil frying experiments (Table 3), fatty acid changes were ≤0.2% for major markers while β-sitosterol (−4.3%) and Δ5-avenasterol (+3.2) had the largest shifts. In industrial frying operations, oil turnover rate and fatty acid composition are expected to influence the extent of processing-induced sterol modification. Oils with higher degrees of unsaturation, such as polyunsaturated vegetable oils, are more susceptible to degradation during repeated thermal exposure than monounsaturated-rich oils such as avocado or olive oil, with natural antioxidants such as tocopherols, frying technique and oxygen exposure further influencing sterol stability (Salta et al., 2008; Soupas et al., 2007; Winkler et al., 2007; Xu et al., 2009). Despite modest redistribution, the combined fatty acid and sterol profile remained clearly characteristic of olive oil and did not approach the compositional patterns typical of common vegetable oils.

Emulsified model mayonnaise prepared with avocado oil showed minimal compositional changes. Absolute differences in fatty acids were ≤0.3%, and sterol shifts were ≤0.5% (Table 4). Clerosterol, a sterol for which many of the avocado-labeled mayonnaise samples showed levels below the Codex limit of 1.0 was unaffected by emulsification, indicating the inconsistency was not caused by formulation processing. Even smaller changes were observed in mayonnaise prepared with olive oil (Table 5), with fatty acid differences ≤0.2% and sterol shifts ≤0.3%. In both avocado oil and olive oil mayonnaise models, C18:1(n-7) remained unchanged following emulsification and short-term refrigerated storage. These findings are consistent with the lack of high-temperature exposure and the limited oxidative stress associated with short-term emulsified product preparation.

These model product experiments indicate that typical frying and emulsification conditions do not substantially alter oil authenticity markers. Although thermal exposure can induce modest sterol degradation or redistribution, the magnitude of change observed here was small. Similar studies of frying oils report sterol losses typically below ~15%, even under extended frying conditions (Winkler et al., 2007). Thus, the minor changes observed in the model systems are insufficient to explain the significant compositional deviations detected in the inconsistent products.

A limitation of this study is the geographic scope and sample size. Products were purchased in California retail stores and online and therefore may not fully represent national market variability. In addition, products were evaluated at a single time point; results reflect only the two specific lots analyzed and are not intended to represent ongoing manufacturing practices or lot-to-lot variability.

4. Conclusion

This study evaluated the authenticity of avocado oil and olive oil used as the sole declared edible oil in commercially processed foods. By extracting lipids from chips, mayonnaise, and salad dressings and assessing fatty acid and sterol profiles against established compositional reference ranges, we identified substantial differences between labeled oil claims and measured oil composition, particularly among avocado oil–labeled products. Laboratory frying and emulsification experiments showed minor shifts in authenticity markers, indicating that typical

Table 5
Selected fatty acids and sterols (%) of olive oil before emulsification and after recovery from laboratory-prepared olive oil mayonnaise (OM).

Marker	Codex limit	Pre-emulsification	OM	Δ
C16:0	7.0-20.0	15.2 ± 0.0	15.0 ± 0.0	-0.2
C16:1	0.3-3.5	1.3 ± 0.0	1.3 ± 0.0	0.0
C18:0	0.5-5.0	2.2 ± 0.0	2.3 ± 0.0	0.1
C18:1	53.0-85.0	69.8 ± 0.0	69.6 ± 0.1	-0.2
C18:1 (n-7)	NA	2.9 ± 0.0	2.9 ± 0.0	0.0
C18:2	2.5-21.0	9.7 ± 0.0	9.9 ± 0.0	0.2
C18:3	≤ 1.0	0.6 ± 0.0	0.6 ± 0.0	0.0
Brassicasterol	≤ 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0
Campesterol	≤ 4.0	3.7 ± 0.0	3.8 ± 0.1	0.1
Stigmasterol	< campesterol	1.1 ± 0.0	1.0 ± 0.0	-0.1
β-sitosterol	NA	74.7 ± 0.1	74.4 ± 0.5	-0.3
Δ5-avenasterol	NA	17.7 ± 0.1	17.8 ± 0.4	0.1
Δ7-stigmastenol	≤ 0.5	0.0 ± 0.0	0.0 ± 0.0	0.0
Apparent β-sitosterol	≥ 93.0	94.1 ± 0.0	93.8 ± 0.1	-0.3

Values are expressed as the relative percentage of total fatty acids or total sterols (mean ± SD). Δ represents absolute percentage point change (post − pre-emulsification). NA denotes fatty acid or sterol is not in the current Codex standards. C16:0, palmitic acid; C16:1, palmitoleic acid; C18:0, stearic acid; C18:1, oleic acid; C18:1(n-7), cis-vaccenic acid; C18:2, linoleic acid; C18:3, α-linolenic acid.

Case 3:26-cv-10580-TSH Document 1-1 Filed 09/16/26 Page 26 of 34

processing conditions do not explain the magnitude of deviations observed in the studied products.

Although products labeled with premium oils were generally sold at higher retail prices, price was not predictive of compositional consistency. These findings highlight ingredient-level oil authenticity in processed foods as an under-monitored area of food integrity. Increased analytical scrutiny of ingredient authenticity in processed products may improve labeling transparency and help maintain consumer confidence in premium oil claims.

Funding

Salaries and benefits for NLA and BV were supported by startup funds from the University of California, Davis and UC Agriculture and Natural Resources. Discretionary funds from the UC Food Quality Lab supported laboratory consumables and sample procurement.

Supplement contents

The article "Authenticity of avocado and olive oils used as ingredients in commercially processed foods" has one supplementary file:

Table S1. Product information, declared oil type, additional ingredients, retail price and collection location for all products analyzed.

Table S2. A list of brands included in the study.

Table S3. Fatty acid profiles of all samples.

Table S4. Sterol profiles of all samples.

Table S5. Fatty acid and sterol profiles of the model products.

Human and animal rights

The authors declare that the work described has not involved experimentation on humans or animals.

CRediT authorship contribution statement

Natalie Lopez-Alvarez: Data curation, Investigation, Validation, Writing – review & editing, Supervision. **Xueqi Li:** Formal analysis, Software, Visualization, Writing – original draft, Writing – review & editing. **Benjamin Vizgordiski:** Data curation, Investigation, Writing – review & editing. **Selina C. Wang:** Conceptualization, Formal analysis, Investigation, Methodology, Resources, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

NLA thanks Yifang Zhang and Martin Kungys from the UC Food Quality Lab in the Department of Food Science and Technology at the University of California, Davis, for their statistical expertise and laboratory assistance, respectively.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.afres.2026.102389.

Data availability

Data will be made available on request.

References

Aras, A. K., & Rohman, A. (2025). Global research trends on avocado oil and its fatty acid composition: A bibliometric review. *Journal of Food and Drug Analysis, 33*(3), Article 1. https://doi.org/10.38212/2224-6614.3548. Article.

Baeten, V., Meurens, M., Morales, M. T., & Aparicio, R. (1996). Detection of virgin olive oil adulteration by fourier transform raman spectroscopy. *Journal of Agricultural and Food Chemistry, 44*(8), 2225–2230. https://doi.org/10.1021/jf9600115

Christopoulou, E., Lazaraki, M., Komaitis, M., & Kaselimis, K. (2004). Effectiveness of determinations of fatty acids and triglycerides for the detection of adulteration of olive oils with vegetable oils. *Food Chemistry, 84*(3), 463–474. https://doi.org/10.1016/S0308-8146(03)00273-5

Codex Alimentarius Commission. (2024). Standard for named vegetable oils. CXS 210-1999, 1-16. (accessed Mar 2, 2026).

Codex Alimentarius Commission. (2024). Standard for olive oils and olive pomace oils. CXS 33-1981, 1-6. (accessed Mar 2, 2026).

Fernando, D., Permastari, D. A. I., Hastuti, A. A. M. B., & Rohman, A. (2025). Authentication of avocado oil mixed with cooking oils (branded and loose palm oil) utilizing fourier transform infrared spectroscopy in conjunction with chemometrics. *Measurement: Food, 19*, Article 100241. https://doi.org/10.1016/j.meafoo.2025.100241

Frankel, E. N. (2010). Chemistry of extra virgin olive oil: Adulteration, oxidative stability, and antioxidants. *Journal of Agricultural and Food Chemistry, 58*(10), 5991–6006. https://doi.org/10.1021/jf1007677

García González, D. L., Aparicio, R., & Aparicio-Ruiz, R. (2018). Olive oil. In J. François Morin, & M. Lees (Eds.), *Food Integrity Handbook* (pp. 315–358). https://www.eurofins.fr/media/jxhfiobf/19_olive-oil.pdf.

Green, H. S., & Wang, S. C. (2020). First report on quality and purity evaluations of avocado oil sold in the US. *Food Control, 116*, Article 107328. https://doi.org/10.1016/j.foodcont.2020.107328

Green, H. S., & Wang, S. C. (2022). Cis-vaccenic acid: New maker to detect seed oil adulteration in avocado oil. *Food Chemistry Advances, 1*, Article 100107. https://doi.org/10.1016/j.focha.2022.100107

Green, H. S., & Wang, S. C. (2023). Purity and quality of private labelled avocado oil. *Food Control, 152*, Article 109837. https://doi.org/10.1016/j.foodcont.2023.109837

Grundy, H., Hird, H., Bailey-Horne, V., Sykes, M., & Charlton, A. (2025). Review of current and emerging analytical methods for the testing of edible oils for authenticity. *FSA Research and Evidence*. https://doi.org/10.46756/001c.145026

Gül, M. K., & Seker, M. (2006). Comparative analysis of phytosterol components from rapeseed (Brassica napus L.) and olive (Olea europaea L.) varieties. *European Journal of Lipid Science and Technology, 108*, 759–765. https://doi.org/10.1002/ejlt.200600085

Hashempour-baltork, F., Zade, S. V., Mazaheri, Y., Alizadeh, A. M., Rastegar, H., Abdian, Z., Torbati, M., & Damirchi, S. A. (2024). Recent methods in detection of olive oil adulteration: State-of-the-Art. *Journal of Agriculture and Food Research, 16*, Article 101123. https://doi.org/10.1016/j.jafr.2024.101123

Hausch, B. J., Arpaia, M. L., Kawagoe, Z., Walse, S., & Obenland, D. (2020). Chemical characterization of two California-grown avocado varieties (Persea americana Mill.) over the harvest season with an emphasis on sensory-directed flavor analysis. *Journal of Agricultural and Food Chemistry, 68*(51), 15301–15310. https://doi.org/10.1021/acs.jafc.0c05917

International Olive Council. (2017). Determination of fatty acid methyl esters by gas chromatography. COI/T.20/Doc. No 33/Rev.1, 1-16. (accessed Mar 4, 2026).

International Olive Council. (2025). Trade Standard applying to olive oils and olive pomace oils. COI/T.15/NC No3/Rev. 21, 1-16. (accessed Mar 4, 2026).

