Biotechnology Advances 32 (2014) 382–389

Contents lists available at ScienceDirect

Biotechnology Advances

journal homepage: www.elsevier.com/locate/biotechadv

Research review paper

# Fatty acid from the renewable sources: A promising feedstock for the production of biofuels and biobased chemicals

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ARTICLE INFO

*Article history:*
Received 16 July 2013
Received in revised form 11 December 2013
Accepted 13 December 2013
Available online 19 December 2013

*Keywords:*
Fatty acid
Biofuels
Biobased chemicals
Multiscale analysis
Interdisciplinary study
Renewable biomass

ABSTRACT

With the depletion of the nonrenewable petrochemical resources and the increasing concerns of environmental pollution globally, biofuels and biobased chemicals produced from the renewable resources appear to be of great strategic significance. The present review described the progress in the biosynthesis of fatty acid and its derivatives from renewable biomass and emphasized the importance of fatty acid serving as the platform chemical and feedstock for a variety of chemicals. Due to the low efficient conversions of lignocellulosic biomass or carbon dioxide to fatty acid, we also put forward that rational strategies for the production of fatty acid and its derivatives should further derive from the consideration of whole bioprocess (pretreatment, saccharification, fermentation, separation), multiscale analysis and interdisciplinary combinations (omics, kinetics, metabolic engineering, synthetic biology, fermentation and so on).



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## 1. Introduction

The traditional oleochemical industry has processed vegetable oils and animal fats for more than 100 years. With the depletion of the nonrenewable petrochemical resources, around 20% of 150 million tonnes of fats and oils have to be transformed into biofuels and chemical products annually in recent years (Schörken and Kempers, 2009). The increased demand for the fuels and chemicals produced from the fatty acid of plant and animal oils resulted in competition with food, higher prices, questionable land-use practices and environmental concerns associated with oil production (Hill et al., 2006; Steen et al., 2010). In order to cope with the increasing energy costs and environmental concerns, sustainable renewable fuels and chemicals in Fig. 1 should be manufactured from free fatty acid directly through microbial conversions in our opinion. In a meanwhile, the free fatty acid should be derived from various types of biomass such as lignocellulosic biomass, nonedible alga oils or waste plant/animal oils and so on.

In the present review, we demonstrated that free fatty acid from renewable resources would be a promising potential feedstock for fuels and chemical manufacture in the future. Due to the development of

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0734-9750/$ – see front matter 
http://dx.doi.org/10.1016/j.biotechadv.2013.12.003

