Study Title

The Impact of SDA Soybean Oil on the Intakes of Individual Fatty Acids in the United Kingdom

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Study Certification Page

This report is an accurate and complete representation of the study/project.

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Abbreviations [1]

AI	adequate intake
ALA	alpha (α)-linolenic acid
BNF	British Nutrition Foundation
DG	dietary goal
DH	Department of Health
DHA	docosahexaenoic acid
DRV	Dietary Reference Value
EPA	eicosapentaenoic acid
FAO	Food and Agriculture Organization (of the United Nations)
GLA	gamma (γ)-linolenic acid
MON 87769	Monsanto SDA-enriched soybean
MUFA	monounsaturated fatty acid
n-3	omega-3 fatty acid
n-6	omega-6 fatty acid
PUFA	polyunsaturated fatty acid
RBC	red blood cell
SDA	stearidonic acid
UK	United Kingdom
U.S.	United States
WHO	World Health Organization

[1] Standard abbreviations (e.g. units of measure) are used without definition.

1.0 Summary

Monsanto has developed biotechnology-derived soybean MON 87769 that produces stearidonic acid (SDA), an omega-3 fatty acid. Production of SDA in soybean seed was achieved through the introduction of genes encoding *Neurospora crassa* Δ15 desaturase (*Nc.Fad3*) and *Primula juliae* Δ6 desaturase (*PjD6D*) via *Agrobacterium*-mediated transformation.

Stearidonic acid-enriched oil (SDA soybean oil) from MON 87769 is a sustainable source of omega-3 fatty acid (18:4 n-3) that is intended to be included in certain foods to increase the omega-3 content of the diet. It is anticipated that the SDA soybean oil will have a concentration of approximately 20% to 30% SDA (wt % of total fatty acids) and that SDA consumption in the United Kingdom (UK) would increase 2.5 g/d such that 8.5 or 11.8 g/d of SDA soybean oil would be consumed for the 30% or 20% oil, respectively. A subsequent analysis was performed to determine the impact of this level of consumption of SDA soybean oil on changes in consumption of individual fatty acids for the UK population. Ten oils that constitute more than 85% of the plant oils in the UK diet were identified (soybean, groundnut, sunflower seed, rape seed, cottonseed oil, sesame seed, olive, rice-bran, maize germ, palm and coconut oils). Due to the high content of polyunsaturated fatty acids (PUFA) in SDA soybean oil, it is unstable and will oxidize readily in frying applications. For this reason, SDA soybean oil cannot be used for frying or solid ingredient oil functionally. Because it is unlikely that SDA soybean oil could replace palm and coconut oils for frying or other applications that require oils containing more saturated fats, these fats were not included in the evaluation. The fatty acid composition of the remaining eight oils (replaceable oil) was compared to the composition of SDA soybean oil in this evaluation.

The current analysis was based on three assumptions. First, these eight plant oils actually are consumed at the same ratios as reported by the Food and Agriculture Organization (FAO) consumption figures. Second, on average, the foods that will be fortified with SDA soybean oil will contain these oils in the same ratios as these eight plant oils (replaceable oil). Third, SDA soybean oil introduced to the diet will replace currently existing plant oils and the total fat intake will remain the same. The average composition of all plant oils in the diet that could be replaced with SDA soybean oil was calculated by using the fatty acid contents of each oil and weighting them by their respective market share. The change in total consumption of each of these fatty acids was calculated when: 1) 11.8 g of the replaceable oil was removed from the diet and replaced with 11.8 g of 20% SDA soybean oil, or 2) 8.5 g of the replaceable oil was removed from the diet and replaced with 8.5 g of 30% SDA soybean oil.

