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# Lipotropes from plant-based foods supplied by a standard French diet *vs.* food guide pyramid recommendations: Grain products are the best sources at lower cost

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ABSTRACT

Lipotropes are compounds that prevent excess hepatic fat deposits. However, although millions of people worldwide suffer from hepatic steatosis, lipotrope consumption has never been investigated. Our objectives were to calculate the amount of lipotropes supplied by a standard French diet *vs.* food guide pyramid recommendations by using 106 ready-to-eat plant-based foods (PBF) as a basis for comparison, to question whether one can easily increase lipotrope consumption *via* lipotrope-rich PBFs, and to estimate the lipotrope quantity supplied by €1.00 (one euro) of PBF *vs.* animal-based foods. Lipotrope potential of PBFs was expressed as the lipotropic capacity (LC) based on the lipotrope densities of 7, 8 or 9 lipotropes (mg/100 kcal), which are identified as betaine, choline, *myo*-inositol, methionine, magnesium, niacin, pantothenic acid, folates and total polyphenol content. Unrefined/minimally processed PBFs had the highest LC, while energy-dense/refined PBFs had the lowest. A standard French diet fails to provide the lipotrope quantity that should be supplied if food guide pyramid recommendations are followed. Such a difference can be easily compensated by increasing lipotrope-rich PBF consumption. On a €1.00-basis, vegetables and fruits are expensive sources of lipotropes, but grain products, especially legumes, appear to be the best compromise between high LC and low cost.



## 1. Introduction

Hepatic steatosis is a diet-related chronic disease characterized by excess hepatic fat deposits, mainly triglycerides, which may further lead to more serious diseases such as steatohepatitis, cirrhosis and cancer. Yet although several million people worldwide suffer from liver steatosis, human intervention studies investigating the potential of plant-based foods to limit or prevent liver steatosis are rather scarce (Fardet and Chardigny, 2011).

Food compounds that limit excess hepatic fat deposits are called lipotropes. Plant-based foods (PBF) may contain more than 25 compounds or groups of compounds with lipotropic potential as revealed by animal studies (Fardet and Chardigny, 2011). The main recognized lipotropes are betaine, choline, *myo*-inositol, methionine and carnitine (Fardet and Chardigny, 2011). Other compounds with a potential lipotropic effect may be found among micronutrients (*e.g.* magnesium and some B-group vitamins), polyphenol-type compounds (phenolic acids, lignans), specific phytochemicals (*e.g.* some unsaturated fatty acids, organosulfur compounds and short-chain fatty acids) and fibre-derived compounds (*e.g.* pectin, phytic acid, lignin, oligofructose and resistant starch) (Fardet and Chardigny, 2011).

However, literature data for PBF lipotrope content are limited. Thus, collected data allowed us to select only 8 compounds among all potential lipotropes (Fardet and Chardigny, 2011) for studying PBF lipotropic capacity, namely betaine, choline, *myo*-inositol, methionine, magnesium, niacin, pantothenic acid and folates (Fardet et al., 2011a). Our research based on these 8 compounds has shown that PBFs are a more diversified and complementary source of lipotropes when compared to animal-based foods (ABF) (Fardet et al., 2011a). Vegetables are among the best sources of lipotropes when expressed on a 100 kcal-basis (Fardet et al., 2011a). We also emphasized the utility of defining an index that expresses in an integrative and simple way the lipotropic potential

*Abbreviations:* ABF, animal-based foods; BeChIMe, sum of betaine, choline, *myo*-inositol (PAI fraction) and methionine; DRI, dietary reference intake; GI, Glycaemic Index; HC, hierarchical classification; INCA 2, Etude Individuelle Nationale des Consommations Alimentaires 2006–2007; IP6, phytate or *myo*-inositol hexakisphosphate; LC, lipotropic capacity; LD, lipotrope density; NDS, nutrient density score; PAI, potentially available *myo*-inositol; PBF, plant-based foods; PCA, principal component analysis; PNNS2, Programme National Nutrition et Santé 2006–2010; TPC, total phenolic compounds; USDA, United States Department of Agriculture.

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