

Diacylglycerol Enhances the Effects of Alpha-Linolenic Acid Against Visceral Fat: A Double-Blind Randomized Controlled Trial

[Shinichiro Saito](#) ¹, [Atsuko Mori](#) ², [Noriko Osaki](#) ¹, [Yoshihisa Katsuragi](#) ¹
Affiliations expand

- PMID: 28851088
- PMCID: [PMC5638073](#)
- DOI: [10.1002/oby.21938](#)

[Free PMC article](#)

Abstract

Objective: To investigate the effect of alpha-linolenic acid-rich diacylglycerol (ALA-DAG) compared with alpha-linolenic acid-rich triacylglycerol (ALA-TAG) on visceral fat area (VFA) in people with overweight.

Methods: Subjects with overweight were recruited to a randomized, double-blind, controlled, parallel-group designed trial and randomly allocated to two groups that consumed either 2.5 g/d ALA-TAG or ALA-DAG for 12 weeks. Two 4-week nontreatment periods were placed before and after the treatment period. One hundred fourteen subjects (n = 57 in the ALA-TAG group, n = 57 in the ALA-DAG group) were enrolled into the analysis set for efficacy evaluation.

Results: The VFA and BMI were significantly decreased by the ALA-DAG treatment with a treatment-by-time interaction compared with the ALA-TAG treatment (P < 0.05). Additionally, the change from baseline of the fasting serum TAG concentration at week 12 was significantly decreased by ALA-DAG treatment compared with ALA-TAG treatment (P < 0.05). Safety parameters such as urinary measurements, hematologic parameters and blood biochemistry, and the incidence of adverse events did not differ significantly between groups, and no ALA-DAG-associated adverse effects were detected.

Conclusions: Incorporation of ALA-DAG in a regular diet for 12 weeks may lead to a reduction in VFA, BMI, and serum TAG in men and women with overweight.

© 2017 The Authors. Obesity published by Wiley Periodicals, Inc. on behalf of The Obesity Society (TOS).

Figures

Figure 1

Participant flow through the study....

Figure 2

Correlation between (**A**)...

Similar articles

- Consumption of alpha-Linolenic Acid-enriched Diacylglycerol Reduces Visceral Fat Area in Overweight and Obese Subjects: a Randomized, Double-blind Controlled, Parallel-group Designed Trial.

Saito S, Fukuhara I, Osaki N, Nakamura H, Katsuragi Y. *J Oleo Sci.* 2016 Jul 1;65(7):603-11. doi: 10.5650/jos.ess16059. Epub 2016 Jun 16. PMID: 27321122 Clinical Trial.

- Consumption of alpha-linolenic acid-enriched diacylglycerol induces increase in dietary fat oxidation compared with alpha-linolenic acid-enriched triacylglycerol: A randomized, double-blind trial.

Ando Y, Saito S, Miura H, Osaki N, Katsuragi Y. *Nutr Res.* 2017 Dec;48:85-92. doi: 10.1016/j.nutres.2017.10.012. Epub 2017 Oct 13. PMID: 29246284 Clinical Trial.

- [Alpha Linolenic Acid-enriched Diacylglycerol Consumption Enhances Dietary Fat Oxidation in Healthy Subjects: A Randomized Double-blind Controlled Trial.](#)

Ando Y, Saito S, Yamanaka N, Suzuki C, Ono T, Osaki N, Katsuragi Y. *J Oleo Sci.* 2017;66(2):181-185. doi: 10.5650/jos.ess16183.PMID: 28154349 Clinical Trial.

- [Metabolism of diacylglycerol in humans.](#)

Takase H. *Asia Pac J Clin Nutr.* 2007;16 Suppl 1:398-403.PMID: 17392138 Review.

- [The effects of diacylglycerol oil on fat oxidation and energy expenditure in humans and animals.](#)

Hibi M, Takase H, Meguro S, Tokimitsu I. *Biofactors.* 2009 Mar-Apr;35(2):175-7. doi: 10.1002/biof.25.PMID: 19449445 Review.