Of the five most common fatty acids (palmitic, stearic, oleic, linoleic, α-linolenic), oleic acid intake would be predicted to change the most, with a decrease between 2.79 to 3.48 g/d for men (Table 3) and between 2.06 and 2.58 g/d for women (Table 4) for 30% and 20% SDA soybean oil, respectively. Stearic acid (18:0) would be least affected and would increase by 0.14 to 0.26 g/d for men and 0.10 to 0.19 g/d for women. *Per capita*

intakes of the omega-3 fatty acid α-linolenic acid (ALA) would be increased by 0.30 to 0.47 g/d for men and 0.22 to 0.35 g/d for women and SDA intake would increase by 2.84 to 2.82 g/d and 2.10 to 2.09 g/d for men and women, respectively. Average SDA intake in the UK diet was calculated to be approximately 20 mg/d. Linoleic acid intake would be reduced by 1.71 to 1.59 g/d for men and 1.26 to 1.18 g/d for women whereas GLA would increase by 0.72 to 0.87 g/d for men and 0.53 to 0.65 g/d for women resulting in a net decrease of omega-6 fatty acids by 0.99 to 0.72 g/d for men and 0.73 to 0.53 g/d for women. The omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), would not be affected but increased consumption of SDA represents a major change in omega-3 fatty acid intake and would help improve the intake of healthy omega-3 fatty acids. Intake of omega-6 fatty acids would decrease by 0.38% to 0.28% of energy intake for men and 0.40% to 0.29% for women and this decrease is a small portion of the total intake of omega-6 fatty acids. Total polyunsaturated fatty acid intake (linoleic, ALA, GLA, SDA, EPA, DHA) would increase by 0.83% to 0.99% and 0.87 to 1.04% of energy intake for men and women, respectively. Saturated fatty acids would increase by 0.24% to 0.35% of energy intake for men and 0.25% to 0.37% of energy intake for women, which is a small portion of total saturated fat intake and would be within dietary goals. Oleic acid, which is the predominate monounsaturated fatty acid in the diet, would be decreased but there are no nutritional recommendations for oleic acid therefore this change is concluded to not have negative nutritional consequences.

These predicted changes are not expected to appreciably change fatty acid consumption compared to dietary recommendations, except for an increase in the intake of SDA. Substitution of SDA soybean oil for plant oils currently used in select food applications in the UK would result in nutritionally positive shifts in fatty acid intakes. Specifically, use of SDA soybean oil would increase intakes of two omega-3 fatty acids, stearidonic acid and α-linolenic acid and have minimal effects on the other fatty acids present in the diet.

2.0 Introduction

Monsanto has developed biotechnology-derived soybean MON 87769 that produces stearidonic acid (SDA), an omega-3 fatty acid. Production of SDA in soybean seed was achieved through the introduction of genes encoding *Neurospora crassa* Δ15 desaturase (*Nc.Fad3*) and *Primula juliae* Δ6 desaturase (*PjD6D*) via *Agrobacterium*-mediated transformation.

Stearidonic acid-enriched oil (SDA soybean oil), from MON 87769, is a sustainable source of omega-3 fatty acid (18:4 n-3) that is intended to be included in certain foods to increase the omega-3 content of the diet. It is anticipated that the SDA soybean oil will have a concentration of approximately 20% to 30% SDA on a w/w basis of total fatty acids. The SDA soybean oil will be introduced to the food industry as a new ingredient that is intended to be used as a substitution for existing liquid ingredient vegetable oils in certain foods that would be suitable for supplementation with omega-3 fatty acids. It is anticipated that food manufacturers would develop new food formulations with SDA soybean oil that maintain and/or minimize the amount of total fat in the recipe as well as possibly rebalancing other sources of fat to eliminate even the minor shifts in saturated fat and monounsaturated fatty acids (MUFA) predicted by this assessment process.

3.0 Purpose

By calculating the consumption of foods targeted for SDA fortification, it was estimated that adult (19-64 years) *per capita* consumption of SDA in the United Kingdom (UK) diet would increase 2.5 g/d and that 8.5 or 11.8 g/d of SDA soybean oil would be consumed for the 30% or 20% SDA soybean oil, respectively (Wang and Petersen, 2009a). The estimated 90th percentile adult consumption of SDA in the UK diet would increase 3.8 g/d and SDA soybean oil consumption would increase 13.3 or 18.5 g/d, respectively (Wang and Petersen, 2009a). A subsequent analysis was performed to determine the impact of this level of consumption of SDA soybean oil on changes in consumption of individual fatty acids for the UK population.

