Date	Limits	Terms	Hits
Jan 2021	English filter	(shea nut) OR (Sheanut) OR (shea butter) OR (Vitellaria paradoxa) OR (Butyrospermum paradoxum) OR (Butyrospermum parkii) OR (Shea stearine) OR (shea oleine) OR (shea stearin) OR (shea olein) OR (shea oil)	197
2/13/2021	-	stearic AND meta-analysis	18
2/13/2021	Humans, English, from 2010/1/1 - 3000/12/12	Search: stearic[tiab] AND ("randomized controlled trial" [pt] OR "controlled clinical trial" [PT] OR "Clinical Trial"[pt] OR clinical trials as topic [mesh: noexp] OR randomized[tiab] OR randomised[tiab] OR randomly[tiab] OR "controlled trial" OR "clinical trial" OR "crossover"[tiab] OR "cross-over"[tiab] OR pilot[tiab] OR placebo[tiab] OR trial[ti])	70
9/26/2021	English, from 2021/1/1 - 3000/12/12	Search: stearic AND meta-analysis	1
9/26/2021	English, from 2021/1/1 - 3000/12/12	Search: stearic[tiab] AND ("randomized controlled trial" [pt] OR "controlled clinical trial" [PT] OR "Clinical Trial"[pt] OR clinical trials as topic [mesh: noexp] OR randomized[tiab] OR randomised[tiab] OR randomly[tiab] OR "controlled trial" OR "clinical trial" OR "crossover"[tiab] OR "cross-over"[tiab] OR pilot[tiab] OR placebo[tiab] OR trial[ti])	19
9/26/2021	English, from 2021/1/1 - 3000/12/12	Search: (shea nut) OR (Sheanut) OR (shea butter) OR (Vitellaria paradoxa) OR (Butyrospermum paradoxum) OR (Butyrospermum parkii) OR (Shea stearine) OR (shea oleine) OR (shea stearin) OR (shea olein) OR (shea oil)	27
5/2/2022	English, from 2021/9/1 - 3000/12/12	Search: stearic AND meta-analysis	2
5/2/2022	English, from 2021/9/1 - 3000/12/12	Search: stearic[tiab] AND ("randomized controlled trial" [pt] OR "controlled clinical trial" [PT] OR "Clinical Trial"[pt] OR clinical trials as topic [mesh: noexp] OR randomized[tiab] OR randomised[tiab] OR randomly[tiab] OR "controlled trial" OR "clinical trial" OR "crossover"[tiab] OR "cross-over"[tiab] OR pilot[tiab] OR placebo[tiab] OR trial[ti])	16
5/2/2022	English, from 2021/9/1 - 3000/12/12	Search: (shea nut) OR (Sheanut) OR (shea butter) OR (Vitellaria paradoxa) OR (Butyrospermum paradoxum) OR (Butyrospermum parkii) OR (Shea stearine) OR (shea oleine) OR (shea stearin) OR (shea olein) OR (shea oil)	11

Date	Limits	Terms	Hits
9/7/2022	English, from 2022/5/1 - 3000/12/12	Search: stearic AND meta-analysis	4
9/7/2022	English, from 2022/5/1 - 3000/12/12	Search: stearic[tiab] AND ("randomized controlled trial" [pt] OR "controlled clinical trial" [PT] OR "Clinical Trial"[pt] OR clinical trials as topic [mesh: noexp] OR randomized[tiab] OR randomised[tiab] OR randomly[tiab] OR "controlled trial" OR "clinical trial" OR "crossover"[tiab] OR "cross-over"[tiab] OR pilot[tiab] OR placebo[tiab] OR trial[ti])	7
9/7/2022	English, from 2022/5/1 - 3000/12/12	Search: (shea nut) OR (Sheanut) OR (shea butter) OR (Vitellaria paradoxa) OR (Butyrospermum paradoxum) OR (Butyrospermum parkii) OR (Shea stearine) OR (shea oleine) OR (shea stearin) OR (shea olein) OR (shea oil)	7

