利用生物技术开发植物功能性产品

一、成果简介

植物中有一些含量虽少却具有重要功能的天然产物，可作为保健产品或工业原料。本项目利用从国内外引进的含有某些特定功能成分的植物或藻类品种，通过现代基因工程技术增强关键酶活，运用生物技术改造代谢途径，并结合植物组织培养、细胞悬浮培养技术，以及最新的气相液相和质谱等分析分离技术，对植物功能性产物进行富集和分离纯化，并进行产业化生产。

目前主要成果有：

1、利用海藻类生产多聚不饱和脂肪酸 EPA 和 DHA

运用生物技术增强蛋白活性，提高天然海藻（marine diatom algae）中长链多不饱和脂肪酸 EPA 和 DHA 的产量，EPA 和 DHA 是人体自身不能合成，但是维护心脑血管健康和促进婴幼儿的大脑发育所必需的保健品。

2、利用特种经济作物生产工业用芥酸

从北美引进一批特种经济植物例如埃塞俄比亚芥（Brassica carinata）等，通过基因工程改造代谢途径生产长链单不饱和脂肪酸--芥酸（22:1），长链单不饱和脂肪酸在普通植物中含量微少，但却是重要的工业原料，可用于制造天然润滑剂，黏胶剂，生物塑料，生物蜡质等，而且也是生产生物能源的重要材料。

3、利用传统中药材生产天然药物

通过分子调控植物次生代谢物的生物合成途径，结合中药材组培和悬浮细胞培养技术，开发生物碱及三萜类等抗癌功能性化合物。

二、合作方式

合作开发，技术入股。

三、市场前景分析

本项目的研发团队依托黑龙江八一农垦大学农学院，在植物生物技术、作物种质改良方面具有丰富经验。本项目借助黑龙江八一农垦大学食品学院和国

家杂粮工程中心的分析分离技术平台，优化植物活性功能成分的分析分离及有效利用，并为其工业化生产提供技术支持。团队主要研究人员先后主持和参与了多项国际国内科研课题, 多项研究成果在 SCI 杂志发表，并有多个植物代谢关键基因的分离和功能研究获得美国专利。研究成果具有国际先进水平。

研发团队带头人徐晶宇博士长期在农业食品和植物生物技术领域学习和工作, 2003-2013 年间在加拿大国家研究院植物生物技术研究所学习和工作，并与美国 Dow AgroSciences LLC（生物制品），加拿大 Bioriginal Food & Science Corp（功能保健品）、Agrisoma Biosciences Inc（生物燃料）、Prairie Plant Systems Inc（生物药品）等开发植物功能产品的科技公司保持多年的合作， 对植物生物技术公司的 R&D（Reserch &Development 研发），知识产权的保护，相关产品的产业化和市场化流程和运作比较熟悉。

本项目最初由团队带头人徐晶宇博士在加拿工作期间启动，前期技术开发比较成熟，自 2013 年 5 月引进回国，目前已顺利本土化。2014 年 8 月，徐晶宇博士曾携带本项目参加黑龙江省欧美同学会主办的“2014 海外学人龙江故乡行活动（绿色农业与食品加工专题）”，与相关企业进行项目洽谈和对接。资金、场地和人员到位之后，可进行中试和规模化试生产。

四、工艺技术

运用生物技术增强蛋白活性，提高天然海藻（marine diatom algae）中长链多不饱和脂肪酸 EPA 和 DHA 的产量，EPA 和 DHA 是人体自身不能合成，但是维护心脑血管健康和促进婴幼儿的大脑发育所必需的保健品。

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五、经济效益分析

随着全球对健康保健产品和绿色环保产品越来越重视，以植物为原材料的功能性保健品和工业用品将占据更大的市场份额，本项目采用先进的生物技术手段，提高植物生物制品的产量，降低生产成本，将创造极大的经济效益。产品将主要面向国际市场，为国家出口创汇。

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(54) **DIACYLGLYCEROL ACYLTRANSFERASE 2 GENES AND PROTEINS ENCODED THEREBY FROM ALGAE**

(76) Inventors: **Jitao Zou**, Saskatchewan (CA); **Jingyu Xu**, Saskatchewan (CA); **Zhifu Zheng**, Zionsville, IN (US)

(21) Appl. No.: **12/735,132**

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(52) **U.S. Cl.** **800/281**; 435/193; 536/23.2; 435/320.1; 800/298; 435/254.2; 554/8; 554/224; 800/306; 800/320; 800/312; 800/320.1; 800/320.3; 800/320.2

(57) **ABSTRACT**

The present disclosure relates to the isolation, purification, and characterization of a diacylglycerol acyltransferase 2 (DGAT2), and genes encoding DGAT2, from algae. DGAT2 can incorporate very long chain polyunsaturated fatty acids in to triacylglycerol more efficiently than DGAT1. The disclosure concerns methods of regulating seed oil content, fatty acid synthesis and fatty acid composition using the DGAT2 gene and to tissues and plants transformed with the gene. The disclosure also relates to transgenic plants, plant tissues and plant seeds having a genome containing an introduced DNA sequence of the disclosure, and a method of producing such plants and plant seeds.

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(52) **U.S. Cl.** **800/281**; 435/193; 536/23.2; 435/320.1; 800/298; 435/254.2; 554/8; 554/224; 800/306; 800/320; 800/312; 800/320.1; 800/320.3; 800/320.2

(57) **ABSTRACT**

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Taylor et al.

(10) **Patent No.: US 8,124,835 B2**
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(54) **ACYL-COA-DEPENDENT DIACYLGLYCEROL ACYLTRANSFERAS 1 (DGAT1) GENE FROM *TROPAEOLUM MAJUS*, PROTEIN ENCODED THEREBY AND USES THEREOF**

(75) Inventors: **David C. Taylor**, Saskatoon (CA); **Jingyu Xu**, Saskatoon (CA); **Elzbieta Mietkiewska**, Saskatoon (CA); **Tammy Francis**, Saskatoon (CA)

(73) Assignee: **National Research Council of Canada**, Ottawa, Ont.

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See application file for complete search history.

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(Continued)

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(57) **ABSTRACT**

A diacylglycerol acyltransferase (DGAT1) gene from *Tropaeolum majus* encodes a DGAT1 polypeptide that regulates the production of triacylglycerols from diacylglycerols. Transformation of cells with the *Tropaeolum majus* DGAT1 (TmDGAT1) gene, or variants thereof, leads to changes in DGAT1 activity and alterations in oil and/or fatty acid content and/or seed weight. In particular, oil content, seed weight, erucic acid and/or trierucin content may be increased.

12 Claims, 12 Drawing Sheets