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**PAPER**

# Thermal and refining processes, not fermentation, tend to reduce lipotropic capacity of plant-based foods†

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Plant-based foods (PBF) are relevant and diversified sources of lipotropes, which are compounds preventing excess hepatic fat deposits. In a first study, we defined the lipotropic capacity (LC, %) of raw PBF as the means of 8 lipotrope densities (LD, mg/100 kcal), each expressed relative to that of a reference food ranking the highest considering its mean 8 LD ranks ($LC_{raw\ asparagus} = 100\%$) (A. Fardet, J.-F. Martin and J. M. Chardigny, *J. Food Comp. Anal.*, 2011, DOI: 10.1016/j.jfca.2011.1003.1013). We showed that vegetables appeared as the best source of lipotropes on a 100 kcal-basis compared to legumes, cereals, fruits and nuts. The main objective of this second study was to quantify the effect of processing on LD and LC of raw PBF based on lipotrope contents collected in a USDA (United State Department of Agriculture) database and the literature, *i.e.* betaine, choline, *myo*-inositol, methionine, magnesium, niacin, pantothenic acid and folate contents. Choline and betaine densities were not significantly affected by processing while methionine and lipotropic micronutrient densities were significantly decreased, especially for magnesium, pantothenate and folates. *Myo*-inositol density decreases were insignificant due to lower product number resulting from limited literature data. Lipotropic micronutrient densities were more affected by processing than other densities. Fermentations increased betaine (median change of +32%) and choline (+34%) densities. Canning and boiling vegetables increased choline densities (+26%). Globally, processing significantly reduced LC by ~20%, fermentations being less drastic (median change of −5%) than refining (−33%) and thermal treatments (−16%). More specifically, canning increased LC of beetroot (536 *vs* 390%) and common bean (40 *vs* 36%) as fermentation towards LC grape (14 *vs* 7% for wine). Results were then mainly discussed based on percentages of lipotrope content changes on a dry-weight basis. Results of this study also showed that the LC is quite a relevant index to estimate effect of processing on lipotropic potential of PBF.

## Introduction

Increased consumption of whole-grain cereals, legumes, fruits and vegetables may be protective against the development of age-related and/or chronic diseases that are, for the most significant in terms of public health, cardiovascular diseases, diabetes, cancers and obesity, the most conclusive results being observed in humans consuming whole-grain cereals.[2] Among mechanisms involved, the most studied have been the antioxidant, anticarcinogenic and hypolipidemic effects of phyto-micronutrients, and the role of fibre-type compounds on digestive physiology and carbohydrate and lipid metabolisms. The ability of phytochemicals of numerous plant-based foods (PBF) to limit excess hepatic fat deposits has been largely less studied and emphasized, especially in humans. Yet, hepatic steatosis or fatty liver may be diagnosed in situations of alcoholism, overweight, obesity, hyperlipidemia, non-insulinodependent type 2 diabetes and malnutrition[3–6] and is the first step that may lead to more severe pathologies like steatohepatitis, fibrosis and cirrhosis.[7] Moreover, patients with hepatic steatosis present an increased risk of developing cardiovascular diseases,[8] those with non-alcoholic steatohepatitis-related cirrhosis an increased risk of developing liver cancer[9] and type 1 diabetic subjects with non-alcoholic fatty liver disease (NAFLD) have a higher prevalence of chronic kidney diseases and retinopathy.[10] Like obesity, fatty liver may be therefore the onset for the development of a cascade of numerous other chronic diseases. Accordingly, it has been shown to be an early predictor of other metabolic disorders.[11]

The prevalence of NAFLD seems to largely depend on the diagnostic method used: Bloomgarden reported that "the prevalence of NAFLD varies from 3 to 20% of the population based on elevated transaminase and from 16 to 19% based on

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