Kadamne, J., & Proctor, A. (2010). Rapid oil extraction from potato chips. *Journal of the American Oil Chemists' Society, 87*, 835–836. https://doi.org/10.1007/s11746-010-1558-1

Kuang, H., Yang, F., Zhang, Y., Wang, T., & Chen, G. (2018). The impact of egg nutrient composition and its consumption on cholesterol homeostasis. *Cholesterol, 2018*(1), Article 6303810. https://doi.org/10.1155/2018/6303810

Lagunes-Galvez, L., Cuvelier, M. E., Ordonnaud, C., & Berset, C. (2002). Oxidative stability of some mayonnaise formulations during storage and daylight irradiation. *Journal of Food Lipids, 9*, 211–224. https://doi.org/10.1111/j.1745-4522.2002.tb00220.x

Laroussi-Mezghani, S., Vanloot, P., Molinet, J., Dupuy, N., Hammami, M., Grati-Kamoun, N., & Artaud, J. (2015). Authentication of Tunisian virgin olive oils by chemometric analysis of fatty acid compositions and NIR spectra. Comparison with Maghrebian and French virgin olive oils. *Food Chemistry, 173*, 122–132. https://doi.org/10.1016/j.foodchem.2014.10.002

Lozano-Castellón, J., López-Yerena, A., Domínguez-López, I., Siscar-Serra, A., Fraga, N., Sámano, S., López-Sabater, C., Lamuela-Raventòs, R. M., Vallverdú-Queralt, A., & Pérez, M. (2022). Extra virgin olive oil: A comprehensive review of efforts to ensure its authenticity, traceability, and safety. *Comprehensive Reviews in Food Science and Food Safety, 21*(3), 2639–2664. https://doi.org/10.1111/1541-4337.12949

Manaf, Y. N., Rahardjo, A. P., Yusof, Y. A., Desa, M. N., & Nusantoro, B. P. (2018). Lipid characteristics and tocopherol content of the oils of native avocado cultivars grown in Indonesia. *International Journal of Food Properties, 21*(1), 2758–2771. https://doi.org/10.1080/10942912.2018.1564761

Marín-Obispo, L. M., Mayorga-Martínez, A. A., Obispo-Fortunato, D. J., Clorio-Carrillo, J. A., Viejo, C. G., Fuentes, S., Schwinghamer, T., Patiño-González, V., & Hernández-Brenes, C. (2025). Fatty acids and fatty alcohol esters as novel markers of authenticity and extraction method of commercial avocado oil. *Food Chemistry: X, 27*, Article 102451. https://doi.org/10.1016/j.fochx.2025.102451

Metri-Ojeda, J., Solana-Lavalle, G., Rosas-Romero, R., Palau, E., Ramírez-Rodrigues, M., & Baigts-Allende, D. (2023). Rapid screening of mayonnaise quality using computer

vision and machine learning. *Journal of Food Measurement and Characterization, 17*, 2792–2804. https://doi.org/10.1007/s11694-023-01814-x

Moore, J. C., Spink, J., & Lipp, M. (2012). Development and application of a database of food ingredient fraud and economically motivated adulteration from 1980 to 2010. *Journal of Food Science, 77*, 118–126. https://doi.org/10.1111/j.1750-3841.2012.02657.x

Pérez-Calabuig, A. M., Pradana-López, S., Ramayo-Muñoez, A., Cancilla, J. C., & Torrecilla, J. S. (2023). Deep quantification of a refined adulterant blended into pure avocado oil. *Food Chemistry, 404*(A), Article 134474. https://doi.org/10.1016/j.foodchem.2022.134474

Priven, M., Baum, J., Vieira, E., Fung, T., & Herbold, N. (2015). The influence of a factitious free-from food product label on consumer perceptions of healthfulness. *Journal of the Academy of Nutrition and Dietetics, 115*(11), 1808–1814. https://doi.org/10.1016/j.jand.2015.03.013

Ramadan, M. F. (2015). Oxidation of β-sitosterol and campesterol in sunflower oil upon deep- and pan-frying of French fries. *Journal of Food Science and Technology, 52*(10), 6301–6311. https://doi.org/10.1007/s13197-015-1738-y

Ramos-Aguilar, A. L., Ornelas-Paz, J., Tapia-Vargas, L. M., Gardea-Béjar, A. A., Yahia, E. M., Ornelas-Paz, J., de, J., Ruiz-Cruz, S., Rios-Velasco, C., & Ibarra-Junquera, V. (2021). Comparative study on the phytochemical and nutrient composition of ripe fruit of Hass and Hass type avocado cultivars. *Journal of Food Composition and Analysis, 97*, Article 103796. https://doi.org/10.1016/j.jfca.2020.103796

Rodríguez-Sánchez, D. G., Marín-Obispo, L. M., Velázquez-Garza, F. E., Garza-Aguilar, S. M., Gonzalez Viejo, C., Fuentes, S., Colin-Oviedo, A., Díaz de la Garza, R. I., & Hernández-Brenes, C. (2025). Joint metabolites for avocado oil identity: Fatty acid profiles and fatty alcohol esters as unique derivatives. *Journal of Agricultural and Food Chemistry, 73*(2), 1529–1541. https://doi.org/10.1021/acs.jafc.4c06815

Rydlewski, A. A., Pizzo, J. S., Manin, L. P., Galuch, M. B., Santos, P. D. S., Zapiello, C., Santos, O. O., & Visentainer, J. V. (2020). Evaluation of possible fraud in avocado oil-based products from the composition of fatty acids by GC-FID and lipid profile by ESI-MS. *Chemical Papers, 74*, 2799–2812. https://doi.org/10.1007/s11696-020-01119-z

Salta, F. N., Kalogeropoulos, N., Karavanou, N., & Andrikopoulos, N. K. (2008). Distribution and retention of phytosterols in frying oils and fried potatoes during repeated deep and pan frying. *European Food Research and Technology, 227*, 391–400. https://doi.org/10.1007/s00217-007-0733-6

Soupas, L., Huikko, L., Lampi, A., & Piironen, V. (2007). Pan-frying may induce phytosterol oxidation. *Food Chemistry, 101*(1), 286–297. https://doi.org/10.1016/j.foodchem.2006.01.035

Srigley, C. T., Oles, C. J., Kia, A. R. F., & Mossoba, M. M. (2016). Authenticity assessment of extra virgin olive oil: Evaluation of desmethylsterols and triterpene dialcohols. *Journal of the American Oil Chemists' Society, 93*(2), 171–181. https://doi.org/10.1007/s11746-015-2759-4

Tan, C. X., Tan, S. S., & Tan, S. T. (2017). Influence of geographical origins on the physicochemical properties of Hass avocado oil. *Journal of the American Oil Chemists' Society, 94*(12), 1431–1437. https://doi.org/10.1007/s11746-017-3042-7

Tang, F., Banker, T., Green, H. S., Wang, S. C., & Hatzakis, E. (2024). Analysis and authentication of avocado oil by low-field benchtop NMR spectroscopy and chemometrics. *Journal of Food Science, 89*(7), 4276–4285. https://doi.org/10.1111/1750-3841.17142

Tang, F., Green, H. S., Wang, S. C., & Hatzakis, E. (2021). Analysis and authentication of avocado oil Using high resolution NMR Spectroscopy. *Molecules, 26*(2), 310. https://doi.org/10.3390/molecules26020310

Thompson, R. H., & Merola, G. V. (1993). A simplified alternative to the AOAC official method for cholesterol in multicomponent foods. *Journal of AOAC International, 76*(5), 1057–1068. https://doi.org/10.1093/jaoac/76.5.1057

U.S. Food and Drug Administration (FDA). (2013). *Guidance for industry: A food labeling guide*. U.S. Department of Health and Human Services.

Ujong, A. E., Emelike, N. J. T., Owuno, F., & Okiyki, P. N. (2023). Effect of frying cycles on the physical, chemical, and antioxidant properties of selected plant oils during deep-fat frying of potato chips. *Food Chemistry Advances, 3*, Article 100338. https://doi.org/10.1016/j.focha.2023.100338

Winkler, J. K., Warner, K., & Glynn, M. T. (2007). Effect of deep-fat frying on phytosterol content in oils with differing fatty acid composition. *Journal of the American Oil Chemists' Society, 84*(11), 1023–1030. https://doi.org/10.1007/s11746-007-1138-1

Wu, C., Chuang, Y., Ho, Y., Lin, Z., & Lee, W. (2024). Using 3-monochloropropanediol esters and glycidyl esters to discriminate adulteration of cold-pressed avocado oils and their refined variants. *European Journal of Lipid Science and Technology, 126*(8), Article 2300178. https://doi.org/10.1002/ejlt.202300178

Xu, G., Guan, L., Sun, J., & Chen, Z. (2009). Oxidation of Cholesterol and β-Sitosterol and prevention by natural antioxidants. *Journal of Agricultural and Food Chemistry, 57*(19), 9284–9292. https://doi.org/10.1021/jf902552s

Yao, S., Aykas, D. P., & Rodriguez-Saona, L. (2020). Rapid authentication of potato chip oil by vibrational spectroscopy combined with pattern recognition analysis. *Foods, 10*(1), 42. https://doi.org/10.3390/foods10010042

Zhang, Y., Zhang, T., Fan, D., Li, J., & Fan, L. (2018). The description of oil absorption behavior of potato chips during the frying. *LWT – Food Science and Technology, 96*, 119–126. https://doi.org/10.1016/j.lwt.2018.04.094

Brand information in **Authenticity of avocado and olive oils used as ingredients in commercially processed foods**

https://doi.org/10.1016/j.afres.2026.102389

Sample #	*Brand*	*Product name*	*Compositionally consistent with authentic oil*
1	Boulder Canyon	Avocado Oil Classic Sea Salt Kettle Style Potato Chips	
2	Boulder Canyon	Avocado Oil Classic Sea Salt Kettle Style Potato Chips	
3	Boulder Canyon	Olive Oil Classic Sea Salt Kettle Style Potato Chips	
4	Boulder Canyon	Olive Oil Classic Sea Salt Kettle Style Potato Chips	√
5	Lesser Evil	Moonions Intergalactic Onion Made with Organic Avocado Oil	
6	Lesser Evil	Moonions Intergalactic Onion Made with Organic Avocado Oil	√
7	Lay's	Baked BBQ Flavored Potato Crisps Made with Olive Oil	√
8	Lay's	Baked BBQ Flavored Potato Crisps Made with Olive Oil	√
9	Simply	Tostitos Sea Salt & Avocado Oil Tortilla Chips	√
10	Simply	Tostitos Sea Salt & Avocado Oil Tortilla Chips	
11	Trader Joe's	Kettle Cooked Olive Oil Potato Chips	√
12	Trader Joe's	Kettle Cooked Olive Oil Potato Chips	√
13	Siete	Kettle Cooked Sea Salt Potato Chips Made with Avocado Oil	
14	Siete	Kettle Cooked Sea Salt Potato Chips Made with Avocado Oil	
15	Siete	Maiz Sea Salt Corn Tortilla Chips Made with Avocado Oil	
16	Siete	Maiz Sea Salt Corn Tortilla Chips Made with Avocado Oil	
17	Kettle Brand	Sea Salt with a Hint of Pink Peppercorn Chips Made with Avocado Oil	
18	Kettle Brand	Sea Salt with a Hint of Pink Peppercorn Chips Made with Avocado Oil	
19	Kettle Brand	Apple Cider Vinegar Chips Made with Avocado Oil	
20	Kettle Brand	Apple Cider Vinegar Chips Made with Avocado Oil	
21	Jackson's	Avocado Oil Sweet Potato Chips	
22	Jackson's	Avocado Oil Sweet Potato Chips	
23	Jackson's	Kettle Cooked Sea Salt Potato Chips Only with Avocado Oil	
24	Jackson's	Kettle Cooked Sea Salt Potato Chips Only with Avocado Oil	

