< Back to results | 1 of 9 Next >

Download Print Save to PDF Add to List More... >

Full Text

Pertanika Journal of Science and Technology • *Open Access* • Volume 31, Issue 1, Pages 109 - 121 • 2023

Document type
Article • *Hybrid Gold Open Access*

Source type
Journal

ISSN
01287680

DOI
10.47836/pjst.31.1.07

Publisher
Universiti Putra Malaysia Press

Original language
English

View less

Study of Metabolic Flux Distribution in Rice (Oryza sativa) Cultures for Starch Production

Nuri, Nur Aqila Syafiqa Abdul[a] ; Puad, Noor Illi Mohamad[a] ; Abduh, Muhammad Yusuf[b] ;
Azmi, Azlin Suhaida[a]

Save all to author list

[a] Department of Chemical Engineering and Sustainability, Kulliyyah of Engineering, International Islamic University Malaysia, P.O. Box 01, Kuala Lumpur, 50728, Malaysia

[b] School of Life Sciences and Technology, Institut Teknologi Bandung, Jalan Ganesha, No. 10, Bandung, 40132, Indonesia

View PDF Full text options Export

Abstract

Author keywords

Sustainable Development Goals 2022

SciVal Topics

Metrics

Funding details

Cited by 0 documents

Inform me when this document is cited in Scopus:

Set citation alert >

Related documents

Development of a compartmentalized model for insight into the structured metabolic pathway of carbon metabolism in cassava leaves

Punyasu, N. , Kalapanulak, S. , Siriwat, W.
(2019) Australian Journal of Crop Science

Critical assessment of genome-scale metabolic models of Arabidopsis thaliana

Zamani Amirzakaria, J. , Marashi, S.-A. , Malboobi, M.A.
(2021) Molecular Omics

Extended utilization of constraint-based metabolic model in a long-growing crop

Chiewchankaset, P. , Kalapanulak, S. , Saithong, T.
(2019) Processes

View all related documents based on references

Find more related documents in Scopus based on:

Authors > Keywords >

Abstract

The demand for starch-rich crops remains high due to their wide applications, and one of them is rice (Oryza sativa). However, large-scale rice production faces challenges such as unstable productivity, climate changes and excessive use of agrochemicals. Plant cell culture technology is proposed to increase rice yield and produce a drought-resistance variety of rice to sustain its demand. However, the amount of starch in rice cultures is expected to be smaller compared to the planted ones. The main aim of this study is to apply Flux Balance Analysis (FBA) to optimize starch production in rice cultures. This study reconstructed the stoichiometric metabolic model for rice culture based on the published articles. It consists of 160 reactions and 148 metabolites representing rice 's main carbon metabolism towards starch production. The model was then formulated in GAMS v31.1.0, and the objective function was set to the maximization of biomass and starch. The selected constraints (sugar uptake rates and cell growth rates) from previous studies were utilized. The simulated starch production rate values were achieved at the highest glucose uptake rates with the value of 0.0544 mol/g CDW.h. The internal metabolic flux distributions demonstrated that the incoming carbon fixes were directed towards the glycolysis pathway, TCA cycle, PPP cycle, and starch biosynthesis reactions. The study results serve as a starting point to further understanding the starch production mechanism in plants known to be complex. © Universiti Putra Malaysia Press.

Author keywords

FBA; General Algebraic Modeling System (GAMS) software; metabolic flux distribution ; rice ; starch

Sustainable Development Goals 2022 New

SciVal Topics

Metrics

Funding details

References (19)

View in search results format >

☐ All

Export Print E-mail Save to PDF Create bibliography

☐ 1 Amthor, J.S.

The McCree-de Wit-Penning de Vries-Thornley respiration paradigms: 30 Years later (Open Access)

(2000) *Annals of Botany*, 86 (1), pp. 1-20. Cited 611 times.
http://aob.oxfordjournals.org/
doi: 10.1006/anbo.2000.1175

View at Publisher

☐ 2 Carnicer, M., Baumann, K., Töplitz, I., Sánchez-Ferrando, F., Mattanovich, D., Ferrer, P., Albiol, J.

Macromolecular and elemental composition analysis and extracellular metabolite balances of Pichia pastoris growing at different oxygen levels (Open Access)

(2009) *Microbial Cell Factories*, 8, art. no. 65. Cited 91 times.
doi: 10.1186/1475-2859-8-65

View at Publisher

☐ 3 Hanegraaf, P.P.F., Muller, E.B.

The dynamics of the macromolecular composition of biomass

(2001) *Journal of Theoretical Biology*, 212 (2), pp. 237-251. Cited 33 times.
http://www.elsevier.com/inca/publications/store/6/2/2/9/0/4/index.htt
doi: 10.1006/jtbi.2001.2369

View at Publisher

☐ 4 Lakshmanan, M., Zhang, Z., Mohanty, B., Kwon, J.-Y., Choi, H.-Y., Nam, H.-J., Kim, D.-I., (...), Lee, D.-Y.

Elucidating rice cell metabolism under flooding and drought stresses using flux-based modeling and analysis (Open Access)

(2013) *Plant Physiology*, 162 (4), pp. 2140-2150. Cited 57 times.
http://www.plantphysiol.org/content/162/4/2140.full.pdf+html
doi: 10.1104/pp.113.220178

View at Publisher

☐ 5 Lee, S.-T., Huang, W.-L.