Appendix E. Oral Toxicity Studies of Stearic and Oleic Acids

Fatty Acid	Dose	Species (no. per group)	Results [Reference as Cited by CIR]
Stearic Acid (eutectic)[a]	0.464, 1.00, 2.15, 4.64, 10.0 g/kg	5 male albino rats (BW 213-223 g)	Range, avg. gain- 71-101 g. One death in 4.64 g/kg dose group on day of dosage; one death in 4.64 g/kg dose group on final day of study [International Bio-Research-U.S., Inc. 1974]
Stearic Acid – 25% (w/v) in corn oil	0.464, 1.00, 2.15, 4.64, 10.0 g/kg	5 male albino rats (bw 216-225 g)	Range, avg. BW gain- 90-104 g at lower doses, 77 g at 10.0 g/kg dose. One death in 10.0 g/kg on Day 7 of study [International Bio-Research-U.S., Inc. 1974]
Stearic Acid – 65% in ethylene oxide, diluted 1:3 in water	5 and 10 g/kg	10 male young adult ARS/Sprague-Dawley albino rats (bw 215-239 g)	Final avg. BW 5 g/kg group 317 g; 10 g/kg group – 258 g. One death in 10 g/kg dose group on Day 5 following dosage. No pharmacotoxical signs noted. No remarkable alterations at necropsy [WARF Institute1978]
Stearic Acid	5 g/kg	Rat	No deaths [FASEB 1975]
Stearic Acid	5% in high-fat diet (6 weeks)	Rat	Decreased clotting time, moderate hyperlipemia, severe phlebothrombosis after initiation with *S. typhosa* lipopolysaccharide (LPS) [Renaud 1968] [Renaud 1969]
Stearic Acid	50% in diet (8 weeks)	Rat	Microscopic foreign body type reaction in excised fat. No reaction in controls. [Herting & Crain 1958]
Stearic Acid	6% in high-fat diet (9 weeks)	Rat	Severe aortic atherosclerosis, high mortality, severe thrombosis after *S. typhosa* LPS initiation [Renaud 1968]
Stearic Acid	50 g/kg/day in diet (24 weeks)	Rat	4/5 rats had foreign body type reaction in perigonadal fat. Lipogranulomas observed. Reversable effects. [Herting *et al.* 1959]
Stearic Acid	3000 ppm in diet (30 weeks)	Rat	Anorexia, severe pulmonary infection, high mortality. No significant pathological legions [Deichmann *et al.* 1958]
Oleic Acid[a]	5.0 g/kg	5 albino rats (bodyweight 193-217 g)	Range of BW after 7 days – 235–273 g. No deaths. Signs of toxicity not reported. Oleic Acid classified "slightly toxic by ingestion" [CTFA 1978]
Oleic Acid[b]	0.464, 1.00, 2.15, 4.64, 10.0, 21.5 ml/kg	5 male albino rats (bw 214-220 g)	LD_{50}> 21.5 ml/kg. Range in avg. BW gains 65-99. No deaths in any group [International Bio-Research-U.S., Inc. 1974]
Oleic Acid	15% in diet (10 weeks)	Rat	Normal appearance. Mammary gland under developed; few rats with ovarian cysts. No lesions in nonreproductive organs. Production

Fatty Acid	Dose	Species (no. per group)	Results [Reference as Cited by CIR]
			of 52 young by 7 adult females – 11/52 survived by 3rd week [Carroll & Noble 1957]
Oleic Acid	15% in diet (16 weeks)	Rat	No impairment of males' fertility. 4/4 females became pregnant; 2/4 deaths at parturition; 1 litter died within 3 days of birth [Carroll & Noble 1957]
Oleic Acid	15% in diet (20 weeks)	Rat	Normal growth observed [Carroll & Noble 1957]

[a] Fatty acid commercially supplied.
[b] These studies were cited in reviews for the safety assessment of particular fatty acids as they are used in foods and in fragrances.

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Appendix F. Composition of Shea-Derived Products Used in Pre-Clinical and Clinical Testing

CONTENTS

Appendix F Table 1. Summary comparison of source, production, and composition of shea stearin, shea olein, and shea butter used in pre-clinical studies