25	Sprouts	Organic Sea Salt & A Hint of Lime Tortilla Chips Made with Avocado Oil	
26	Sprouts	Organic Sea Salt & A Hint of Lime Tortilla Chips Made with Avocado Oil	
27	Sprouts	Kettle Style Potato Chips Made with 100% Avocado Oil Sea Salt	
28	Sprouts	Kettle Style Potato Chips Made with 100% Avocado Oil Sea Salt	
29	Sensible Portions	Garden Veggie Straws Made with Avocado Oil Sea Salt	
30	Sensible Portions	Garden Veggie Straws Made with Avocado Oil Sea Salt	
31	Torres	Extra Virgin Olive Oil Potato Chips	√
32	Torres	Extra Virgin Olive Oil Potato Chips	√
33	Bettergoods	Hatch Chile Tortilla Chips Fried in 100% Avocado Oil	
34	Bettergoods	Hatch Chile Tortilla Chips Fried in 100% Avocado Oil	
35	Good Health	Kettle Style Avocado Oil Potato Chips Sea Salt	
36	Good Health	Kettle Style Avocado Oil Potato Chips Sea Salt	
37	Graza	Extra Virgin Olive Oil Potato Chips	√
38	Graza	Extra Virgin Olive Oil Potato Chips	√
39	Sprouts	Balsamic Vinaigrette with Avocado Oil	
40	Sprouts	Balsamic Vinaigrette with Avocado Oil	
41	Primal Kitchen	Avocado Oil and Vinegar Vinaigrette & Marinade	
42	Primal Kitchen	Avocado Oil and Vinegar Vinaigrette & Marinade	
43	Primal Kitchen	Italian Dressing & Marinade Made with Avocado Oil	
44	Primal Kitchen	Italian Dressing & Marinade Made with Avocado Oil	
45	Chosen Foods	Lemon Garlic Dressing & Marinade Made with 100% Pure Avocado Oil	
46	Chosen Foods	Lemon Garlic Dressing & Marinade Made with 100% Pure Avocado Oil	
47	Chosen Foods	Zesty Italian Dressing & Marinade Made with 100% Pure Avocado Oil	
48	Chosen Foods	Zesty Italian Dressing & Marinade Made with 100% Pure Avocado Oil	
49	Bella Sun Luci	Sonoma Vinaigrette Made with 100% Olive Oil	√
50	Bella Sun Luci	Sonoma Vinaigrette Made with 100% Olive Oil	√
51	Bragg	Organic Vinaigrette Dressing Made with 100% Extra Virgin Olive Oil	√
52	Bragg	Organic Vinaigrette Dressing Made with 100% Extra Virgin Olive Oil	√
53	Briannas	Classic Balsamic Vinaigrette Made with 100% Avocado Oil	
54	Briannas	Classic Balsamic Vinaigrette Made with 100% Avocado Oil	

55	California Olive Ranch	Balsamic Vinaigrette Dressing Made with Extra Virgin Olive Oil	√
56	California Olive Ranch	Balsamic Vinaigrette Dressing Made with Extra Virgin Olive Oil	√
57	Chosen Foods	Vegan Mayo Made with 100% Pure Avocado Oil	
58	Chosen Foods	Vegan Mayo Made with 100% Pure Avocado Oil	
59	Chosen Foods	Classic Mayo Made with 100% Pure Avocado Oil	
60	Chosen Foods	Classic Mayo Made with 100% Pure Avocado Oil	
61	Primal Kitchen	Real Mayonnaise Made with Avocado Oil	
62	Primal Kitchen	Real Mayonnaise Made with Avocado Oil	
63	Sir Kensington's	Avocado Oil Mayonnaise	
64	Sir Kensington's	Avocado Oil Mayonnaise	
65	BetterBody Foods	100% Avocado Oil Mayo	
66	BetterBody Foods	100% Avocado Oil Mayo	
67	Grove	AvoYeah! Mayo Sauce Made with Avocado Oil	√
68	Grove	AvoYeah! Mayo Sauce Made with Avocado Oil	√
69	Grove	AvoYeah! Garlic Aioli Sauce Made with Avocado Oil	√
70	Grove	AvoYeah! Garlic Aioli Made with Avocado Oil	√
71	Graza	"Original" Mayo 100% Olive Pomace Oil & E.V.O.O.	√
72	Graza	"Original" Mayo 100% Olive Pomace Oil & E.V.O.O.	√
73	Graza	"Fancy" Mayo 100% Extra Virgin Olive Oil	√
74	Graza	"Fancy" Mayo 100% Extra Virgin Olive Oil	√

The study evaluated products purchased during a specific time period and represents a snapshot of the marketplace rather than a continuous assessment of brand quality. Consumers, manufacturers, and suppliers should recognize that ingredient sourcing and formulations may change over time. Consistent results across multiple lots provide greater confidence in ingredient authenticity than results based on a single lot.

	A	B	C	D
1	Table S1. Product category information, declared oil type, ingredients, retail price of all commercial samples analyzed and collec			
2	**Sample Number**	**Category**	**Declared oil**	**Front of package label**
3	1	Chips	Avocado Oil	Avocado Oil
4	2	Chips	Avocado Oil	Avocado Oil
5	3	Chips	Olive Oil	Olive Oil
6	4	Chips	Olive Oil	Olive Oil
7	5	Chips	Organic Avocado Oil	Organic Avocado Oil
8	6	Chips	Organic Avocado Oil	Organic Avocado Oil
9	7	Chips	Olive Oil	Made With Olive Oil
10	8	Chips	Olive Oil	Made With Olive Oil
11	9	Chips	Avocado Oil	Made with Avocado Oil
12	10	Chips	Avocado Oil	Made with Avocado Oil
13	11	Chips	Olive Oil	Olive Oil
14	12	Chips	Olive Oil	Olive Oil
15	13	Chips	Avocado Oil	Made with Avocado Oil
16	14	Chips	Avocado Oil	Made with Avocado Oil
17	15	Chips	Avocado Oil	Made with Avocado Oil
18	16	Chips	Avocado Oil	Made with Avocado Oil
19	17	Chips	Avocado Oil	Made with Avocado Oil
20	18	Chips	Avocado Oil	Made with Avocado Oil
21	19	Chips	Avocado Oil	Made with Avocado Oil
22	20	Chips	Avocado Oil	Made with Avocado Oil
23	21	Chips	Avocado Oil	Avocado Oil
24	22	Chips	Avocado Oil	Avocado Oil
25	23	Chips	Avocado Oil	Only With Avocado Oil
26	24	Chips	Avocado Oil	Only With Avocado Oil
27	25	Chips	Organic Avocado Oil	Made with Avocado Oil
28	26	Chips	Organic Avocado Oil	Made with Avocado Oil
29	27	Chips	Avocado Oil	100% Avocado Oil
30	28	Chips	Avocado Oil	100% Avocado Oil
31	29	Chips	Avocado Oil	Made with Avocado Oil
32	30	Chips	Avocado Oil	Made with Avocado Oil
33	31	Chips	Extra Virgin Olive Oil	100% Extra Virgin Olive Oil
34	32	Chips	Extra Virgin Olive Oil	100% Extra Virgin Olive Oil
35	33	Chips	Avocado Oil	100% Avocado Oil
36	34	Chips	Avocado Oil	100% Avocado Oil
37	35	Chips	Avocado Oil	Avocado Oil
38	36	Chips	Avocado Oil	Avocado Oil
39	37	Chips	Extra Virgin Olive Oil	Extra Virgin Olive Oil
40	38	Chips	Extra Virgin Olive Oil	Extra Virgin Olive Oil
41	39	Salad Dressing	Avocado Oil	Made with Avocado Oil
42	40	Salad Dressing	Avocado Oil	Made with Avocado Oil
43	41	Salad Dressing	Avocado Oil	Made with Avocado Oil
44	42	Salad Dressing	Avocado Oil	Made with Avocado Oil
45	43	Salad Dressing	Avocado Oil	Made with Avocado Oil
46	44	Salad Dressing	Avocado Oil	Made with Avocado Oil
47	45	Salad Dressing	Avocado Oil	Made with 100% Pure Avocado Oil
48	46	Salad Dressing	Avocado Oil	Made with 100% Pure Avocado Oil
49	47	Salad Dressing	Avocado Oil	Made with 100% Pure Avocado Oil
50	48	Salad Dressing	Avocado Oil	Made with 100% Pure Avocado Oil
51	49	Salad Dressing	Olive Oil	Made with 100% Olive Oil
52	50	Salad Dressing	Olive Oil	Made with 100% Olive Oil
53	51	Salad Dressing	Organic Extra Virgin Olive Oil	Made with 100% Extra Virgin Olive Oil
54	52	Salad Dressing	Organic Extra Virgin Olive Oil	Made with 100% Extra Virgin Olive Oil
55	53	Salad Dressing	Avocado Oil	100% Avocado Oil
56	54	Salad Dressing	Avocado Oil	100% Avocado Oil
57	55	Salad Dressing	Extra Virgin Olive Oil	Made with Extra Virgin Olive Oil
58	56	Salad Dressing	Extra Virgin Olive Oil	Made with Extra Virgin Olive Oil
59	57	Mayonnaise	Avocado Oil	Made with 100% Pure Avocado Oil
60	58	Mayonnaise	Avocado Oil	Made with 100% Pure Avocado Oil
61	59	Mayonnaise	Avocado Oil	Made with 100% Pure Avocado Oil
62	60	Mayonnaise	Avocado Oil	Made with 100% Pure Avocado Oil
63	61	Mayonnaise	Avocado Oil	Made with Avocado Oil
64	62	Mayonnaise	Avocado Oil	Made with Avocado Oil
65	63	Mayonnaise	Avocado Oil	Avocado Oil
66	64	Mayonnaise	Avocado Oil	Avocado Oil
67	65	Mayonnaise	Avocado Oil	100% Avocado Oil
68	66	Mayonnaise	Avocado Oil	100% Avocado Oil
69	67	Mayonnaise	Avocado Oil	With Avocado Oil
70	68	Mayonnaise	Avocado Oil	With Avocado Oil
71	69	Mayonnaise	Avocado Oil	With Avocado Oil
72	70	Mayonnaise	Avocado Oil	With Avocado Oil
73	71	Mayonnaise	Refined Olive Pomace Oil, Extra Virgin Olive Oil	100% Olive Pomace Oil & E.V.O.O.
74	72	Mayonnaise	Refined Olive Pomace Oil, Extra Virgin Olive Oil	100% Olive Pomace Oil & E.V.O.O.
75	73	Mayonnaise	Extra Virgin Olive Oil	100% Extra Virgin Olive Oil
76	74	Mayonnaise	Extra Virgin Olive Oil	100% Extra Virgin Olive Oil
77	75	Chips	Vegetable Oil (corn, canola, soybean, and/or sunflower oil)	
78	76	Chips	Vegetable Oil (canola, corn, soybean, and/or sunflower oil)	
79	77	Chips	Vegetable Oil (canola, sunflower, safflower, and/or soybean)	
80	78	Mayonnaise	Sunflower Oil	
81	79	Mayonnaise	Canola Oil, Soybean Oil	
82	80	Mayonnaise	Olive oil, Canola Oil, Soybean Oil	