4.0 Methods

4.1 SDA Dose

Evidence from epidemiological and interventional trials has shown that the omega-3 fatty acids, eicosapentaenoic acid (EPA, 20:5 n-3) and docosahexaenoic acid (DHA, 22:6 n-3), reduce the risk of coronary heart disease, particularly sudden cardiac death (Albert et al., 2002; Dyerberg and Bang, 1982; GISSI Prevenzione Investigators, 1999). EPA has also been shown to positively impact cardiovascular markers such as triglycerides (Grimsgaard et al., 1997), and improve cardiovascular outcomes (Saito et al., 2008; Yokoyama et al., 2007) independent of DHA. EPA is approved for treatment of hyperlipidemia and arteriosclerosis obliterans in Japan (Mochida Pharmaceuticals, 2009). Stearidonic acid (SDA, 18:4) is the omega-3 fatty acid produced by desaturation of alpha-linolenic acid (ALA, 18:3 n-3) in humans. Because the rate-limiting reaction in the conversion of ALA to EPA is the conversion of ALA to SDA, consumption of SDA produces significantly more EPA in the human body than consumption of ALA (Harris et al., 2008b; James et al., 2003).

The EPA and DHA content in red blood cells (RBCs) has been correlated with reduced risk of cardiovascular disease, particularly sudden cardiac death. It has been estimated that for those individuals with low baseline EPA and DHA levels in RBCs, i.e. < 4% (w/w % total fatty acids in RBC membrane), a rise to 5% is associated with a 50% reduction in risk for sudden cardiac death (Harris and von Schacky, 2008). A dose of 1.5 g/day SDA in humans was shown to raise EPA in RBC phospholipids by 0.5% (James et al., 2003).

Intake recommendations for EPA and DHA for healthy individuals vary worldwide; however, many government agencies and health organizations have focused on approximately 400-500 mg/day (ISSFAL, 2009). Most recommendations do not provide specific guidance on the appropriate ratio of EPA and DHA. Fish and fish oils, which are a major food source of EPA and DHA, typically range between approximately 1:2 and 2:1 ratios of the two fatty acids (Ackman et al., 1998; Harris et al., 2008a). Taken together, about half of the 500 mg/day recommended intake equates to a goal of approximately 250 mg EPA/day, which could be obtained from eating foods prepared with oil containing SDA. Establishing a sufficient amount of SDA in the diet can be based on the relative efficacy of SDA vs. EPA to raise RBC EPA levels. Relative efficacies of SDA vary slightly between studies, from ~3:1 to 6:1 (Harris and von Schacky, 2008; James et al., 2003). Thus, 250 mg EPA/day could be achieved by 750 to 1500 mg SDA/day. This level of SDA intake should be made reasonable for consumers to achieve. U.S. FDA practice is to divide an effective dose amongst four servings a day (FDA, 1999). This is equivalent to 187 to 375 mg SDA/serving, the higher dose being likely to deliver greater benefit across a generally healthy but diverse population.

In summary, a dose of 1.5 g SDA/day divided amongst four servings to deliver 375 mg SDA/serving is the target SDA intake based on meaningful changes in EPA enrichment in the body. This intake target was utilized to estimate SDA consumption by adults in the United Kingdom (Wang and Petersen, 2009a).

4.2 Fatty acid intake.

Ten major vegetable oils (Table 1) in the UK diet were identified using FAOSTAT (FAO, 2003). Of these, palm and coconut oils have high saturated fat contents and are used primarily as frying oil or ingredient oil for foods that require solid fats. Due to the high content of polyunsaturated fatty acids (PUFA) in SDA soybean oil, it is unstable and will oxidize readily in frying applications. For this reason, SDA soybean oil cannot be used for frying or solid ingredient oil functionally. Therefore, substitution of SDA soybean oil for palm and coconut oils are not included in these calculations since that is a highly unlikely scenario that would result in unpalatable and/or unacceptable food products. In contrast, SDA soybean oil is intended to be used to replace portions of the other eight types of liquid plant oils used in formulation of specific foods in the UK market that would be suitable for supplementation with omega-3 fatty acids; therefore, these oils (replaceable oil) are included in these calculations.

The current analysis was based on three assumptions. First, these eight plant oils (ten oils minus palm and coconut oils) actually are consumed at the same ratios as reported by the Food and Agriculture Organization consumption figures. Second, on average, the foods that will be fortified with SDA soybean oil will contain these oils in the same ratios as these eight plant oils (replaceable oil). Third, SDA soybean oil introduced to the diet will replace currently existing plant oils and the total fat intake will remain the same. The change in total consumption of each of these fatty acids was calculated when: 1) 11.8 g of the replaceable oil was removed from the diet and replaced with 11.8 g of 20% SDA soybean oil, or 2) 8.5 g of the replaceable oil was removed from the diet and replaced with 8.5 g of 30% SDA soybean oil.