Parameter	AAK Shea Stearin[a]	GRN 850 Shea Olein[b]	Shea Butter[c]
Source	Crude shea butter	Crude shea butter	Crude shea butter
Production	Fractionation	Fractionation	-
Composition			
Total triglycerides, g per 100 g	~99	~92	~93
Stearic acid, g per 100 g	57	30	42
Oleic acid, g per 100 g	32	54	46
Total unsaponifiables, g per 100 g	1	6	7
Total sterols/triterpenes, g per 100 g	0.5	5.5	3.5
Normalized percentages by component			
α-Amyrin	35.7%	38.6%	40.9%
Butyrospermol	20.6%	22.2%	18.0%
Lupeol	18.8%	19.7%	15.7%
β-Amyrin	10.5%	7.0%	11.0%
Taraxasterol	4.8%	3.9%	7.1%
Δ7-Stigmastenol	3.4%	2.9%	2.0
24-Methylene cycloartenol	0.9%	1.1%	0.6%
Psi-Taraxasterol	0.4%	0.8%	0.0%
Others	4.9%	4.0%	4.8%

[a] Mean of 3 AAK batches; data as reported in Appendix A.
[b] Mean of 3 batches as presented in GRN 850.
[c] Single analysis for sterols/triterpenes concentration and distribution; data as reported in Appendix A. Total unsaponifiable value represents mean of 4 batches; data as reported in Appendix A.

Appendix F Table 2. Summary comparison of source, production, and composition of shea stearin and shea extracts used in pre-clinical studies

Parameter	AAK Shea Stearin	SheaNature shea butter extract (SBE)	BSP-201	SheaFlex75
Source	Crude Shea butter	Shea butter	Shea butter	Shea butter
Production	Fractionation	Concentration	Concentration	Concentration
Triglycerides, %	~99	-	>40 (di- and triglycerides)	-
Free fatty acids, %	<0.1	-	0.05-0.2	-
Unsaponifiables, %	1	75	50-55	50-70
Composition of unsaponifiables[a]	α-amyrin, butyrospermol, lupeol, β-amyrin, taraxasterol, Δ7-stigmastenol, 24-methylene, cycloartenol, psi-taraxasterol, others	esterified triterpene alcohols & sterols (primarily α-amyrin, butyrospermol, lupeol, β-amyrin, other triterpene alcohols[b])		α-amyrin, butyrospermol, lupeol, β-amyrin, other triterpene alcohols[b]
Non sterol/ triterpenes un-saponifiables, %	0.5	-	1.3	-
Other, %		-	1-5[c]	-
Data Source	AAK [d]	BSP Pharma A/S, 2003	BSP Pharma A/S, 2003	Kao *et al*., 2016

[a] Largely occurring as acetate or cinnamate esters.
[b] Based on published literature for shea butter.
[c] Reported to include 1-4% cinnamic acid and hydrogenated cinnamic acid, free sterols, free triterpene alcohols, and some other minor components (0-1%).
[d] Mean of 3 AAK batches; see Appendix A.
Note: BSP Pharma A/S, 2003 also describes SheaNature, a supplement with up to 82% unsaponifiables and >16% di- and triglycerides; it was not used in a dietary intervention.

Appendix F Table 3. Summary comparison of source, production, and composition of shea stearin and sheanut oil sterol concentrates used in clinical studies

Parameter	AAK Shea Stearin[a]	Sheanut oil sterol concentrate[b]
Source	Crude shea butter	Sheanut oil
Production	Fractionation	Not specified
Normalized percentages of sterols/triterpenes by component		
α-Amyrin	35.7%	32.0%
Butyrospermol	20.6%	17.8%
Lupeol	18.8%	15.0%
β-Amyrin	10.5%	5.7%
24-Methylene cycloartenol	0.9%	0%
Taraxasterol	4.8%	24.8%
Δ7-Stigmastenol	3.4%	
Psi-Taraxasterol	0.4%	
Others	4.9%	
Data source	AAK[a]	Weststrate and Meijer, 1998; Sierksma *et al*., 1999; and Vissers *et al*., 2000

[a] Mean of 3 AAK batches; see Appendix A.
[b] Data reported for sheanut oil sterol concentrate present only major sterols, which account for 95% of total reported sterols (93% of sterols as listed along with 2% combined from sitostanol, sitosterol, stigmasterol, campesterol); data reported in Westrate and Meirjer, 1998.
[c] Largely occurring as acetate and cinnamate esters.