	E
1	tion location.
2	**Other ingredients**
3	potatoes, sea salt
4	potatoes, sea salt
5	potatoes, sea salt
6	potatoes, sea salt
7	organic milled corn, organic raw cane sugar, organic tapioca solids, sea salt, organic onion powder, organic garlic powder, organic spices, citric acid
8	organic milled corn, organic raw cane sugar, organic tapioca solids, sea salt, organic onion powder, organic garlic powder, organic spices, citric acid
9	dried potatoes, corn starch, sugar, less than 2% of salt, soy lecithin, onion powder, brown sugar, molasses, dextrose, spices, fructose, garlic powder, tomato powder, yeast, natural flavors (contains milk), paprika extract (color), and
10	dried potatoes, corn starch, sugar, less than 2% of salt, soy lecithin, onion powder, brown sugar, molasses, dextrose, spices, fructose, garlic powder, tomato powder, yeast, natural flavors (contains milk), paprika extract (color), and
11	corn, sea salt
12	corn, sea salt
13	potatoes, sea salt
14	potatoes, sea salt
15	potatoes, sea salt
16	potatoes, sea salt
17	nixtamalized corn blend (organic white corn, organic yellow corn, lime), sea salt. (may contain coconut)
18	nixtamalized corn blend (organic white corn, organic yellow corn, lime), sea salt. (may contain coconut)
19	potatoes, maltodextrin, sea salt, sugar, dried pink peppercorn, garlic powder, onion powder, yeast extract, natural flavor, citric acid
20	potatoes, maltodextrin, sea salt, sugar, dried pink peppercorn, garlic powder, onion powder, yeast extract, natural flavor, citric acid
21	potatoes, apple cider vinegar powder, sea salt, sugar, malic acid, acetic acid, citric acid, natural flavor
22	potatoes, apple cider vinegar powder, sea salt, sugar, malic acid, acetic acid, citric acid, natural flavor
23	sweet potatoes, sea salt
24	sweet potatoes, sea salt
25	potatoes, sea salt
26	potatoes, sea salt
27	stone ground yellow organic corn, sea salt, lime
28	stone ground yellow organic corn, sea salt, lime
29	potatoes, sea salt
30	potatoes, sea salt
31	straws (potato starch, potato flour, corn starch, cane sugar, sweet potato powder, salt, calcium chloride, potassium chloride, spinach powder, tomato powder, beetroot powder [color], turmeric [color], beta-carotene [color]), sea salt
32	straws (potato starch, potato flour, corn starch, cane sugar, sweet potato powder, salt, calcium chloride, potassium chloride, spinach powder, tomato powder, beetroot powder [color], turmeric [color], beta-carotene [color]), sea salt
33	potatoes, salt
34	potatoes, salt
35	cassava flour, non-GMO yellow corn flour, hatch chile seasoning (salt, dextrose, maltodextrin, spices, onion powder, sugar, spinach powder, hatch chile pepper powder, garlic powder, green bell pepper powder, jalapeño pepper po
36	cassava flour, non-GMO yellow corn flour, hatch chile seasoning (salt, dextrose, maltodextrin, spices, onion powder, sugar, spinach powder, hatch chile pepper powder, garlic powder, green bell pepper powder, jalapeño pepper po
37	potatoes, sea salt
38	potatoes, sea salt
39	potatoes, salt
40	potatoes, salt
41	balsamic vinegar, water, sea salt, dehydrated garlic, gum blend (gum acacia, xanthan gum), onion powder, oregano, dehydrated red bell pepper, paprika, parsley, basil, turmeric, natural flavor
42	balsamic vinegar, water, sea salt, dehydrated garlic, gum blend (gum acacia, xanthan gum), onion powder, oregano, dehydrated red bell pepper, paprika, parsley, basil, turmeric, natural flavor
43	water, organic red wine vinegar, organic stone ground mustard (water, organic mustard seeds, organic vinegar, salt, organic spices), sea salt, garlic, organic lemon juice concentrate, organic black pepper, organic celery seed, orga
44	water, organic red wine vinegar, organic stone ground mustard (water, organic mustard seeds, organic vinegar, salt, organic spices), sea salt, garlic, organic lemon juice concentrate, organic black pepper, organic celery seed, orga
45	water, organic red wine vinegar, sea salt, contains less than 2% of organic lemon juice concentrate*, onion powder, organic black pepper, dried basil, garlic powder, organic dried oregano, organic konjac root fiber, organic crushed
46	water, organic red wine vinegar, sea salt, contains less than 2% of organic lemon juice concentrate*, onion powder, organic black pepper, dried basil, garlic powder, organic dried oregano, organic konjac root fiber, organic crushed
47	lemon juice from concentrate (water, lemon juice concentrate), water, sea salt, garlic powder, tapioca starch, citrus fiber, dehydrated garlic, black pepper, tamarind seed gum, turmeric powder
48	lemon juice from concentrate (water, lemon juice concentrate), water, sea salt, garlic powder, tapioca starch, citrus fiber, dehydrated garlic, black pepper, tamarind seed gum, turmeric powder
49	water, red wine vinegar, pear juice concentrate, garlic puree, shallots, organic parmesan concentrate (organic parmesan cheese [pasterized milk, cultures, salt, enzyme], water, sea salt), italian seasoning (spices, sea salt, onion po
50	water, red wine vinegar, pear juice concentrate, garlic puree, shallots, organic parmesan concentrate (organic parmesan cheese [pasterized milk, cultures, salt, enzyme], water, sea salt), italian seasoning (spices, sea salt, onion po
51	filtered water, white wine vinegar, apple cider vinegar, aged balsamic vinegar (grape must, wine vinegar), honey, sea salt, spice, garlic*, red bell pepper*, dried Roma Tomatoes, xanthan gum, rosemary extract, lemon juice concent
52	filtered water, white wine vinegar, apple cider vinegar, aged balsamic vinegar (grape must, wine vinegar), honey, sea salt, spice, garlic*, red bell pepper*, dried Roma Tomatoes, xanthan gum, rosemary extract, lemon juice concent
53	water, organic apple cider vinegar, organic honey, organic garlic puree (organic garlic, organic white vinegar), organic coconut liquid aminos (organic coconut blossom nectar, water, organic apple cider vinegar and sea salt), organi
54	water, organic apple cider vinegar, organic honey, organic garlic puree (organic garlic, organic white vinegar), organic coconut liquid aminos (organic coconut blossom nectar, water, organic apple cider vinegar and sea salt), organi
55	balsamic vinegar, water, salt, dried oregano, garlic powder, spices, xanthan gum
56	balsamic vinegar (wine vinegar, concentrated grape must, caramel color) , water, salt, dried oregano, garlic powder, spices, xanthan gum
57	water, balsamic vinegar (red wine vinegar, red grape must), cane sugar, sea salt, garlic powder, xanthan gum, dried rosemary, dried thyme
58	water, balsamic vinegar (red wine vinegar, red grape must), cane sugar, sea salt, garlic powder, xanthan gum, dried rosemary, dried thyme
59	filtered water, distilled white vinegar, chickpea protein blend (chickpea protein, tamarind seed gum), salt, mustard* (distilled vinegar*, water, mustard seed*, salt, spices*), xanthan gum, rosemary extract (for freshness), mustard oil.
60	filtered water, distilled white vinegar, chickpea protein blend (chickpea protein, tamarind seed gum), salt, mustard* (distilled vinegar*, water, mustard seed*, salt, spices*), xanthan gum, rosemary extract (for freshness), mustard oil.
61	filtered water, egg yolks, whole eggs*, distilled white vinegar*, mustard* (distilled vinegar*, water, mustard seed*, salt, spices*) salt, rosemary extract* (for freshness). *=Organic
62	filtered water, egg yolks, whole eggs, distilled white vinegar, mustard (distilled vinegar, water, mustard seed, salt, spices), salt, rosemary extract (for freshness)
63	organic vinegar, organic eggs, organic egg yolks, salt, rosemary extract, mustard seed extract
64	organic vinegar, organic eggs, organic egg yolks, contains less than 2% of salt, rosemary extract, mustard seed extract
65	Certified Humane cage-free egg yolks, water, distilled vinegar, salt, lime juice concentrate, citric acid, lime oil
66	Certified Humane cage-free egg yolks, water, distilled vinegar, salt, lime juice concentrate, citric acid, lime oil
67	egg yolk, water, distilled white vinegar, coconut palm sugar, lemon juice, salt, ground mustard, garlic powder, onion powder, EDTA (preservative)