The average composition of all plant oils in the diet that could be replaced with SDA soybean oil was calculated by using the fatty acid contents for each oil and calculating a weighted average by the market shares of each plant oil (Table 1). The fatty acid composition data were from Holland et al. (1991), except for cottonseed oil (USDA ARS, 2008). This procedure was done for: 1) five fatty acids that make up more than 90% of the fatty acids in these oils (palmitic [16:0], stearic [18:0], oleic [18:1 n-9], linoleic [18:2 n-6], and α-linolenic acids [ALA, 18:3 n-3]); 2) fatty acids at relatively high concentrations in SDA soybean oil (γ-linolenic [GLA, 18:3 n-6] and SDA); and, 3) omega-3 fatty acids implicated in improved human health (eicosapentaenoic [EPA, 20:5 n-3] and docosahexaenoic acids [DHA, 22:6 n-3]). Then, the change in total consumption of each of these fatty acids was calculated for adults, adult males and adult females when a portion of the oil was removed from the diet and replaced with the same amount of 20% (actual = 20.7% SDA) or 30% (actual = 28.7% SDA) SDA soybean oil. The proportions of fatty acids in SDA soybean oils were provided by Monsanto (Studies: # 07-PP-83-16; #07-PP-83-02).

5.0 Results and Discussion

Predicted changes (g/d) in *per capita* intake of the nine fatty acids of interest after replacement with SDA soybean oil for adults in the UK are presented in Table 2. For the five most common fatty acids, oleic acid intake would be changed the most, with a decrease between 2.39 to 3.02 g/d for 30% and 20% SDA soybean oil, respectively. Stearic acid would be least affected and would increase between 0.12 to 0.22 g/d *per capita* and palmitic acid would change 0.42 to 0.56 g/d resulting in a change in saturated fat of 0.54 to 0.79 g/d. *Per capita* intakes of the omega-3 fatty acid ALA would be increased by 0.26 to 0.41 g/d and, as intended, SDA intake increased 2.44 g/d, resulting in the total omega-3 fatty acids intake (ALA + SDA) increasing 2.70 to 2.85 g/d. There would be no impact on the intakes of EPA and DHA since EPA and DHA levels in all types of plant oils are negligible. Linoleic acid intake would be reduced by 1.47 to 1.38 g/d and GLA would increase by 0.62 to 0.76 g/d resulting in a net decrease of omega-6 fatty acids by 0.85 to 0.62 g/d. Total PUFA intake would increase 1.85 to 2.22 g/d.

According to Givens and Gibbs (2006), the recommended intake of very long chain (VLC; C ≥ 20) omega-3 PUFA is not being met in the diets of the UK population. The Committee on Medical Aspects of Food Policy (COMA) recommended that intake of VLC omega-3 PUFA should be 200 mg/d (DH, 1994). The Scientific Advisory Committee on Nutrition suggested that the recommendation should be increased to 450 mg/d (SACN, 2004). Current mean intake of VLC omega-3 PUFA by adults is estimated to be about 282 mg/day with EPA and DHA contributing about 244 mg/day. Furthermore, the fact that only about 27% of adults eat any oil-rich fish (excluding canned tuna) and given the poor conversion of ALA to EPA and DHA *in vivo*, particularly in men, Givens and Gibbs (2006) concluded that current dietary sources of these fatty acids are not sufficient and that dietary enrichment may be needed. SDA soybean oil would increase consumption of SDA by 2.8 and 2.1 g/d (1.1 and 1.2% of total energy intake) for men and women, respectively, which represents a significant change in intake, compared to the current diet, and would help to improve the intake of healthy omega-3 fatty acids. Substituting the replaceable oil with SDA soybean oil would also result in an increase of ALA omega-3 intake.