Appendix G. Clinical Trials with Test Products Containing Shea(nut) Butter/oil

Clinical trials with test products containing shea(nut) butter/oil: Corroborative evidence

Reference	Study Design	Population Characteristics	Shea(nut) butter/ oil Test Article	Summary of Key Findings
Tholstrup *et al.*, 1994	Crossover RT; 3 weeks/ arm, 1-2 mo WO	15 Healthy male subjects, mean age 24.9 y	- Shea butter ('high-stearic acid' diet) provided 90% of the total fat vs fat from palm-kernel oil and palm-kernel oil + sunflower oil. Assuming mean intake of 14.4 MJ and 10.7 g fat per MJ and 90% of total fat from the test fat, average intake of shea butter was 139 g/day. - Shea butter composed of 42.1% stearic acid and 45% oleic acid. Shea butter was refined and rinsed, 6.9% unsaponifiables (Note: paper also reports unsaponifiables as 5.9%). - Source: Aarhus Olie, Aarhus, Denmark.	- Compared to Palm-kernel oil and Palm-kernel oil + sunflower oil diets, the shea butter diet resulted in significant reduction in plasma cholesterol, LDL cholesterol, HDL cholesterol, and reduced FVIIc compared to the palm-kernel oil diet. - No adverse effects reported.
Dougherty *et al.*, 1995	Crossover; RT, 40 days/ arm	10 Healthy males, 37.4 ± 2.1 y	- Sheanut oil was primary source of stearic acid in high stearate diet (stearic acid 25% of fatty acids, equal to 7.3% of energy (2870 kcal/d) as 18:0) vs a diet with 6% stearate from palm oil and butter. Amount of sheanut oil consumed per day not specified. - Sheanut oil composed of 40% stearic acid and 43.5% oleic acid, <0.8% unsaponifiables. - Source: VAN DEN BERGH Foods Company, Baltimore.	- Plasma total-, LDL-, and HDL-cholesterol were significantly lower with the sheanut oil diet than with the low stearate diet. - Total fecal fatty acid excretion was higher throughout the high stearate diet period. -No adverse effects reported.
Park *et al.*, 1996	Three-period crossover; RT, 4 weeks/ arm, 4-6 week WO	17 Healthy males, 21 - 32 y	- Sheanut butter (with lard and coconut oil) was the primary source of stearic acid in the '16.0 + 18.0' diet vs. diets high in '12.0 + 14.0' or '14.0 + 16.0'. - The diet containing sheanut butter provided 11.7 ± 0.4 MJ/d, 125 ± 4 g fat, with 15.4 ± 0.5 g C18:0 (12.3% of fat/5% of total energy). Amount of sheanut butter consumed per day not specified. - Sheanut butter composition and source not specified.	- Effects on serum total- and LDL-cholesterol did not differ across the diets. - The diet 16:0 + 18:0 appeared to enhance receptor-mediated LDL degradation, at least in subjects with a common apo E (3/3) phenotype; authors attributed this effect to 18:0. -No adverse effects reported.

Reference	Study Design	Population Characteristics	Shea(nut) butter/ oil Test Article	Summary of Key Findings
Tholstrup *et al.*, 1996; Tholstrup *et al.*, 2003	Crossover RT; 1 day, 8 d WO	10 Healthy male subjects, mean age 23 y	- Shea butter provided ~43% of the total fat vs fat from myristic acid in each of 2 test meals. Assuming mean intake of 97 g fat/meal, average intake of shea butter was 41.7 g/meal (total intake of shea butter 83.4 g). - Shea butter composed of 42.1% stearic acid and 45% oleic acid. Shea butter was refined and rinsed, 6.9% unsaponifiables, 0.74% keratine. - Source: Aarhus Olie, Aarhus, Denmark.	- Compared to fasting levels, both fats decreased platelet aggregation, and plasminogen activator inhibition was lower 24 h after intake compared with initial levels. Results do not confirm acute prothrombotic effect of the fats. -The myristic fat meal resulted in a higher postprandial HDL TG response than stearic fat meal, while no differences were observed in other lipid fractions. - No adverse effects reported.
Storm *et al.*, 1997	Three-period crossover; RT, 3 weeks/ arm, 2 week WO	15 Patients with NIDDM, 53 ± 9 y	- Sheanut butter was the primary source of stearic acid in a test diet that provided 13% energy as stearic acid (2168 ± 303 kcal/d) vs. diets rich in palmitic acid or CHO. Amount of sheanut butter consumed per day not specified. - Source: Aarhus oil; sheanut butter composition not specified.	- The stearic acid and CHO-rich diets had similar effects on lipid profiles, which resulted in lower total cholesterol than the palmitic-rich diet. No significant changes seen in HDL-cholesterol. - No negative effects on glycemic control, TG, or diurnal blood pressure.
Snook *et al.*, 1999	Three-period crossover; RT, 5 weeks/ arm, 7 week WO	18 Healthy females, 28 ±1.5 y	- Sheanut butter was a primary source of fat in the high stearic acid diet vs. high myristic acid or high palmitic acid. The high stearic diet contained 24 g sheanut oil, 21 g high oleic safflower oil, 14 g tristearin and 4 g coconut oil (13% total energy from C18:0). - Sheanut butter composition and source not specified.	- Mean concentrations of serum total-, esterified-, and LDL-cholesterol were significantly lower after the stearic acid diet than after palmitic acid diet. - Differences in the digestibilities of the fats were not a major factor in the results. - No adverse effects reported.
Sanders & Berry, 2005	crossover RT; acute; ≥1 week WO	16 Healthy men	- Shea butter (50 g) as unrandomized native oil vs high-oleic sunflower oil (50 g) (n=13), and shea butter (50 g) as native (unrandomized) or randomly interesterified (randomized) shea butter (50 g) (n=16). - Shea butter composition and source not specified.	- Both forms of shea butter led to only a modest increase in postprandial lipids - A test meal containing unrandomized shea butter resulted in decreased lipemia compared to a test meal consisting of high-oleic sunflower oil.