68	egg yolk, water, distilled white vinegar, coconut palm sugar, lemon juice, salt, ground mustard, garlic powder, onion powder, EDTA (preservative)
69	water, whole egg, egg yolk, prepared mustard (water, mustard flour, sugar, salt, acetic acid, corn starch, white pepper, garlic powder, turmeric, smoked paprika), vinegar, lemon juice concentrate, sugar, salt, xanthan gum, polysorba
70	water, whole egg, egg yolk, prepared mustard (water, mustard flour, sugar, salt, acetic acid, corn starch, white pepper, garlic powder, turmeric, smoked paprika), vinegar, lemon juice concentrate, sugar, salt, xanthan gum, polysorba
71	water, whole egg, roasted garlic, vinegar, egg yolk, dijon mustard (water, mustard seed, salt, sugar, acetic acid, turmeric), salt, xanthan gum, lemon juice concentrate, sugar, white pepper, natural flavor, polysorbate 80, potassium s
72	water, whole egg, roasted garlic, vinegar, egg yolk, dijon mustard (water, mustard seed, salt, sugar, acetic acid, turmeric), salt, xanthan gum, lemon juice concentrate, sugar, white pepper, natural flavor, polysorbate 80, potassium s
73	water, egg yolks, white wine vinegar, sugar, salt, lemon juice from concentrate, xanthan gum, natural flavor, tocopherols (to help protect flavor), ascorbyl palmitate
74	water, egg yolks, white wine vinegar, sugar, salt, lemon juice from concentrate, xanthan gum, natural flavor, tocopherols (to help protect flavor), ascorbyl palmitate
75	water, egg yolks, sugar, white wine vinegar, salt, garlic, lemon juice from concentrate, xanthan gum, natural flavor, tocopherols (to help protect flavor), ascorbyl palmitate
76	water, egg yolks, sugar, white wine vinegar, salt, garlic, lemon juice from concentrate, xanthan gum, natural flavor, tocopherols (to help protect flavor), ascorbyl palmitate
77	corn, salt
78	potatoes, salt
79	potatoes, sea salt
80	Certified Humane cage-free egg yolks, water, distilled vinegar, salt, cane sugar, lemon juice, citric acid, lemon oil
81	water, sugar, distilled vinegar, salt, contains 2% or less of each of the following: modified food starch (corn, potato), lemon juice concentrate, natural flavor, calcium disodium EDTA (used to protect quality), paprika oleoresin
82	water, whole eggs, modified corn starch, sugar, distilled vinegar, egg yolks, salt, lemon juice concentrate, sorbic acid and calcium disodium EDTA (used to protect quality), vitamin E, natural flavor, paprika extract (for color)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Table S3. Fatty acid profiles (% of total identified fatty acids) of oils extracted from commercial products labeled as containing avocado oil or olive oil (1-74). Values represent mean of duplicate analyses ± standard deviation.																			
2		C6:0	C8:0	C10:0	C12:0	C14:0	C16:0	C16:1	C17:0	C17:1	C18:0	C18:1	C:18:1 cis(n7)	C18:2	C18:3	C20:0	C20:1	C20:2	C22:0	C24:1
3	CODEX	ND	ND	ND	ND	ND-0.3	11.0-26.0	4.0-17.1	ND-0.3	ND-0.1	0.1-1.3	42.0-75.0		7.8-19.0	0.5-2.1	ND-0.7	ND-0.3	ND	ND-0.5	ND-0.2
4	Sample Number					≤ 0.03	7.0-20.0	0.3-3.5	≤ 0.4	≤ 0.6	0.5-5.0	53.0-85.0		2.5-21.0	≤ 1.0a	≤ 0.6	≤ 0.5		≤ 0.2	
5	1	ND	ND	ND	ND	ND	8.1 ± 0.0	1.0 ± 0.0	ND	0.1 ± 0.0	2.6 ± 0.0	74.2 ± 0.0	1.6 ± 0.0	12.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
6	2	ND	ND	ND	ND	ND	8.7 ± 0.0	1.0 ± 0.0	ND	ND	2.5 ± 0.0	72.2 ± 0.2	1.5 ± 0.0	14.2 ± 0.2	0.4 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.5 ± 0.0	ND
7	3	ND	ND	ND	ND	ND	7.8 ± 0.0	1.0 ± 0.0	ND	0.1 ± 0.0	2.6 ± 0.0	71.8 ± 0.0	1.5 ± 0.0	15.1 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.7 ± 0.0	ND
8	4	ND	ND	ND	ND	ND	12.1 ± 0.0	0.9 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	3.0 ± 0.0	70.5 ± 0.0	2.3 ± 0.0	11.4 ± 0.0	0.7 ± 0.0	0.5 ± 0.0	0.3 ± 0.0	ND	0.2 ± 0.0	ND
9	5	ND	ND	ND	ND	ND	14.2 ± 0.0	2.3 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	2.7 ± 0.0	69.5 ± 0.0	3.0 ± 0.0	9.7 ± 0.0	0.6 ± 0.0	0.4 ± 0.0	0.2 ± 0.0	ND	0.1 ± 0.0	ND
10	6	ND	ND	ND	ND	0.1 ± 0.0	14.1 ± 0.0	4.9 ± 0.0	ND	0.1 ± 0.0	1.3 ± 0.0	65.0 ± 0.0	3.8 ± 0.0	13.5 ± 0.0	0.6 ± 0.0	0.2 ± 0.0	0.2 ± 0.0	ND	0.2 ± 0.0	ND
11	7	ND	ND	ND	ND	ND	12.3 ± 0.0	1.2 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	3.8 ± 0.0	71.0 ± 0.0	2.3 ± 0.0	9.8 ± 0.0	0.9 ± 0.0	0.4 ± 0.0	0.2 ± 0.0	ND	0.1 ± 0.0	ND
12	8	ND	ND	ND	ND	ND	12.3 ± 0.0	1.2 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	3.8 ± 0.0	71.0 ± 0.0	2.3 ± 0.0	9.9 ± 0.0	0.9 ± 0.0	0.4 ± 0.0	0.2 ± 0.0	ND	0.1 ± 0.0	ND
13	9	ND	ND	ND	ND	ND	16.8 ± 0.0	6.9 ± 0.0	ND	0.1 ± 0.0	1.0 ± 0.0	60.8 ± 0.0	5.1 ± 0.0	13.5 ± 0.0	0.5 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	ND	0.1 ± 0.0	ND
14	10	ND	ND	ND	ND	ND	10.2 ± 0.0	2.0 ± 0.0	ND	0.1 ± 0.0	2.5 ± 0.0	65.9 ± 0.0	2.3 ± 0.0	17.7 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.5 ± 0.0	ND
15	11	ND	ND	ND	ND	ND	13.7 ± 0.0	0.9 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	3.4 ± 0.0	69.4 ± 0.0	2.1 ± 0.0	10.7 ± 0.0	0.6 ± 0.0	0.5 ± 0.0	0.3 ± 0.0	ND	0.2 ± 0.0	ND
16	12	ND	ND	ND	ND	ND	11.9 ± 0.0	1.0 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	3.6 ± 0.0	74.4 ± 0.0	2.2 ± 0.0	7.4 ± 0.0	0.6 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	ND	0.1 ± 0.0	ND
17	13	ND	ND	ND	ND	ND	9.1 ± 0.0	1.4 ± 0.0	ND	ND	2.5 ± 0.0	72.9 ± 0.0	1.9 ± 0.0	12.2 ± 0.0	0.6 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
18	14	ND	ND	ND	ND	ND	8.5 ± 0.0	1.5 ± 0.0	ND	0.1 ± 0.0	2.6 ± 0.0	75.1 ± 0.0	1.9 ± 0.0	10.6 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
19	15	ND	ND	ND	ND	0.1 ± 0.0	9.4 ± 0.0	0.6 ± 0.0	0.1 ± 0.0	ND	2.8 ± 0.0	53.8 ± 0.1	1.2 ± 0.0	31.8 ± 0.1	0.4 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.6 ± 0.0	ND
20	16	ND	ND	ND	ND	ND	8.6 ± 0.0	0.7 ± 0.0	ND	ND	3.1 ± 0.0	56.9 ± 0.0	1.2 ± 0.0	29.1 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.7 ± 0.0	ND
21	17	ND	ND	ND	ND	ND	12.4 ± 0.0	1.0 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	3.0 ± 0.0	70.3 ± 0.1	2.4 ± 0.0	11.4 ± 0.0	0.7 ± 0.0	0.5 ± 0.0	0.3 ± 0.0	ND	0.2 ± 0.0	ND
22	18	ND	ND	ND	ND	0.1 ± 0.0	8.5 ± 0.0	1.3 ± 0.0	ND	ND	2.5 ± 0.0	72.6 ± 0.0	1.6 ± 0.0	13.6 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.5 ± 0.0	ND
23	19	ND	ND	ND	ND	ND	8.3 ± 0.3	1.1 ± 0.0	ND	0.1 ± 0.0	2.5 ± 0.1	71.9 ± 0.1	1.5 ± 0.0	14.8 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.4 ± 0.1	ND
24	20	ND	ND	ND	ND	0.1 ± 0.0	7.8 ± 0.1	1.1 ± 0.0	ND	ND	2.5 ± 0.0	70.6 ± 0.1	1.4 ± 0.0	16.5 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.5 ± 0.0	ND
25	21	ND	ND	ND	ND	ND	8.3 ± 0.0	1.0 ± 0.0	ND	0.1 ± 0.0	2.5 ± 0.0	70.0 ± 0.0	1.5 ± 0.0	16.5 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.5 ± 0.0	ND
26	22	ND	ND	ND	ND	ND	8.9 ± 0.1	1.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	2.8 ± 0.0	69.9 ± 0.3	1.7 ± 0.0	15.6 ± 0.2	0.5 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	ND	0.5 ± 0.0	ND
27	23	ND	ND	ND	ND	ND	8.4 ± 0.0	1.2 ± 0.0	ND	0.1 ± 0.0	2.5 ± 0.0	70.5 ± 0.0	1.6 ± 0.0	15.7 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
28	24	ND	ND	ND	ND	ND	8.4 ± 0.0	1.1 ± 0.0	ND	ND	2.7 ± 0.0	72.5 ± 0.0	1.6 ± 0.0	14.0 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.4 ± 0.0	ND
29	25	ND	ND	ND	ND	0.2 ± 0.0	23.7 ± 0.0	4.0 ± 0.0	ND	0.1 ± 0.0	1.7 ± 0.0	53.0 ± 0.0	3.6 ± 0.0	16.4 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	0.2 ± 0.0	ND	0.2 ± 0.0	ND
30	26	ND	ND	ND	ND	0.1 ± 0.0	9.3 ± 0.1	1.5 ± 0.0	ND	ND	2.1 ± 0.0	64.7 ± 0.2	1.5 ± 0.0	21.0 ± 0.1	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.4 ± 0.0	ND
31	27	ND	ND	ND	ND	ND	7.4 ± 0.0	1.1 ± 0.0	ND	ND	2.5 ± 0.0	71.6 ± 0.1	1.5 ± 0.0	15.9 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.7 ± 0.0	ND
32	28	ND	ND	ND	ND	0.1 ± 0.0	8.6 ± 0.2	0.6 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	3.0 ± 0.0	60.7 ± 0.3	1.4 ± 0.0	25.0 ± 0.1	0.5 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	ND	0.7 ± 0.0	ND
33	29	ND	ND	ND	ND	ND	8.7 ± 0.0	1.1 ± 0.0	ND	0.1 ± 0.0	2.6 ± 0.0	70.1 ± 0.0	1.6 ± 0.0	15.8 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
34	30	ND	ND	ND	ND	ND	8.3 ± 0.0	1.0 ± 0.0	ND	0.1 ± 0.0	2.6 ± 0.0	70.4 ± 0.0	1.5 ± 0.0	15.9 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