Data on consumption of SDA in the UK are not available. Givens and Gibbs (2006) calculated intake of EPA+DHA from seafood. Using their reported intakes and average composition of their food categories from the UK's *McCance and Widdowsons The Composition of Foods* integrated database (Holland et al., 1991), we calculated that intake of EPA + DHA from whitefish and oily fish, which are the major sources for dietary SDA, was approximately 150 mg/d. This is near the 170 mg/d calculated by Givens and Gibbs (2006). Using these sources, the SDA consumption in the UK diet was estimated to be 20 mg/d, which is a reasonable value considering the level of seafood consumption in the UK diet. The SDA intake of the U.S. population was estimated to be 4 mg/day (Wang and Petersen, 2009b) and the intake of SDA by the Japanese population was estimated to be 60 mg/day (Wang and Vicini, 2009). The major food sources of SDA are seaweed and seafood (Holland et al., 1991; MECSST, 2008) and the average daily fish intake of the Japanese population is about 84 g (MHW, 1994). Daily intake of oily fish for British adults is 7.1 g and average daily intake of white fish is 14.9 g (SACN, 2004). It is anticipated that baseline intake of SDA in the UK is less than the intake for the Japanese population (60 mg/d) and is closer to the level of intake of Americans (4 mg/d).

In the UK, the Committee on Medical Aspects of Food and Nutrition Policy (COMA) set Dietary Reference Values (DRV) for PUFA at 6% of total energy in the diet. An individual PUFA maximum of 10% applies (with an individual minimum of 0.2% from linolenic acid, and 1% linoleic acid) as reported by the British Nutrition Foundation (BNF, 2004). According to the National Diet & Nutrition Survey (Henderson et al., 2003), Arnoult (2006), andHulshof et al. (1999), current intake of PUFAs in the adult UK population is approximately between 6.0% and 6.4% (Table 5) and increasing PUFA by addition of SDA soybean oil will increase intake of PUFA, primarily from added SDA, by approximately 1% of energy intake, which will be below the 10% maximum.

The Dietary Reference Value (DRV) for saturated fat intake is 10% of total energy intake (BNF, 2004) (Table 5). Intake of saturated fatty acids for British adults was between 13.2% and 14.3% of energy intake (Arnoult, 2006; Henderson et al., 2003; Hulshof et al., 1999). Following the inclusion of SDA soybean oil, saturated fat consumption will increase by 0.24% to 0.37% of energy intake for adults, which is a small portion of the total.

Oleic acid is the predominant MUFA in the diet and intake was calculated to change -2.79 or -3.48 g/d (-1.08% or -1.35% of energy intake) for men when using 30% or 20% SDA oil, respectively, and -2.06 or -2.58 g/d (-1.13% or -1.42 % of energy intake) for women, respectively. It is recommended that monounsaturated fatty acids provide 12-13% of total energy in the diet (BNF, 2004). According to Henderson et al. (2003), current average British adult intake of monounsaturated fatty acids is 12.1% and 11.5% of total energy for men and women, respectively. Hulshof et al. (1999) and Arnoult (2006) estimated combined MUFA intake for men and women at 11.4% and 12.99%, respectively. Other health authorities have not been able to set minimum recommended intake levels for MUFAs. For instance, the U.S. Institute of Medicine did not set an adequate intake level, estimated average requirement, or recommended daily allowance for oleic acid because, “there is no evidence that monounsaturated fatty acids are essential in the diet, and monounsaturated fatty acids have no known independent role in preventing chronic disease” (IOM/NAS, 2002). The Dietary Guidelines for Americans Technical Report (USDHHS/USDA, 2004) similarly acknowledged that MUFAs are not required in the diet; however, they provide a vehicle to achieving total fat intake recommendations within the context of saturated fat and PUFA recommendations. WHO (2009) does not recommend a specific intake for oleic acid but recommends that it should make up the difference between total fat intake of 15 to 30% of total energy and its goals for saturated fat (<10%), trans fat (<1%) and PUFA (6 to 10%). Therefore, the level of oleic acid can vary, as long as the diet provides other macronutrients in appropriate amounts. Therefore, the small decrease in oleic acid seen in this substitution is not likely to have any negative nutritional consequences.

The increase in SDA soybean oil intake is an overestimate (Wang and Petersen, 2009a), therefore, changes in the intake of other fatty acids are exaggerated, especially when considering that it is reasonable to expect food manufactures to rebalance other sources of fat to eliminate even the minor shifts in saturated fat and MUFA predicted by this assessment process.