Reference	Study Design	Population Characteristics	Shea(nut) butter/ oil Test Article	Summary of Key Findings
Berry *et al.*, 2007	Crossover; RT, 3 weeks/ arm, 4 week WO	16 Healthy males, 26.8 ± 8.0 y	- Shea butter, either as unrandomized or randomized, was a source of stearic acid in 2 daily snacks for a total intake of 30 g of the test fat. - Source: Britannia Food Ingredients, Goole, United Kingdom; refined and randomized by Unilever Research (Vlaardingen, Holland) and blended with a small amount of sunflower oil so linoleic acid was ~10% of fatty acids. Stearic acid was 49.8% of fatty acids in randomized blend and 53.3% in unrandomized blend. - Follow on study: Acute study - fasting and postprandial blood samples were collected after the consumption of test meals containing 50 g unrandomized shea butter blend or oleic acid–rich fat, which were separated by ≥1 wk.	- The shea butter blend was well digested and absorbed. - Randomization did not affect fasting or postprandial lipid, glucose, insulin, or FVIIa concentrations. - There were no side effects or abnormal stool habits associated with consumption of the randomized and unrandomized shea blends. Authors also concluded that the study indicated no adverse effects of randomized stearic acid–rich fats on cardiovascular disease risk factors.
Maljaars *et al.*, 2009	DB, crossover RCT; acute	15 Healthy subjects, mean age 24 y; subjects intubated with a naso-ileal catheter	-Shea oil was source of fat in high stearic acid diet (59% C18:0) vs canola oil (2% C18:0) or safflower oil (2% C18:0) given by ileal infusion. Emulsions delivered 6 g fat over 60 minutes. - Shea oil composition 59% C18:0; source not specified.	- Compared to the control (saline), the stearic acid-rich emulsion did not significantly increase satiety.

Appendix H. GRAS Panel Signed Consensus Statement

GRAS PANEL CONSENSUS STATEMENT

The Generally Recognized as Safe (GRAS) Conclusion for the Use of Shea Stearin in Select Foods

Introduction

The undersigned, an independent panel of experts, qualified by their scientific training and national and international experience to evaluate the safety of food and food ingredients (the "GRAS Panel"), was specially convened to conduct a critical and comprehensive evaluation of the available pertinent data and safety information, and to determine whether under the conditions of intended use in select foods, shea stearin, a fractionated derivative of shea butter, would be generally recognized as safe (GRAS) based on scientific procedures. For purposes of this review, "safe" or "safety" means that there is "a reasonable certainty in the minds of competent scientists that the substance is not harmful under the intended conditions of use," as defined by the United States Food and Drug Administration (FDA) in 21 CFR §170.30.

At the request of AAK USA Inc. ("AAK"), Exponent, Inc. ("Exponent") performed a comprehensive search of the scientific literature in February 2021 relating to the safety of shea stearin with respect to the proposed use. Exponent summarized results of the literature searches and prepared a draft safety dossier, "Documentation Supporting a Generally Recognized As Safe (GRAS) Conclusion for the Use of Shea Stearin in Foods" (June 4, 2021) for consideration by the GRAS Panel.