35	31	ND	ND	ND	ND	ND	10.4 ± 0.0	0.8 ± 0.0	0.1 ± 0.0	ND	3.5 ± 0.0	76.6 ± 0.0	2.0 ± 0.0	7.0 ± 0.0	0.6 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	ND	0.2 ± 0.0	ND
36	32	ND	ND	ND	ND	ND	10.9 ± 0.0	0.8 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	3.8 ± 0.0	76.0 ± 0.0	1.9 ± 0.0	6.7 ± 0.0	0.6 ± 0.0	0.5 ± 0.0	0.3 ± 0.0	ND	0.2 ± 0.0	ND
37	33	ND	ND	ND	ND	0.1 ± 0.0	7.0 ± 0.0	0.4 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	3.7 ± 0.0	66.6 ± 0.0	1.1 ± 0.0	19.1 ± 0.0	1.6 ± 0.0	0.4 ± 0.0	0.2 ± 0.0	ND	0.9 ± 0.0	ND
38	34	ND	ND	ND	ND	0.1 ± 0.0	10.6 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	4.3 ± 0.0	24.8 ± 0.1	1.4 ± 0.0	52.5 ± 0.0	6.5 ± 0.1	0.4 ± 0.0	0.2 ± 0.0	ND	0.3 ± 0.0	ND
39	35	ND	ND	ND	ND	0.1 ± 0.0	8.1 ± 0.0	0.8 ± 0.0	ND	ND	2.9 ± 0.0	56.8 ± 0.0	1.4 ± 0.0	29.7 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.6 ± 0.0	ND
40	36	ND	ND	ND	ND	0.1 ± 0.0	9.7 ± 0.0	0.8 ± 0.0	ND	ND	2.8 ± 0.0	72.2 ± 0.1	1.2 ± 0.0	13.0 ± 0.1	0.1 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.7 ± 0.0	ND
41	37	ND	ND	ND	ND	ND	10.9 ± 0.0	0.8 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	3.3 ± 0.0	63.3 ± 0.1	2.2 ± 0.1	20.1 ± 0.0	0.6 ± 0.0	0.4 ± 0.0	0.2 ± 0.0	ND	0.3 ± 0.0	ND
42	38	ND	ND	ND	ND	ND	10.9 ± 0.0	0.8 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	3.5 ± 0.0	71.4 ± 0.0	2.0 ± 0.0	11.5 ± 0.1	0.7 ± 0.0	0.4 ± 0.0	0.2 ± 0.0	ND	0.2 ± 0.0	ND
43	39	ND	ND	ND	ND	ND	7.8 ± 0.0	1.2 ± 0.0	ND	0.1 ± 0.0	2.4 ± 0.0	71.5 ± 0.0	1.7 ± 0.0	15.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
44	40	ND	ND	ND	ND	ND	8.6 ± 0.0	1.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	2.8 ± 0.0	69.0 ± 0.0	1.7 ± 0.0	16.7 ± 0.0	0.5 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	ND	0.5 ± 0.0	ND
45	41	ND	ND	ND	ND	ND	9.2 ± 0.0	2.0 ± 0.0	ND	0.1 ± 0.0	2.2 ± 0.0	71.7 ± 0.0	2.0 ± 0.0	13.3 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
46	42	ND	ND	ND	ND	ND	10.2 ± 0.0	3.0 ± 0.0	ND	0.1 ± 0.0	2.1 ± 0.0	69.5 ± 0.0	2.3 ± 0.0	13.8 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.5 ± 0.0	ND
47	43	ND	ND	ND	ND	ND	10.2 ± 0.0	2.6 ± 0.0	ND	0.1 ± 0.0	2.0 ± 0.0	65.8 ± 0.0	2.2 ± 0.0	17.8 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.5 ± 0.0	ND
48	44	ND	ND	ND	ND	ND	8.9 ± 0.0	1.8 ± 0.0	ND	0.1 ± 0.0	2.3 ± 0.0	72.1 ± 0.0	1.9 ± 0.0	13.3 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.6 ± 0.0	ND
49	45	ND	ND	ND	ND	ND	6.6 ± 0.0	0.8 ± 0.0	ND	ND	3.0 ± 0.0	70.7 ± 0.0	1.2 ± 0.0	17.2 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.8 ± 0.0	ND
50	46	ND	ND	ND	ND	ND	6.0 ± 0.0	0.7 ± 0.0	ND	ND	3.2 ± 0.0	71.1 ± 0.0	1.2 ± 0.0	17.2 ± 0.0	0.2 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.8 ± 0.0	ND
51	47	ND	ND	ND	ND	0.1 ± 0.0	6.9 ± 0.0	0.9 ± 0.0	ND	ND	2.7 ± 0.0	70.6 ± 0.0	1.2 ± 0.0	17.1 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	ND	0.7 ± 0.0	ND
52	48	ND	ND	ND	ND	0.1 ± 0.0	7.2 ± 0.1	1.0 ± 0.0	ND	ND	2.7 ± 0.0	70.2 ± 0.0	1.2 ± 0.0	17.2 ± 0.1	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.7 ± 0.0	ND
53	49	ND	ND	ND	ND	ND	14.0 ± 0.0	1.0 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	3.0 ± 0.0	70.0 ± 0.0	2.4 ± 0.0	10.0 ± 0.0	0.6 ± 0.0	0.5 ± 0.0	0.3 ± 0.0	ND	0.1 ± 0.0	ND
54	50	ND	ND	ND	ND	ND	13.3 ± 0.0	0.9 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	3.2 ± 0.0	69.4 ± 0.0	2.2 ± 0.0	11.2 ± 0.0	0.7 ± 0.0	0.5 ± 0.0	0.3 ± 0.0	ND	0.1 ± 0.0	ND
55	51	ND	ND	ND	ND	ND	16.2 ± 0.4	1.9 ± 0.3	0.0 ± 0.1	0.1 ± 0.0	2.4 ± 0.1	63.1 ± 2.5	2.7 ± 0.2	15.0 ± 2.1	0.7 ± 0.0	0.4 ± 0.0	0.2 ± 0.0	ND	0.1 ± 0.0	ND
56	52	ND	ND	ND	ND	ND	16.3 ± 0.5	2.0 ± 0.1	0.1 ± 0.0	0.1 ± 0.0	2.4 ± 0.1	61.1 ± 0.2	3.0 ± 0.0	16.8 ± 0.0	0.7 ± 0.0	0.2 ± 0.3	0.3 ± 0.1	ND	0.1 ± 0.0	ND
57	53	ND	ND	ND	ND	ND	8.9 ± 0.0	1.1 ± 0.0	ND	0.1 ± 0.0	2.4 ± 0.0	70.5 ± 0.1	1.5 ± 0.0	15.3 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
58	54	ND	ND	ND	ND	ND	8.6 ± 0.0	1.2 ± 0.0	ND	0.1 ± 0.0	2.6 ± 0.0	71.9 ± 0.0	1.8 ± 0.0	14.1 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.5 ± 0.0	ND
59	55	ND	ND	ND	ND	ND	17.2 ± 0.0	2.2 ± 0.0	0.1 ± 0.0	0.3 ± 0.0	1.9 ± 0.0	62.4 ± 0.0	4.1 ± 0.0	14.3 ± 0.0	0.8 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	ND	0.1 ± 0.0	ND
60	56	ND	ND	ND	ND	ND	14.3 ± 0.0	1.3 ± 0.0	0.2 ± 0.0	0.3 ± 0.0	2.3 ± 0.0	69.6 ± 0.0	2.9 ± 0.0	10.4 ± 0.0	0.7 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	ND	0.1 ± 0.0	ND
61	57	ND	ND	ND	ND	ND	6.8 ± 0.0	0.8 ± 0.0	ND	ND	2.5 ± 0.0	71.1 ± 0.0	1.3 ± 0.0	17.2 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.7 ± 0.0	ND
62	58	ND	ND	ND	ND	ND	6.0 ± 0.0	0.8 ± 0.0	ND	ND	3.2 ± 0.0	71.1 ± 0.0	1.2 ± 0.0	17.2 ± 0.0	0.2 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.8 ± 0.0	ND
63	59	ND	ND	ND	ND	ND	6.9 ± 0.0	0.9 ± 0.0	ND	ND	2.9 ± 0.0	69.7 ± 0.0	1.3 ± 0.0	18.0 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.8 ± 0.0	ND
64	60	ND	ND	ND	ND	ND	6.8 ± 0.0	0.8 ± 0.0	ND	ND	2.7 ± 0.0	69.8 ± 0.0	1.2 ± 0.0	18.1 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.7 ± 0.0	ND
65	61	ND	ND	ND	ND	ND	8.9 ± 0.0	1.7 ± 0.0	ND	0.1 ± 0.0	2.3 ± 0.0	72.5 ± 0.0	1.9 ± 0.0	13.0 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.5 ± 0.0	ND
66	62	ND	ND	ND	ND	ND	8.6 ± 0.0	1.1 ± 0.0	ND	0.1 ± 0.0	2.5 ± 0.0	70.6 ± 0.0	1.7 ± 0.0	15.6 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.5 ± 0.0	ND
67	63	ND	ND	ND	ND	0.1 ± 0.0	8.0 ± 0.0	1.2 ± 0.0	ND	0.1 ± 0.0	2.5 ± 0.0	72.0 ± 0.0	1.6 ± 0.0	14.8 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
68	64	ND	ND	ND	ND	0.1 ± 0.0	7.8 ± 0.0	1.2 ± 0.0	ND	0.1 ± 0.0	2.6 ± 0.0	69.8 ± 0.0	1.6 ± 0.0	17.0 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
69	65	ND	ND	ND	ND	0.1 ± 0.0	8.1 ± 0.0	1.6 ± 0.0	ND	0.1 ± 0.0	2.1 ± 0.0	68.8 ± 0.0	1.7 ± 0.0	17.9 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.5 ± 0.0	ND
70	66	ND	ND	ND	ND	0.1 ± 0.0	7.6 ± 0.0	1.2 ± 0.0	ND	0.1 ± 0.0	2.5 ± 0.0	69.4 ± 0.1	1.6 ± 0.0	17.8 ± 0.1	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.6 ± 0.0	ND
71	67	ND	ND	ND	ND	0.1 ± 0.0	13.5 ± 0.0	5.1 ± 0.0	ND	0.1 ± 0.0	1.1 ± 0.0	64.0 ± 0.0	5.1 ± 0.0	14.8 ± 0.0	0.8 ± 0.0	0.2 ± 0.0	0.2 ± 0.0	ND	0.1 ± 0.0	ND
72	68	ND	ND	ND	ND	0.1 ± 0.0	13.9 ± 0.0	7.2 ± 0.0	ND	0.1 ± 0.0	0.6 ± 0.0	65.1 ± 0.0	6.5 ± 0.0	12.0 ± 0.0	0.6 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	ND	ND	ND
73	69	ND	ND	ND	ND	0.1 ± 0.0	13.8 ± 0.0	5.0 ± 0.0	ND	0.1 ± 0.0	1.2 ± 0.0	63.8 ± 0.0	5.0 ± 0.0	14.7 ± 0.0	0.8 ± 0.0	0.2 ± 0.0	0.2 ± 0.0	ND	0.1 ± 0.0	ND
74	70	ND	ND	ND	ND	0.1 ± 0.0	14.2 ± 0.0	7.1 ± 0.0	ND	0.1 ± 0.0	0.6 ± 0.0	64.9 ± 0.0	6.4 ± 0.0	12.1 ± 0.0	0.7 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	ND	ND	ND
75	71	ND	ND	ND	ND	ND	13.3 ± 0.0	1.3 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	2.7 ± 0.0	69.0 ± 0.0	2.6 ± 0.0	11.7 ± 0.0	0.8 ± 0.0	0.5 ± 0.0	0.3 ± 0.0	ND	0.2 ± 0.0	ND
76	72	ND	ND	ND	ND	ND	13.2 ± 0.0	1.3 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	2.8 ± 0.0	69.7 ± 0.0	2.5 ± 0.0	11.0 ± 0.0	0.7 ± 0.0	0.5 ± 0.0	0.3 ± 0.0	ND	0.2 ± 0.0	ND
77	73	ND	ND	ND	ND	ND	13.6 ± 0.0	1.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.0	3.5 ± 0.0	71.4 ± 0.0	2.3 ± 0.0	8.1 ± 0.0	0.8 ± 0.0	0.5 ± 0.0	0.3 ± 0.0	ND	0.1 ± 0.0	ND
78	74	ND	ND	ND	ND	ND	15.0 ± 0.0	1.6 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	2.7 ± 0.0	69.0 ± 0.0	3.1 ± 0.0	10.0 ± 0.0	0.7 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	ND	0.1 ± 0.0	ND
79	75	ND	ND	ND	ND	ND	12.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	ND	1.7 ± 0.0	29.9 ± 0.0	0.6 ± 0.0	54.5 ± 0.0	0.8 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	ND	0.1 ± 0.0	ND
80	76	ND	ND	ND	ND	0.1 ± 0.0	4.0 ± 0.2	0.3 ± 0.1	0.1 ± 0.0	0.1 ± 0.0	1.7 ± 0.0	73.7 ± 0.3	3.4 ± 0.0	15.7 ± 0.1	2.1 ± 0.0	0.6 ± 0.0	1.4 ± 0.0	ND	0.3 ± 0.0	ND
81	77	ND	ND	ND	ND	ND	3.7 ± 0.1	0.1 ± 0.0	ND	ND	3.5 ± 0.2	85.4 ± 0.5	0.7 ± 0.0	5.6 ± 0.0	0.1 ± 0.0	0.3 ± 0.1	0.2 ± 0.0	ND	0.9 ± 0.3	ND
82	78	ND	ND	ND	ND	ND	4.2 ± 0.0	0.2 ± 0.0	ND	ND	2.8 ± 0.0	85.7 ± 0.0	0.9 ± 0.1	5.5 ± 0.0	0.1 ± 0.0	0.3 ± 0.0	0.3 ± 0.0	ND	0.9 ± 0.0	ND
83	79	ND	ND	ND	ND	0.1 ± 0.0	4.4 ± 0.0	0.2 ± 0.0	ND	ND	2.0 ± 0.0	63.1 ± 0.0	3.1 ± 0.0	20.2 ± 0.0	7.8 ± 0.0	0.6 ± 0.0	1.1 ± 0.0	ND	0.3 ± 0.0	ND
84	80	ND	ND	ND	ND	ND	9.6 ± 0.0	0.5 ± 0.0	0.1 ± 0.0	ND	3.0 ± 0.0	52.1 ± 0.0	2.4 ± 0.0	28.2 ± 0.0	5.2 ± 0.0	0.5 ± 0.0	0.5 ± 0.0	ND	0.3 ± 0.0	ND