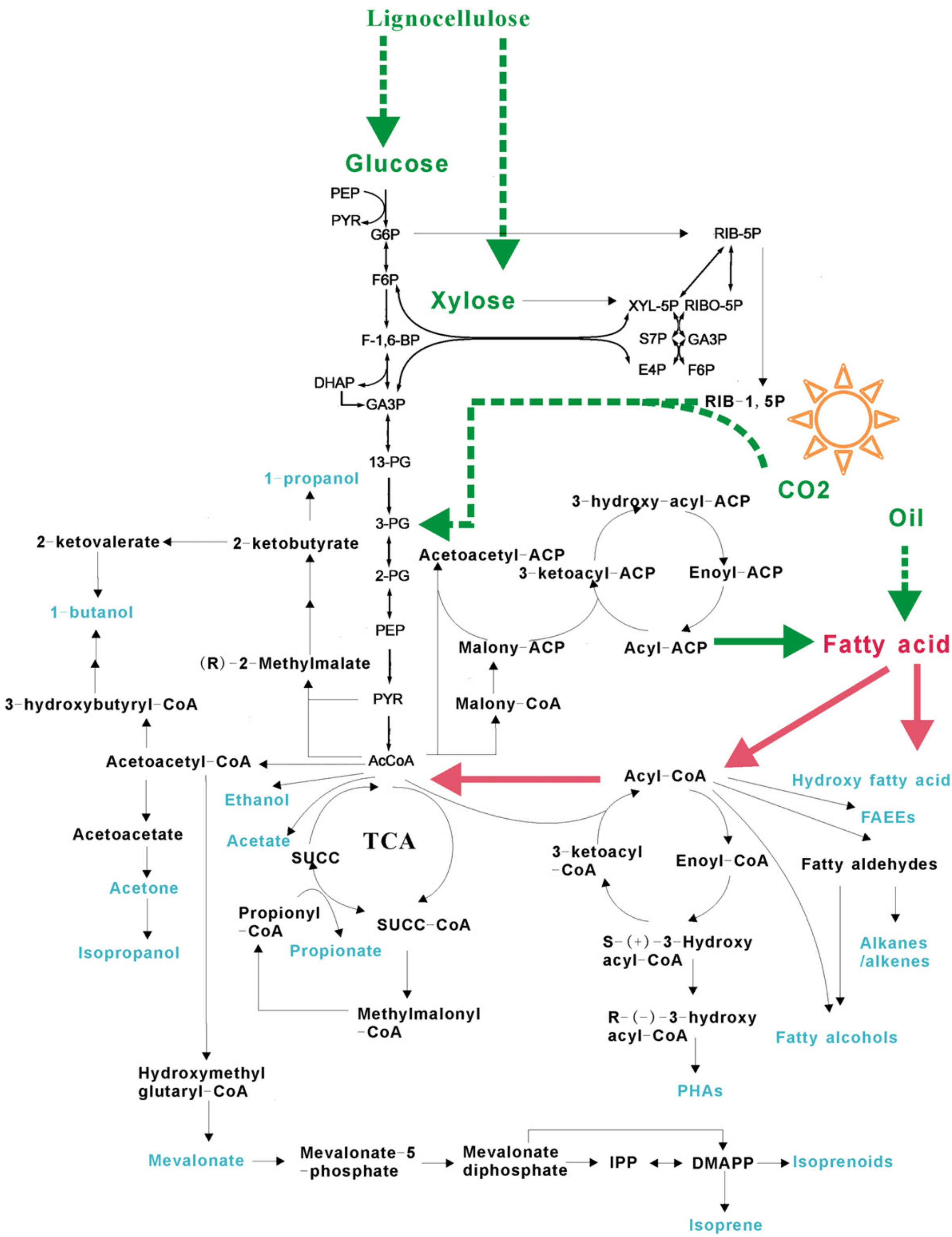


**Fig. 1.** Metabolic network of fatty acid derived from renewable resources. Reversible reactions are represented by a double-headed arrow. Abbreviations: G6P: glucose-6-phosphate; F6P: fructose-6-phosphate; F-1,6-BP: fructose-1,6-bisphosphate; GA3P: glyceraldehyde 3-phosphate; DHAP: dihydroxyacetone phosphate; 1,3-PG: 1,3-bisphosphoglycerate; 3-PG: 3-phospho-glycerate;2-PG:2-phospho-glycerate; AcCoA: acetyl coenzyme A; PYR: pyruvate; PEP: phosphoenol-pyruvate; SUCC-CoA: succinyl coenzyme A; SUCC: succinate; RIB-5P: ribulose 5-phosphate; RIBO-5P: ribose 5-phosphate; XYL-5P: xylulose 5-phosphate; S7P: sedoheptulose 7-phosphate; E-4P: erythrose 4-phosphate; $CO_2$: carbon dioxide; IPP: isopentenylpyrophosphate; DMAPP: dimethylallyl pyrophosphate.

metabolic engineering, the free fatty acid can presently be obtained from the renewable resources like lignocellulosic sugars and carbon dioxide through microbial conversion (Liu et al., 2011; Steen et al., 2010), which has the following advantages: renewability, short production cycle, less labor requirement, less affection by venue, season and climate, and easier to scale up (Li et al., 2008). Furthermore, as the direct precursor of advanced biofuels, the cost-effective production process of free fatty acid is greatly essential for the production of alkanes, biodiesel, fatty alcohols and so on. Finally, free fatty acid could also be an important feedstock for the biosynthesis of platform chemicals