6.0 **Conclusion**

Overall, the substitution of SDA soybean oil for plant oils in select food applications in the UK would be predicted toresult in nutritionally positive shifts in fatty acid intakes. Specifically, use of SDA soybean oil will increase intakes of two omega-3 fatty acids, stearidonic acid and α-linolenic acid and have minimal effects on other fatty acids.

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Table 1. Edible plant oil inventories in the United Kingdom, their fatty acid compositions, and fatty acid compositions of 20% and 30% SDA soybean oil

	Market share	Replaceable oil market share	Palmitic 16:0	Stearic 18:0	Oleic 18:1 n-9	Linoleic 18:2 n-6	ALA[1] 18:3 n-3	GLA[2] 18:3 n-6	SDA[3] 18:4 n-3	EPA[4] 20:5 n-3	DHA[5] 22:6 n-3
	%[6]	%[7]	% of fatty acids[8]								
Soybean Oil	28.1	32.1	11.2	4	21.8	53.9	7.6	0	0	0	0
Groundnut Oil	0.8	1.0	11.4	3.3	45.3	32.5	0	0	0	0	0
Sunflower seed Oil	8.0	9.1	6.5	4.5	21.1	66.2	0.1	0	0	0	0
Rape seed Oil	42.6	48.6	4.4	1.6	60.3	20.6	10.1	0	0	0	0
Cottonseed Oil	<0.1	0.0	22.7	2.3	17.0	51.5	0.2	0	0	0	0
Sesame seed Oil	0.3	0.3	9	5.3	39	45.2	0.3	0	0	0	0
Olive Oil	5.2	6.0	10.6	3.1	75.28	7.85	0.73	0	0	0	0
Maize Germ Oil	2.5	2.8	11.8	0	30.8	52.8	0.9	0	0	0	0
Palm Oil	8.4	0									
Coconut Oil	1.4	0									
Market-Weighted Replaceable oil	87.5	100.0	7.4	2.7	44.2	35.8	7.4	0	0	0	0
20% SDA soybean oil[8]oil[9]			12.2	4.6	18.6	24.1	10.9	6.4	20.7	0	0
30% SDA soybean oil[8]oil[9]			12.4	4.1	16	18.5	10.5	7.3	28.7	0	0

[1] α-Linolenic acid
[2] γ-Linolenic acid
[3] Stearidonic acid
[4] Eicosapentaenoic acid
[5] Docosahexaenoic acid
[6] From (FAO, 2003)
7 Excludes palm and coconut oil because it is a highly unlikely that SDA would replace these fats
[8] As reported by (Holland et al., 1991)
[9] Monsanto studies (# 07-PP-83-16; #07-PP-83-02)

Table 2. Change in per capita fatty acid consumption for adults aged 19-64 following replacement of plant oils with 20% or 30% SDA soybean oil.

	After 11.8 g/d of 20% SDA soybean oil	After 8.5 g/d of 30% SDA soybean oil
	(g/d)[1]	
Palmitic (16:0)	0.56	0.42
Stearic (18:0)	0.22	0.12
Oleic (18:1 n-9)	-3.02	-2.39
Linoleic (18:2 n-6)	-1.38	-1.47
ALA[2] (18:3 n-3)	0.41	0.26
GLA[3] (18:3 n-6)	0.76	0.62
SDA[4] (18:4 n-3)	2.44	2.44
EPA[5] (20:5 n-3)	0	0
DHA[6] (22:6 n-3)	0	0
n-3 PUFA[7]	2.85	2.70
n-6 PUFA	-0.62	-0.85
PUFA	2.22	1.85
Total saturated fatty acids	0.79	0.54

[1] Values presented are only for g/d. Values for percent of energy intake are not presented because energy intake is not specified.
[2] α-Linolenic acid
[3] γ-Linolenic acid
[4] Stearidonic acid
[5] Eicosapentaenoic acid
[6] Docosahexaenoic acid
[7] Polyunsaturated fatty acid

Table 3. Change *per capita* fatty acid consumption for adult males aged 19-64 following replacement of plant oils with 20% or 30% SDA soybean oil.