[See all similar articles](#)

Cited by 2 articles

- [Current Evidence to Propose Different Food Supplements for Weight Loss: A Comprehensive Review.](#)

Watanabe M, Risi R, Masi D, Caputi A, Balena A, Rossini G, Tuccinardi D, Mariani S, Basciani S, Manfrini S, Gnessi L, Lubrano C. *Nutrients.* 2020 Sep 20;12(9):2873. doi: 10.3390/nu12092873.PMID: 32962190 **Free PMC article.** Review.

- [Blautia genus associated with visceral fat accumulation in adults 20-76 years of age.](#)

Ozato N, Saito S, Yamaguchi T, Katashima M, Tokuda I, Sawada K,

Katsuragi Y, Kakuta M, Imoto S, Ihara K, Nakaji S. *NPJ Biofilms*

Microbiomes. 2019 Oct 4;5(1):28. doi: 10.1038/s41522-019-0101-x.

eCollection 2019. PMID: 31602309 **Free PMC article.**

References

1. Kuk JL, Katzmarzyk PT, Nichaman MZ, Church TS, Blair SN, Ross R. Visceral fat is an independent predictor of all-cause mortality in men. *Obesity (Silver Spring)* 2006;14:336-341. - [PubMed](#)
1. McNeely MJ, Shofer JB, Leonetti DL, Fujimoto WY, Boyko EJ. Associations among visceral fat, all-cause mortality, and obesity-related mortality in Japanese Americans. *Diabetes Care* 2012;35:296-298. - [PMC](#) - [PubMed](#)
1. Koster A, Murphy RA, Eiriksdottir G, et al. Fat distribution and mortality: the AGES-Reykjavik Study. *Obesity (Silver Spring)* 2015;23:893-897. - [PMC](#) - [PubMed](#)
1. Matsushita Y, Nakagawa T, Yamamoto S, et al. Associations of visceral and subcutaneous fat areas with the prevalence of metabolic risk factor clustering in 6,292 Japanese individuals: the Hitachi Health Study. *Diabetes Care* 2010;33:2117-2119. - [PMC](#) - [PubMed](#)
1. Shah RV, Murthy VL, Abbasi SA, et al. Visceral adiposity and the risk of metabolic syndrome across body mass index: the MESA Study. *JACC Cardiovasc Imaging* 2014;7:1221-1235. - [PMC](#) - [PubMed](#)
1. Kishida K, Funahashi T, Matsuzawa Y, Shimomura I. Visceral adiposity as a target for the management of the metabolic syndrome. *Ann Med* 2012;44:233-241. - [PubMed](#)
1. Kabir Y, Ide T. Activity of hepatic fatty acid oxidation enzymes in rats fed alpha-linolenic acid. *Biochim Biophys Acta* 1996;1304:105-119. - [PubMed](#)
1. Vijaimohan K, Jainu M, Sabitha KE, Subramaniam S, Anandhan C, Shyamala Devi CS. Beneficial effects of alpha linolenic acid rich flaxseed

- oil on growth performance and hepatic cholesterol metabolism in high fat diet fed rats. *Life Sci* 2006;79:448-454. - [PubMed](#)
1. Takeuchi H, Matsuo T, Tokuyama K, Shimomura Y, Suzuki M. Diet-induced thermogenesis is lower in rats fed a lard diet than in those fed a high oleic acid safflower oil diet, a safflower oil diet or a linseed oil diet. *J Nutr* 1995;125:920-925. - [PubMed](#)
 1. Jones PJ, Jew S, AbuMweis S. The effect of dietary oleic, linoleic, and linolenic acids on fat oxidation and energy expenditure in healthy men. *Metabolism* 2008;57:1198-1203. - [PubMed](#)
 1. Gillingham LG, Robinson KS, Jones PJ. Effect of high-oleic canola and flaxseed oils on energy expenditure and body composition in hypercholesterolemic subjects. *Metabolism* 2012;61:1598-1605. - [PubMed](#)
 1. Rallidis LS, Paschos G, Liakos GK, Velissaridou AH, Anastasiadis G, Zampelas A. Dietary alpha-linolenic acid decreases C-reactive protein, serum amyloid A and interleukin-6 in dyslipidaemic patients. *Atherosclerosis* 2003;167:237-242. - [PubMed](#)
 1. Watanabe H, Onizawa K, Taguchi H, et al. Nutritional characterization of diacylglycerols in rats. *Journal of Japan Oil Chemists' Society* 1997;46:301-307.
 1. Kondo H, Hase T, Murase T, Tokimitsu I. Digestion and assimilation features of dietary DAG in the rat small intestine. *Lipids* 2003;38:25-30. - [PubMed](#)
 1. Yanagita T, Ikeda I, Wang YM, Nakagiri H. Comparison of the lymphatic transport of radiolabeled 1,3-dioleoylglycerol and trioleoylglycerol in rats. *Lipids* 2004;39:827-832. - [PubMed](#)
 1. Tomonobu K, Hase T, Tokimitsu I. Dietary diacylglycerol in a typical meal suppresses postprandial increases in serum lipid levels compared with dietary triacylglycerol. *Nutrition* 2006;22:128-135. - [PubMed](#)
 1. Saito S, Yamaguchi T, Shoji K, Hibi M, Sugita T, Takase H. Effect of low concentration of diacylglycerol on mildly postprandial hypertriglyceridemia. *Atherosclerosis* 2010;213:539-544. - [PubMed](#)
 1. Ando Y, Saito S, Oishi S, et al. Alpha linolenic acid-enriched diacylglycerol enhances postprandial fat oxidation in healthy subjects: a randomized double-blind controlled trial. *J Oleo Sci* 2016;65:685-691. - [PubMed](#)

