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process with *Pseudomonas taetrolens* at 30 °C. Mayamoto et al. (2000) reached 90% of lactobionic acid from lactose with *Pseudomonas taetrolens*. Alonso et al. (2012) reached 100% of lactobionic acid yield from sweet whey after 60 h of cultivation with *Pseudomonas taetrolens*. Seems like acid medium hinders *Pseudomonas taetrolens* ability to convert lactose to lactobionic acid. It could be explained with *Pseudomonas taetrolens* lactose dehydrogenase composition, containing flavin adenine dinucleotide as a prosthetic group. This flavoprotein does not use oxygen as direct electron acceptor and presents an optimum pH at 5.6. Lactose is converted by lactose oxidase to lactobiono-δ-lactone and then by lactonase in lactobionic acid. Lactonase presents an optimum at pH 6.5–6.7 (Alonso et al., 2013b). Low acid whey pH is the reason why the conversion yield is not reached as high as it is in other researches, where sweet whey was used as a substrate.

Conclusions

The most suitable acid whey permeate concentration is up to 20% for lactose oxidation with *Pseudomonas taetrolens* NCIB 9396 and DSM 21104. Low acid whey pH is the reason why the conversion yield is not reached as high as it is in other researches. The study suggests to adjust the acid whey pH prior lactose oxidation with *Pseudomonas taetrolens* and to prolong cultivation time.

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References

1. Alonso S., Rendueles M., Díaz M. (2017) Tunable decoupled overproduction of lactobionic acid in Pseudomonas taetrolens through temperature-control strategies, *Process Biochemistry*, Vol. 58, p. 9–16.
2. Alonso S., Rendueles M., Díaz M. (2013a) Feeding strategies for enhanced lactobionic acid pro- duction from whey by Pseudomonas taetrolens, *Bioresource Technology*, Vol. 134, p. 134–142.
3. Alonso S., Rendueles M., Diaz M. (2013b) Bio-production of lactobionic acid: Current status, applications and future prospects, *Biotechnology Advances*, Vol. 31(8), p. 1275–1291.
4. Alonso S., Rendueles M., Díaz M. (2012) Role of dissolved oxygen availability on lactobionic acid production from whey by *Pseudomonas taetrolens*, *Bioresource Technology*, Vol. 109, p. 140–147.
5. Alonso S., Rendueles M., Díaz M. (2011) Efficient lactobionic acid production from whey by Pseudomonas taetrolens under pH-shift conditions, *Bioresource Technology*, Vol. 102, 9730–9736.
6. Borodina V. G., Mirgorod Y. A. (2014) Catalytic synthesis lactobionic acid, *Journal of Nano- and Electronic Physics*, Vol. 6, p. 3052-1–3052-2.
7. Giorgi S. D., Raddadi N., Fabbri A. Toschi T. G., Fava F. (2018) Potential use of ricotta cheese whey for the production of lactobionic acid by *Pseudomonas taetrolens* strains, *New Biotechnology Journal*, Vol. 42, p. 71–76.
8. Goderska K., Szwengiel A., Czarnecki Z. (2014) The utilization of *Pseudomonas taetrolens* to produce lactobionic acid, *Biotechnology and Applied Biochemistry*, Vol. 173, p. 2189–2197.
9. Gutiérrez L. F., Hamoudi S., Belkacemi K. (2012) Lactobionic acid: a high value-added lactose derivative for food and pharmaceutical applications, *International Dairy Journal*, Vol. 26(2), p. 103–111.
10. Gutiérrez L.F., Hamoudi S., Belkacemi K. (2011) Selective production of lactobionic acid by aerobic oxidation of lactose over gold crystallites supported on mesoporous silica, *Applied Catalysis A: General*, Vol. 402, p. 94–103.
11. Miyamoto Y., Ooi T., Kinoshita S. (2000) Production of lactobionic acid from whey by *Pseudomonas* sp. LS13-1. *Biotechnology Letters*, Vol. 22(5), p.427–430.
12. Murakami H., Seko A., Azumi M., Ueshima N., Yoshizumi H., Nakano H., Kitahata S. (2003) Fermentative production of lactobionic acid by *Burkholderia cepacia. Journal of Applied Glycoscience*, Vol. 50 (2), p.117–120.
13. Pleissener D., Dietz D., Duuren J. B.J.H., Wittmann C., Yang X., Lin C. S. L., Venus J. (2017) Biotechnological production of organic acids from renewable resources, *Advances in Biochemical Engineering / Biotechnology*, Vol 166. p. 373–410.
14. Schaafsma G. (2008) Lactose and lactose derivatives as bioactive ingredients in human nutrition, *International Dairy Journal*, Vol. 18, p. 458–465.
15. Seki N., Saito H. (2012) Lactose as a source for lactulose and other functional lactose derivatives, *International Dairy Journal*, Vol. 22, p. 110–115.
16. Silva A. N., Perez R., Minim V. P. R., Martins D. D. S., Minim L. A. (2015) Integrated production of whey protein concentrate and lactose derivatives: What is the best combination? *Food Research International*, Vol. 73, p. 62–74.
17. Song Y. S., Lee H. U., Park C., Kim S.W. (2013) Optimization of lactulose synthesis from whey lactose by immobilized β-galactosidase and glucose isomerase. *Carbohydrate Research*, Vol. 369, p. 1–5.
18. Wijayanti B. H., Bansal N., Deeth H. C. (2014) Stability of whey proteins during thermal processing: A Review. *Comprehensive Reviews in Food Science and Food Safety*, Vol. 13, p. 1235–1251.