	After 13.6 g/d of 20% SDA soybean oil	After 9.9 g/d of 30% SDA soybean oil	After 13.6 g/d of 20% SDA soybean oil	After 9.9 g/d of 30% SDA soybean oil	
	(g/d)		(% of energy intake)[1]		
Palmitic (16:0)	0.65	0.49	0.25	0.19	
Stearic (18:0)	0.26	0.14	0.10	0.05	
Oleic (18:1 n-9)	-3.48	-2.79	-1.35	-1.08	
Linoleic (18:2 n-6)	-1.59	-1.71	-0.62	-0.66	
ALA[2] (18:3 n-3)	0.47	0.30	0.18	0.12	
GLA[3] (18:3 n-6)	0.87	0.72	0.34	0.28	
SDA[4] (18:4 n-3)	2.82	2.84	1.09	1.10	
EPA[5] (20:5 n-3)	0	0	0	0	
DHA[6] (22:6 n-3)	0	0	0	0	
n-3 PUFA[7]	3.29	3.14	1.27	1.22	
n-6 PUFA	-0.72	-0.99	-0.28	-0.38	
PUFA	2.56	2.15	0.99	0.83	
Total saturated fatty acids	0.91	0.63	0.35	0.24	

1 Assumes per capita caloric intake of 2321.58 kcal/d (9.72 MJ) (Henderson et al., 2003).
2 α-Linolenic acid
3 γ-Linolenic acid
4 Stearidonic acid
5 Eicosapentaenoic acid
6 Docosahexaenoic acid
7 Polyunsaturated fatty acid

Table 4. Change *per capita* fatty acid consumption for adult females aged 19-64 following replacement of plant oils with 20% or 30% SDA soybean oil.

	After 10.1 g/d of 20% SDA soybean oil	After 7.3 g/d of 30% SDA soybean oil	After 10.1 g/d of 20% SDA soybean oil	After 7.3 g/d of 30% SDA soybean oil
	(g/d)		(% of energy intake)[1]	
Palmitic (16:0)	0.48	0.36	0.26	0.20
Stearic (18:0)	0.19	0.10	0.10	0.06
Oleic (18:1 n-9)	-2.58	-2.06	-1.42	-1.13
Linoleic (18:2 n-6)	-1.18	-1.26	-0.65	-0.69
ALA[2] (18:3 n-3)	0.35	0.22	0.19	0.12
GLA[3] (18:3 n-6)	0.65	0.53	0.35	0.29
SDA[4] (18:4 n-3)	2.09	2.10	1.15	1.15
EPA[5] (20:5 n-3)	0	0	0	0
DHA[6] (22:6 n-3)	0	0	0	0
n-3 PUFA[7]	2.44	2.32	1.34	1.27
n-6 PUFA	-0.53	-0.73	-0.29	-0.40
PUFA	1.90	1.59	1.04	0.87
Total saturated fatty acids	0.67	0.46	0.37	0.25

[1] Assumes per capita caloric intake of 1640.87 kcal/d (6.87 MJ) (Henderson et al., 2003).
[2] α-Linolenic acid
[3] γ-Linolenic acid
[4] Stearidonic acid
[5] Eicosapentaenoic acid
[6] Docosahexaenoic acid
[7] Polyunsaturated fatty acid

Table 5. Intakes of individual fatty acids or groups of fatty acids in the United Kingdom and recommended intakes

	Intakes				Recommended Intakes	
	Henderson[1]		Hulshof[2]	Arnoult[3]	COMA[4]	WHO[5]
	Men	Women	Men & Women	Men & Women		
	g/d					
Stearic (18:0)			6			
Oleic (18:1 n-9)			19.3			
Linoleic (18:2 n-6)			11.4			
ALA[6] (18:3 n-3)			1.4			
	% of total energy					
Saturated fat	13.4%	13.2%	13.2%	14.29%	11%	<10%
Monounsaturated fat	12.1%	11.5%	11.4%	12.99%	13%	
n-3 PUFA	1%	1%				1% - 2%
n-6 PUFA	5.4%	5.3%				5% - 8%
PUFA	6.4%	6.3%	6.2%	5.95%	6.5%	6% - 10%
Total Fat	35.8%	34.9%	35.7%	33.45%	35%	15% – 30%

[1] Henderson et al. (2003)
[2] Hulshof et al. (1999)
[3] Arnoult (2006)
[4] BNF (2004)
[5] WHO (2009)
[6] α-Linolenic acid
[7] Polyunsaturated fatty acid