Table S4. Sterol composition (% of total sterols) of oils extracted from commercial products labeled as containing avocado oil or olive oil (1-74). Values represent mean of duplicate analyses ± standard deviation.

	Brassicasterol	24-Methylene cholesterol	Campesterol	Campestanol	Stigmasterol	Delta-7-campesterol	Clerosterol	Beta-sitosterol	Sitostanol	Delta-5-avenasterol	Delta-5,24-stigmastadienol	Delta-7-stigmastenol	Delta-7-avenasterol	Delta-5,23-stigmastadienol+clerosterol+Beta-sitosterol+sitostanol+Delta-5-avenasterol+Delta-5,24-stigmastadienol
CODEX	**ND-0.5**		**4.0-8.3**		**0.3-2.0**		**1.0-2.5**	**79.0-93.4**		**2.0-8.0**		**ND-1.5**	**ND-1.5**	
Sample Number	**≤ 0.1**		**≤ 4.0**		**< campesterol**							**≤ 0.5**		**≥ 93.0**
1	0.3±0.0	0.4±0.0	9.8±0.1	0.7±0.0	6.6±0.1	1.2±0.0	0.5±0.0	68.0±0.2	0.2±0.0	2.6±0.1	1.3±0.0	5.5±0.2	3.0±0.0	
2	ND	0.5±0.0	11.5±0.0	0.8±0.0	7.0±0.0	1.3±0.0	0.5±0.0	64.8±0.2	0.6±0.1	3.2±0.1	1.1±0.0	5.8±0.3	2.8±0.1	
3	0.2±0.0	0.5±0.0	9.6±0.1	0.7±0.0	7.0±0.0	1.4±0.0	0.5±0.0	67.0±0.5	0.5±0.0	4.0±0.1	0.2±0.3	5.9±1.0	2.4±0.1	72.3±0.9
4	0.3±0.0	1.1±0.0	4.0±0.0	0.3±0.0	1.8±0.0	0.2±0.0	1.2±0.0	80.3±0.0	ND	10.3±0.0	ND	ND	0.6±0.0	91.8±0.1
5	ND	0.3±0.0	5.9±0.0	0.3±0.0	1.6±0.1	ND	0.9±0.0	81.7±0.4	1.6±0.1	3.2±0.1	0.6±0.0	3.5±0.2	0.5±0.0	
6	ND	0.3±0.0	7.0±0.0	0.5±0.0	1.7±0.0	0.6±0.0	1.3±0.0	78.6±0.0	1.3±0.0	4.9±0.1	2.5±0.1	ND	1.2±0.1	
7	0.4±0.0	0.3±0.0	5.5±0.0	ND	3.5±0.1	ND	0.4±0.0	82.9±0.1	ND	6.4±0.1	ND	ND	0.6±0.0	89.7±0.3
8	ND	0.5±0.1	5.6±0.0	ND	3.5±0.2	ND	0.4±0.1	82.3±0.5	ND	7.2±0.4	ND	ND	0.7±0.0	89.8±1.0
9	ND	0.4±0.0	9.1±0.0	0.8±0.0	2.3±0.0	0.4±0.1	0.9±0.0	80.0±0.1	2.7±0.0	2.4±0.0	0.6±0.0	ND	0.5±0.0	
10	ND	0.5±0.0	9.9±0.1	2.0±0.1	4.3±0.0	0.7±0.0	0.7±0.0	68.7±0.3	4.0±0.5	1.9±0.1	0.7±0.0	5.0±0.0	1.5±0.0	
11	ND	0.7±0.0	3.5±0.1	ND	1.7±0.1	ND	0.7±0.0	83.3±0.1	ND	8.6±0.2	0.6±0.0	ND	0.8±0.1	93.2±0.1
12	ND	0.8±0.1	3.6±0.1	ND	2.2±0.1	ND	0.6±0.1	83.4±0.8	ND	8.6±0.8	0.2±0.0	ND	0.7±0.0	92.7±0.1
13	1.2±0.1	0.8±0.0	11.4±0.0	0.8±0.0	5.3±0.1	1.3±0.0	0.4±0.1	65.2±0.0	0.7±0.0	4.8±0.0	0.7±0.2	4.9±0.0	2.5±0.0	
14	0.5±0.0	0.5±0.0	8.6±0.0	0.8±0.0	5.3±0.0	1.4±0.0	0.5±0.1	65.2±0.1	ND	6.0±0.1	1.1±0.1	7.3±0.2	3.0±0.1	
15	ND	0.5±0.0	11.8±0.1	2.6±0.0	6.0±0.1	0.9±0.0	0.6±0.0	63.6±1.0	5.6±0.1	1.4±0.1	1.3±0.1	3.6±1.1	2.1±0.0	
16	ND	0.4±0.0	12.6±0.1	1.3±0.1	6.6±0.3	1.2±0.1	0.6±0.1	66.2±0.1	1.8±0.1	1.9±0.0	0.7±0.0	4.5±0.5	2.4±0.0	
17	0.3±0.0	1.0±0.0	3.9±0.0	0.3±0.0	1.7±0.0	ND	1.2±0.1	77.6±0.2	0.2±0.0	7.1±0.1	ND	6.1±0.1	0.6±0.0	
18	0.2±0.0	0.3±0.0	10.0±0.1	0.6±0.0	6.6±0.1	1.3±0.1	0.3±0.0	65.3±0.2	0.6±0.1	3.5±0.1	0.5±0.2	8.2±0.5	2.5±0.1	
19	ND	0.5±0.1	9.5±0.0	0.7±0.0	6.5±0.0	1.2±0.0	0.5±0.0	67.4±0.0	ND	4.1±0.1	1.3±0.2	5.6±0.2	2.7±0.0	
20	ND	0.4±0.0	11.0±0.1	0.8±0.0	6.8±0.1	1.4±0.1	0.5±0.0	63.4±0.2	1.4±0.0	3.6±0.0	0.9±0.4	7.1±0.3	2.7±0.1	
21	ND	0.3±0.0	12.8±0.1	0.5±0.0	5.6±0.1	1.0±0.0	0.5±0.0	68.7±0.3	0.4±0.1	2.4±0.0	1.0±0.0	4.4±0.2	2.3±0.1	
22	ND	0.4±0.0	10.7±0.0	0.5±0.0	3.8±0.0	0.8±0.0	0.7±0.0	71.5±0.1	0.3±0.0	3.0±0.0	0.7±0.0	5.8±0.2	1.7±0.1	
23	ND	0.5±0.0	10.0±0.0	0.5±0.0	6.6±0.0	1.1±0.0	0.6±0.0	66.1±0.4	0.2±0.0	3.7±0.0	0.8±0.2	7.5±0.4	2.5±0.1	
24	ND	0.4±0.1	7.5±0.1	0.8±0.0	4.7±0.1	1.2±0.1	0.2±0.3	71.3±0.6	0.2±0.0	4.6±0.4	0.6±0.2	5.8±0.3	2.8±0.1	
25	ND	0.5±0.0	9.1±0.0	0.6±0.0	7.0±0.0	1.3±0.0	0.5±0.0	65.8±0.5	0.5±0.0	3.6±0.0	0.8±0.2	7.8±0.3	2.4±0.0	
26	ND	0.6±0.0	13.0±0.0	2.2±0.1	5.4±0.0	0.9±0.0	0.7±0.0	62.4±0.0	6.2±0.1	2.3±0.0	0.7±0.0	4.0±0.0	1.7±0.1	
27	0.5±0.0	0.4±0.0	11.2±0.0	0.9±0.0	7.2±0.0	1.4±0.0	0.7±0.0	59.0±0.3	0.7±0.1	5.1±0.0	1.7±0.1	8.1±0.3	3.0±0.1	
28	1.1±0.0	0.6±0.0	11.7±0.2	0.8±0.1	5.6±0.1	1.6±0.0	0.5±0.0	63.8±1.0	1.2±0.1	3.6±0.0	1.4±0.0	6.0±0.9	2.4±0.5	
29	0.2±0.0	0.4±0.1	9.4±0.1	0.6±0.0	5.6±0.1	1.1±0.0	0.6±0.1	68.2±0.1	0.4±0.1	2.7±0.1	0.8±0.0	7.3±0.3	2.5±0.1	
30	0.2±0.0	0.5±0.1	9.6±0.1	0.9±0.0	6.1±0.0	1.3±0.0	0.7±0.1	67.6±0.3	0.5±0.1	2.8±0.0	1.4±0.0	5.7±0.6	2.9±0.0	
31	ND	0.6±0.0	4.1±0.0	0.4±0.0	2.3±0.0	0.6±0.0	0.5±0.1	79.6±0.2	ND	9.7±0.1	1.4±0.1	ND	0.9±0.0	91.2±0.1
32	ND	0.7±0.0	3.7±0.1	0.3±0.0	1.7±0.0	ND	0.8±0.0	82.1±0.1	ND	10.1±0.0	ND	ND	0.7±0.0	93.0±0.1
33	0.3±0.0	0.2±0.0	12.7±0.0	1.2±0.0	10.5±0.1	1.1±0.0	0.4±0.0	60.0±0.0	2.5±0.0	2.2±0.0	0.5±0.2	6.0±0.2	2.5±0.0	
34	0.4±0.0	0.6±0.0	18.9±0.0	1.3±0.0	14.7±0.0	0.5±0.0	0.3±0.0	55.4±0.5	2.4±0.0	1.6±0.0	ND	2.3±0.4	1.6±0.1	
35	0.3±0.0	0.3±0.0	10.0±0.1	1.0±0.0	7.3±0.1	1.6±0.0	0.5±0.1	61.3±0.8	0.3±0.0	5.0±0.0	1.6±0.2	7.6±0.9	3.3±0.1	
36	ND	0.3±0.0	8.9±0.1	1.2±0.0	7.2±0.1	2.2±0.1	0.7±0.0	59.6±0.6	0.4±0.0	3.0±0.1	2.3±0.1	9.8±1.0	4.4±0.1	