The GRAS Panel consisted of the following individuals: Richard W. Lane, Ph.D., DABT (Lane Toxicology Consulting, LLC); Nadine R. Sahyoun, PhD, RD (Professor of Nutritional Epidemiology, University of Maryland); and Neil R. Widlak, MS, MBA (Consultant). The GRAS Panel, independently and collectively, critically evaluated Exponent's safety documentation (the dossier) and other available data and information that the members of the GRAS Panel believed to be pertinent to the safety of the proposed use of shea stearin, a fractionated derivative of shea butter.

On June 18, 2021, the GRAS Panel convened via teleconference and independently, jointly, and unanimously concluded that under the conditions of intended use described herein, shea stearin, produced in a manner consistent with current good manufacturing practice (cGMP) and meeting the stated specifications, is safe for the intended use. The GRAS Panel further concluded unanimously that the intended use of shea stearin, a fractionated derivative of shea butter, are GRAS based on scientific procedures. It is also the unanimous consensus opinion of this GRAS Panel that other qualified experts would concur with these conclusions.

Summarized below are the data, information, and interpretive analysis supporting the GRAS Panel's conclusions.

Description

Shea stearin is a fractionated vegetable fat comprised of triglycerides and a small fraction of unsaponifiable matter. The triglycerides in shea stearin are predominantly composed of stearic and oleic acids, and to a lesser extent palmitic, linoleic, and arachidic acids. Shea stearin therefore shares fatty acids with commonly consumed fats and oils in the diet.

Shea stearin is a GRAS-affirmed substance (referred to as "sheanut oil" in 21 CFR §184.1702) for use in confections and frostings, coatings of soft candy, sweet sauce and toppings at levels not to exceed current good manufacturing practice (21 CFR §184.1702).

The shea stearin that is the subject of this review is defined by specifications that differ slightly from the specifications for sheanut oil as defined in 21 CFR §184.1702, and the proposed use of shea stearin as defined in this dossier expands the use delineated in 21 CFR §184.1702. The specifications for shea stearin in this review reflect industry needs for uses of vegetable-derived solid fat in the absence of hydrogenation.

Production of the Substance and Specifications

- Sheanuts used to produce AAK's shea stearin are sourced from Africa and meet criteria established by AAK for moisture, mold, and physical defects. The sheanuts are processed under current Good Manufacturing Practices (cGMP) conditions using standard procedures, and the extracted crude shea oil is fractionated to produce shea stearin, which is then refined, bleached, and deodorized.
- Specifications for AAK's shea stearin include color ≤ 5 Lovibond Red, a neutral odor and taste, ≥50% stearic acid, ≤ 40% oleic acid, and limits for peroxide value (≤10 milliequivalents/kg), free fatty acid (≤1.0% as oleic acid), unsaponifiable matter (≤3.0%), iron (≤ 1.5 mg/kg), copper (≤ 0.1 mg/kg), and heavy metals including lead (≤0.1 mg/kg) and arsenic (≤0.1 mg/kg). Analytical data from non-consecutive batches of shea stearin demonstrate that the product meets these specifications.
- Specifications for shea stearin in this review include limits on stearic and oleic acids to define the material, while the specifications for the product described in 21 CFR §184.1702 include limits on iodine value and saponification value. The specifications in 21 CFR §184.1702 allow for up to 1.5% unsaponifiable matter, while the specifications for shea stearin as defined in this review allow for up to 3.0% unsaponifiable matter. The current Food Chemicals Codex (FCC12) specifications for "refined sheanut oil" are consistent with specifications detailed in 21 CFR §184.1702 on parameters of peroxide value, iodine value, saponification value, free fatty acids, unsaponifiable matter, and lead.

- In addition to meeting AAK's specifications for the established parameters, routine monitoring of the shea stearin is conducted for potential contaminants and analytical data demonstrate that the shea stearin is high quality and a suitable food ingredient.