Cytokinin, auxin, and abscisic acid affects sucrose metabolism conduce to de novo shoot organogenesis in rice (Oryza sativa L.) callus (Open Access)

(2013) *Botanical Studies*, 54 (1). Cited 31 times.
http://www.as-botanicalstudies.com/content/pdf/1999-3110-54-5.pdf
doi: 10.1186/1999-3110-54-5

View at Publisher

☐ 6 Lularevic, M., Racher, A.J., Jaques, C., Kiparissides, A.

Improving the accuracy of flux balance analysis through the implementation of carbon availability constraints for intracellular reactions (Open Access)

(2019) *Biotechnology and Bioengineering*, 116 (9), pp. 2339-2352. Cited 17 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1097-0290
doi: 10.1002/bit.27025

View at Publisher

☐ 7 Marco, C., Pérez, G., León, A.E., Rosell, C.M.

Effect of transglutaminase on protein electrophoretic pattern of rice, soybean, and rice-soybean blends (Open Access)

(2008) *Cereal Chemistry*, 85 (1), pp. 59-64. Cited 28 times.
doi: 10.1094/CCHEM-85-1-0059

View at Publisher

☐ 8 Masni, Z., Wasli, M.E.

Yield Performance and Nutrient Uptake of Red Rice Variety (MRM 16) at Different NPK Fertilizer Rates (Open Access)

(2019) *International Journal of Agronomy*, 2019, art. no. 5134358. Cited 7 times.
www.hindawi.com/journals/ija/
doi: 10.1155/2019/5134358

View at Publisher

☐ 9 Orth, J.D., Thiele, I., Palsson, B.O.

What is flux balance analysis? (Open Access)

(2010) *Nature Biotechnology*, 28 (3), pp. 245-248. Cited 2262 times.
doi: 10.1038/nbt.1614

View at Publisher

☐ 10 Pfister, B., Zeeman, S.C.

Formation of starch in plant cells (Open Access)

(2016) *Cellular and Molecular Life Sciences*, 73 (14), pp. 2781-2807. Cited 207 times.
http://link.springer.de/link/service/journals/00018/index.htm
doi: 10.1007/s00018-016-2250-x

View at Publisher

☐ 11 Poolman, M.G., Miguet, L., Sweetlove, L.J., Fell, D.A.

A genome-scale metabolic model of Arabidopsis and some of its properties (Open Access)

(2009) *Plant Physiology*, 151 (3), pp. 1570-1581. Cited 236 times.
http://www.plantphysiol.org/cgi/reprint/151/3/1570
doi: 10.1104/pp.109.141267

View at Publisher

☐ 12 Puad, N.
(2011) *Modelling the Metabolism of Plant Cell Culture (Arabidopsis)*. Cited 2 times.
(PhD thesis). The University of Manchester, UK

☐ 13 Raman, K., Chandra, N.

Flux balance analysis of biological systems: Applications and challenges (Open Access)

(2009) *Briefings in Bioinformatics*, 10 (4), pp. 435-449. Cited 271 times.
doi: 10.1093/bib/bbp011

View at Publisher

☐ 14 Shaw, R., Kundu, S.

Flux balance analysis of genome-scale metabolic model of rice (Oryza sativa): Aiming to increase biomass

(2015) *Journal of Biosciences*, 40 (4), pp. 819-828. Cited 6 times.
http://www.ias.ac.in/jbiosci/
doi: 10.1007/s12038-015-9563-z

View at Publisher

☐ 15 Shu, X., Jia, L., Gao, J., Song, Y., Zhao, H., Nakamura, Y., Wu, D.

The influences of chain length of amylopectin on resistant starch in rice (Oryza sativa L.)

(2007) *Starch/Staerke*, 59 (10), pp. 504-509. Cited 37 times.
doi: 10.1002/star.200700640

View at Publisher

☐ 16 Toivonen, L., Laakso, S., Rosenqvist, H.

The effect of temperature on hairy root cultures of Catharanthus roseus: Growth, indole alkaloid accumulation and membrane lipid composition

(1992) *Plant Cell Reports*, 11 (8), pp. 395-399. Cited 34 times.
doi: 10.1007/BF00234368

View at Publisher

☐ 17 Tony, L. P. A., McFarland, L. M.
(2021) *Essential nutrients for plants-How do nutrients affect plant growth? Texas A&M Agrilife Extension*
https://agrilifeextension.tamu.edu/library/gardening/essential-nutrients-for-plants/

☐ 18 Wang, M.Y., Siddiqi, M.Y., Ruth, T.J., Glass, A.D.M.

Ammonium uptake by rice roots: II. Kinetics of $^{13}NH_4^+$ influx across the plasmalemma (Open Access)

(1993) *Plant Physiology*, 103 (4), pp. 1259-1267. Cited 253 times.
http://www.plantphysiol.org/
doi: 10.1104/pp.103.4.1259

View at Publisher

☐ 19 Zeeman, S.C., Kossmann, J., Smith, A.M.

Starch: Its metabolism, evolution, and biotechnological modification in plants

(2010) *Annual Review of Plant Biology*, 61, pp. 209-234. Cited 701 times.
doi: 10.1146/annurev-arplant-042809-112301

View at Publisher

Puad, N.I.M.; Department of Chemical Engineering and Sustainability, Kulliyyah of Engineering, International Islamic University Malaysia, P.O. Box 01, Kuala Lumpur, Malaysia; email:illi@iium.edu.my