37	ND	0.5±0.0	5.3±0.0	0.5±0.0	4.2±0.1	0.9±0.0	0.8±0.0	76.0±0.2	ND	8.3±0.1	1.7±0.0	ND	1.9±0.0	86.7±0.3
38	ND	0.6±0.1	4.2±0.1	0.3±0.0	2.8±0.0	0.5±0.0	0.8±0.0	79.8±0.1	ND	8.9±0.1	1.0±0.1	ND	1.1±0.0	90.5±0.3
39	ND	0.3±0.0	9.4±0.1	0.8±0.0	6.8±0.0	1.4±0.1	0.5±0.0	68.2±0.4	0.2±0.0	2.1±0.0	0.7±0.2	6.4±0.2	3.2±0.1	
40	0.2±0.0	0.4±0.1	6.5±0.2	0.5±0.1	4.0±0.2	0.9±0.1	0.4±0.0	74.3±0.3	0.2±0.0	2.8±0.0	0.6±0.0	7.1±0.4	2.2±0.1	
41	ND	0.3±0.0	9.8±0.1	0.8±0.0	5.8±0.1	1.3±0.0	0.7±0.0	67.9±0.8	0.3±0.0	2.6±0.0	1.8±0.0	6.0±1.1	2.9±0.1	
42	0.1±0.0	0.2±0.0	10.4±0.0	0.5±0.1	5.8±0.1	1.4±0.1	0.8±0.1	67.9±0.4	0.9±0.1	2.3±0.0	1.4±0.1	5.7±0.5	2.6±0.0	
43	ND	0.2±0.0	11.3±0.4	0.5±0.0	5.8±0.2	1.0±0.1	0.8±0.1	69.8±3.0	0.5±0.0	2.7±0.1	1.6±0.1	5.5±0.7	2.4±0.1	
44	ND	0.3±0.0	9.7±0.2	0.7±0.0	5.7±0.2	1.3±0.0	0.7±0.0	67.9±0.5	0.5±0.0	2.6±0.0	1.8±0.1	5.9±0.2	2.9±0.1	
45	ND	0.5±0.0	11.5±0.0	1.2±0.1	6.0±0.1	1.6±0.0	0.7±0.0	64.7±0.3	0.8±0.1	2.2±0.1	2.5±0.1	5.4±0.6	3.2±0.0	
46	ND	0.3±0.0	10.4±0.1	1.3±0.0	6.4±0.1	2.2±0.0	0.6±0.0	62.1±0.2	0.4±0.0	2.1±0.1	3.3±0.1	7.0±0.1	4.0±0.1	
47	ND	ND	12.0±0.0	ND	6.6±0.0	1.2±0.1	0.6±0.0	69.2±0.6	ND	1.9±0.0	0.9±0.1	5.1±0.6	2.6±0.0	
48	ND	0.3±0.0	11.2±0.1	0.7±0.0	6.6±0.0	1.2±0.1	0.5±0.0	65.7±0.1	0.5±0.0	1.8±0.0	1.5±0.0	7.6±0.3	2.4±0.6	
49	ND	0.6±0.0	3.5±0.0	ND	1.4±0.1	ND	0.8±0.1	83.0±0.2	ND	9.6±0.1	0.4±0.1	ND	0.8±0.0	93.8±0.1
50	ND	0.6±0.0	3.6±0.1	ND	1.4±0.3	ND	0.9±0.0	83.8±0.5	ND	9.0±0.9	ND	ND	0.8±0.0	93.7±0.4
51	ND	0.2±0.0	3.3±0.1	ND	0.5±0.1	ND	0.7±0.1	85.3±0.2	ND	9.7±0.0	ND	ND	0.4±0.0	95.6±0.1
52	ND	0.3±0.0	3.4±0.0	ND	0.6±0.1	ND	0.8±0.0	84.0±0.1	ND	10.0±0.1	0.3±0.0	ND	0.6±0.1	95.1±0.0
53	ND	0.3±0.0	12.0±0.0	0.8±0.0	5.8±0.1	1.1±0.2	0.5±0.0	66.7±0.1	ND	2.4±0.0	1.6±0.0	6.4±0.5	2.5±0.1	
54	ND	0.3±0.0	8.7±0.0	0.6±0.0	5.5±0.1	1.1±0.1	0.4±0.0	70.2±0.2	0.2±0.0	2.5±0.1	1.0±0.1	6.7±0.4	2.8±0.0	
55	ND	0.7±0.1	3.9±0.0	ND	1.0±0.1	ND	0.9±0.0	84.4±0.1	ND	8.5±0.2	0.4±0.0	ND	0.3±0.0	94.1±0.2
56	0.3±0.0	0.8±0.1	3.8±0.0	ND	0.9±0.0	ND	0.9±0.1	79.8±0.1	ND	12.7±0.0	0.4±0.0	ND	0.3±0.0	93.9±0.1
57	ND	0.4±0.0	12.0±0.0	0.9±0.0	7.1±0.0	1.2±0.0	0.7±0.0	64.5±0.1	0.8±0.0	2.1±0.0	1.6±0.0	6.1±0.0	2.6±0.0	
58	ND	0.3±0.0	9.7±0.2	1.3±0.1	7.8±2.5	2.0±0.0	0.6±0.0	62.1±1.2	0.3±0.1	2.0±0.0	2.9±0.2	7.2±0.7	3.9±0.1	
59	ND	0.6±0.0	11.8±0.1	1.2±0.1	5.8±0.0	1.5±0.0	0.7±0.0	62.3±0.8	0.8±0.0	2.3±0.0	2.4±0.0	7.7±0.8	3.1±0.0	
60	ND	0.6±0.0	12.0±0.1	1.1±0.0	6.1±0.0	1.5±0.0	0.7±0.0	63.8±0.5	0.9±0.0	2.1±0.0	2.2±0.0	6.2±0.6	3.0±0.0	
61	0.3±0.0	0.3±0.0	9.8±0.1	0.6±0.0	5.2±0.1	1.2±0.0	0.5±0.1	69.4±0.2	0.5±0.1	2.1±0.0	0.7±0.1	6.5±0.1	2.9±0.1	
62	ND	0.5±0.0	10.5±0.3	0.9±0.0	5.6±0.2	1.1±0.0	0.5±0.0	66.5±0.2	0.3±0.0	2.9±0.0	1.3±0.1	7.2±0.3	2.7±0.0	
63	ND	0.5±0.0	10.1±0.0	0.7±0.0	6.9±0.0	1.4±0.0	0.6±0.0	65.8±0.1	0.3±0.1	2.1±0.1	0.9±0.1	7.9±0.1	2.9±0.0	
64	ND	0.4±0.0	9.6±0.1	0.9±0.0	6.6±0.0	1.5±0.0	0.6±0.1	65.2±0.4	0.3±0.0	2.9±0.0	1.2±0.0	7.6±0.3	3.3±0.1	
65	ND	0.3±0.0	11.8±0.0	0.4±0.0	5.9±0.0	1.3±0.0	0.6±0.0	68.5±0.4	0.7±0.1	2.3±0.0	0.8±0.0	4.7±0.7	2.7±0.2	
66	ND	0.5±0.0	10.0±0.0	0.9±0.0	5.3±0.0	1.6±0.0	0.6±0.0	67.4±0.1	0.4±0.0	2.3±0.1	1.2±0.0	6.7±0.1	3.1±0.0	
67	ND	0.4±0.0	5.9±0.0	0.1±0.0	1.1±0.0	0.3±0.1	0.9±0.0	86.7±0.0	0.4±0.0	3.2±0.1	0.6±0.1	ND	0.5±0.0	
68	ND	0.2±0.0	5.3±0.0	ND	0.2±0.0	0.1±0.0	1.2±0.0	86.8±0.1	0.4±0.0	4.3±0.0	1.3±0.1	ND	0.3±0.0	
69	0.2±0.0	0.3±0.0	6.0±0.0	0.1±0.0	1.1±0.0	0.3±0.0	0.9±0.0	86.4±0.1	0.4±0.0	3.1±0.0	0.6±0.0	ND	0.5±0.0	
70	ND	0.2±0.0	6.1±0.0	ND	0.2±0.0	0.1±0.0	1.2±0.0	86.2±0.1	0.4±0.0	4.2±0.1	1.2±0.0	ND	0.3±0.0	
71	0.2±0.0	1.0±0.0	3.6±0.0	0.1±0.0	1.2±0.0	ND	1.7±0.0	81.9±0.2	ND	10.0±0.2	ND	ND	0.2±0.0	93.6±0.0
72	0.2±0.0	1.1±0.0	3.6±0.1	0.2±0.1	1.2±0.0	ND	1.8±0.0	81.4±0.1	ND	10.3±0.1	ND	ND	0.2±0.0	93.5±0.1
73	ND	0.9±0.1	3.2±0.0	ND	1.0±0.0	ND	1.0±0.1	84.0±0.0	ND	9.0±0.0	0.4±0.0	ND	0.4±0.0	94.5±0.0
74	ND	0.9±0.0	3.3±0.0	ND	0.9±0.0	ND	1.0±0.0	81.3±0.1	ND	11.6±0.0	0.6±0.0	ND	0.4±0.0	94.4±0.1
75	ND	0.8±0.0	17.1±0.3	1.5±0.0	6.0±0.1	ND	0.7±0.1	66.2±0.4	3.7±0.1	2.5±0.1	0.5±0.0	0.4±0.1	0.7±0.0	
76	13.3±0.0	0.2±0.0	30.8±0.1	ND	0.4±0.0	0.7±0.0	0.4±0.0	51.0±0.1	0.2±0.0	2.2±0.0	0.1±0.0	0.5±0.0	0.1±0.0	
77	0.2±0.0	0.3±0.0	9.1±0.0	1.3±0.0	9.8±0.0	2.0±0.1	0.5±0.0	59.3±0.0	1.0±0.1	3.1±0.0	ND	9.7±0.3	3.9±0.0	
78	ND	ND	9.3±0.2	1.2±0.0	9.7±0.3	2.2±0.0	0.5±0.0	57.2±1.4	ND	1.5±0.0	2.0±0.3	11.6±2.3	4.7±0.1	
79	10.5±0.0	ND	34.7±0.0	ND	0.6±0.0	0.4±0.0	0.3±0.0	50.1±0.0	ND	2.6±0.0	0.1±0.0	0.5±0.1	0.1±0.0	
80	6.5±0.0	0.3±0.0	26.9±0.1	0.1±0.0	4.9±0.1	0.5±0.0	0.4±0.0	56.9±0.2	0.2±0.1	2.6±0.0	0.2±0.0	ND	0.5±0.0	