Proposed Use and Estimated Daily Intake of the Substance

- Shea stearin is intended for use in plant-based meat & poultry analogues including burgers/ground meat and sausages, plant-based dairy alternatives and dairy analogues (including butter, cheese, cream cheese, creamers, frozen desserts, milks, sour cream, and yogurt); nut/seed spreads and butters, margarines/spreads, and bakery products including bars, biscuits, cakes, cookies, laminated dough products (Danish pastry/croissants), muffins, and pie crust. The maximum intended use of shea stearin ranges from 3.5 to 45% by category and represents the maximum concentration of shea stearin used alone or in combination with other oils as a blend.
- Use of shea stearin as an ingredient is intended to provide a source of fat in select analogues of animal-based products, and a replacement for animal fats and vegetable oils in specified foods. Intake of shea stearin will be substitutional for other sources of fat in the diet, including lard and tallow in ground meats and sausage, butterfat in dairy products, and butter and other fats and oils used in spreads and baked goods. Given that the intended use is largely substitutional, including substitution for animal fats with a comparable fatty acid profile, the intended use of shea stearin is not expected to substantially alter overall fat intake or intake of specific fatty acids.
- The estimated per user intake of shea stearin by the U.S. population ages 2 years and older from the proposed use is 25 g/p/day at the mean and 48 g/p/day at the 90th percentile of intake, which corresponds to 0.4 and 0.8 g/kg bw/day, respectively. In calculating the estimates of intake, all foods in each proposed use category were assumed to contain the maximum intended use of shea stearin, which is a standard approach for developing estimated intakes. In reality, manufacturers may not use the maximum intended use of shea stearin in products, and not all consumers may select products with shea stearin at all eating occasions. Additionally, the availability of shea stearin is restricted due to agronomic and economic factors specific to the production of shea butter and shea derivatives
- In a reference diet providing 2,000 kcal, adults may consume 400 to 700 kcal as fat per day as part of a diet aligning with acceptable macronutrient distribution ranges established by the IOM in 2005. This level of fat intake is equivalent to 44 to 78 g of fat per day. The per user estimated daily intake of shea stearin from the proposed use at the 90^{th} percentile (48 g/p/day) is well below the upper limit of the range and does not present a safety concern.

Established Recognition of Safety of Shea Stearin and Compositionally Similar Substances

- Outside of the U.S., shea butter and its fractions have a long history of safe use in food. Refined and unrefined shea butter have been used extensively in Africa as cooking oil since at least the 19th century, while exportation of shea butter from Africa to Europe has occurred since the latter part of the 19th century and it became more significant in the 1930s (FR, 1998; Honfo *et al.*, 2014).
- Shea stearin (referred to as "sheanut oil" in 21 CFR §184.1702) and related substances from shea butter have established specifications for safe use and are recognized as safe food ingredients in the US and globally:
    - Sheanut oil is an affirmed GRAS food substance for use in confections and frostings, coatings of soft candy, sweet sauce and toppings at levels not to exceed current good manufacturing practice (21 CFR §184.1702). Evidence of the common use of sheanut oil in food prior to 1958 and the absence of reported adverse effects resulting from common use provided the basis for FDA's affirmation of GRAS status of the use of sheanut oil in 1998.
    - Shea olein, sharing common fatty acids with shea stearin, and containing a significantly higher concentration of unsaponifiables relative to the shea stearin as defined in this dossier (9% in shea olein vs 3% in shea stearin), is also recognized as GRAS for use as a replacement for animal fats and vegetable fats rich in palmitic, myristic, and lauric fatty acids in conventional foods at levels within cGMP and principles as specified in GRN 850. FDA reviewed the GRAS notification and responded with a "no questions" letter.
- Globally, CODEX has established standards for unrefined shea butter that can be used for direct food consumption (CXS 325R-2017). Refined shea stearin is among the vegetable fats permitted to be added to chocolate products in the EU (EU Directive 2000/36/EC).
- Fats account for approximately 30% of energy in the diet, and triglycerides are the primary source of dietary fats. The absorption, distribution, metabolism, and excretion of triglycerides such as those present in shea stearin are well understood and documented in the literature.

Evidence of Safety from Published Pre-Clinical Studies and Corroboration from Unpublished Studies

- Given the compositional similarities of shea stearin to other shea-derived products, published studies on shea butter and shea olein are directly relevant to the safety of shea stearin.
- Published studies demonstrate that the absorption of shea butter is comparable to that of other GRAS fats and oils, and published studies demonstrate that growth of animals consuming shea butter is comparable to growth of animals fed other fats and oils that

have been recognized as GRAS; these studies provided supportive evidence for FDA's affirmation of the GRAS status of shea stearin (referred to as "sheanut oil" in 21 CFR §184.1702) (Thomasson, 1955; Thomasson, 1956; FR, 1998). Additionally, FDA noted that findings from an unpublished 104-week toxicity/carcinogenicity study demonstrated that sheanut oil had no carcinogenic potential.