1. Ando Y, Saito S, Yamanaka N, et al. Alpha linolenic acid-enriched diacylglycerol consumption enhances dietary fat oxidation in healthy subjects: A randomized double-blind controlled trial. *J Oleo Sci* 2017;66:181-185. - [PubMed](#)
1. Saito S, Fukuhara I, Osaki N, Nakamura H, Katsuragi Y. Consumption of alpha-linolenic acid-enriched diacylglycerol reduces visceral fat area in overweight and obese subjects: a randomized, double-blind controlled, parallel-group designed trial. *J Oleo Sci* 2016;65:603-611. - [PubMed](#)
1. Micha R, Khatibzadeh S, Shi P, et al. Global, regional, and national consumption levels of dietary fats and oils in 1990 and 2010: a systematic analysis including 266 country-specific nutrition surveys. *BMJ* 2014;348:g2272. doi:10.1136/bmj.g2272 - DOI - PMC - [PubMed](#)
1. Watanabe T, Shimizu M, Sugiura M, et al. Optimization of reaction conditions for the production of DAG using immobilized 1,3-regiospecific lipase lipozyme RM IM. *J Am Oil Chem Soc* 2003;80:1201-1207.
1. Ryo M, Maeda K, Onda T, et al. A new simple method for the measurement of visceral fat accumulation by bioelectrical impedance. *Diabetes Care* 2005;28:451-453. - [PubMed](#)
1. Murase T, Nagasawa A, Suzuki J, Wakisaka T, Hase T, Tokimitsu I. Dietary alpha-linolenic acid-rich diacylglycerols reduce body weight gain accompanying the stimulation of intestinal beta-oxidation and related gene expressions in C57BL/KsJ-db/db mice. *J Nutr* 2002;132:3018-3022. - [PubMed](#)
1. Murase T, Aoki M, Tokimitsu I. Supplementation with alpha-linolenic acid-rich diacylglycerol suppresses fatty liver formation accompanied by an up-regulation of beta-oxidation in Zucker fatty rats. *Biochem Biophys Acta* 2005;1733:224-231. - [PubMed](#)
1. Anjana M, Sandeep S, Vimalleswaran KS, Farooq S, Mohan V. Visceral and central abdominal fat and anthropometry in relation to diabetes in Asian Indians. *Diabetes Care* 2004;27:2948-2953. - [PubMed](#)

1: Saito S, Mori A, Osaki N, Katsuragi Y. Diacylglycerol Enhances the Effects of Alpha-Linolenic Acid Against Visceral Fat: A Double-Blind Randomized Controlled Trial. *Obesity (Silver Spring)*. 2017 Oct;25(10):1667-1675. doi: 10.1002/oby.21938. Epub 2017 Aug 29. PMID: 28851088; PMCID: PMC5638073. <https://pubmed.ncbi.nlm.nih.gov/28851088/>