- Published studies assessing the subchronic, reproductive, and carcinogenicity of shea olein in rats are reported in the peer-reviewed literature (Baldrick *et al.*, 2001, Carthew *et al.*, 2001, Earl *et al.*, 2002). These studies provided shea olein at levels up to 20% of the diet, corresponding to 7.5 to 15 g/kg bw/day. Diets containing shea olein were well tolerated and no adverse effects were attributed to shea olein. No indication of point mutations or chromosomal aberrations is noted in unpublished genotoxicity studies with shea olein as summarized in publicly available information (GRN 850).
- Information from unpublished but publicly available studies submitted to FDA for a new dietary ingredient derived from shea having high levels of unsaponifiables shows the absence of genotoxicity and acute toxicity (U.S. FDA, 2004).
- It is recognized that traditional use of pre-clinical studies to assess safety of food ingredients may not be applicable for macroadditives that result in large intakes (Borzelleca, 1992). The per user estimated daily intake of shea stearin from the proposed use at the 90th percentile (0.8 g/kg bw/day) is below the intake of 7.5 to 15 g/kg bw/day of shea olein examined in the studies cited above and demonstrated to be well tolerated with no adverse effects.

Evidence of Safety from Published Clinical Studies

- Human clinical studies with test products identified as sheanut butter, shea butter, sheanut oil, shea oil, or shea sterols provide evidence that acute or repeat intake of shea(nut) butter/oil or sterols/triterpenes does not result in adverse effects, and the shea test substances did not adversely impact biochemical measures.
- Six clinical studies report use of a test product identified as sheanut butter, shea butter, sheanut oil, or shea oil as a component of a test article. Daily intake of the shea products was not specified in all repeat-intake studies, but among the studies that did provide information to estimate intake, 24 g to 139 g of these products were consumed daily, and the duration of intake was 21 to 40 days (Berry *et al.*, 2007; Dougherty *et al.*, 1995; Park *et al.*, 1996; Snook *et al.*, 1999; Tholstrup *et al.*, 1994; Storm *et al.*, 1997). These studies were not designed to study the safety of shea(nut) butter/ oil, though no adverse effects were reported in the studies and the efficacy outcomes do not suggest that shea products as provided in these interventions adversely impacted biochemical measures. The estimated daily intake of shea stearin from the proposed use is estimated at 48 g/p/day at the 90th percentile of intake for the population ages 2 years and older, which is within the range of intake reported in clinical studies.

The intended use of shea stearin has been determined to be safe following the scientific procedures set forth in 21 CFR §170.3(b), thus satisfying the so-called “technical” element of the GRAS determination. Because this safety evaluation was based on generally available and widely accepted data and information, it also satisfies the so-called “common knowledge” element of a GRAS determination.

Conclusion

We, the undersigned independent qualified members of the GRAS Panel, have individually and collectively, critically evaluated the published and unpublished data and information summarized above that is pertinent to the proposed use of shea stearin, a fractionated derivative of shea butter, in select foods. We unanimously conclude that the proposed use of shea stearin, produced in a manner that is consistent with current Good Manufacturing Practice (cGMP) and meeting appropriate food-grade specifications as presented in the supporting dossier ["Documentation Supporting a Generally Recognized As Safe (GRAS) Conclusion for the Use of Shea Stearin in Foods"] is safe.

We, the members of the GRAS Panel, further unanimously conclude that the intended use of shea stearin, a fractionated derivative of shea butter, produced consistent with current Good Manufacturing Practice (cGMP) and meeting appropriate food-grade specifications as presented in the supporting dossier is Generally Recognized as Safe (GRAS) based on scientific procedures under the conditions of intended use in select foods specified herein.

It is our professional opinion that other qualified experts would also concur with this conclusion.

By:

[redacted]

Richard W. Lane, Ph.D., D.A.B.T., Chair
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July 22, 2021
Date

Nadine R. Sahyoun, PhD, RD.
Professor of Nutritional Epidemiology
University of Maryland

Date

Neil R. Widlak, MS, MBA
Consultant

Date

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