



Combined hydrothermal pre-treatment and enzymatic hydrolysis of corn fibre: Production of ferulic acid extracts and assessment of their antioxidant and antiproliferative properties

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ABSTRACT

Ferulic acid may be used as a nutraceutical ingredient or as a substrate to produce bio-vanillin. There is an increasing market demand for ferulic acid obtained from natural sources such as low-cost agro-industrial by-products, due to its potential applications as nutraceutical ingredient and as a substrate to produce bio-vanillin. This work aims to study ferulic acid recovery from corn fibre (one of the most abundant natural sources of ferulic acid), involving an integrated process of hydrothermal pre-treatment followed by enzymatic hydrolysis. The objective is primarily to produce natural extracts with a maximum ferulic acid recovery yield, but it is also to assess their antioxidant and antiproliferative properties and their cytotoxicity.

Different commercial enzyme preparations were tested for release of ferulic acid from corn fibre. The best results were obtained for Ultraflo®XL in a concentration of 2 % ($w_{\text{enzyme preparation}}/w_{\text{dry corn fibre}}$) at a pH of 5 and at 55 °C, presenting a recovery yield of esterified ferulic acid of 7.83 ± 1.35 % ($w_{\text{recovered ferulic acid}}/w_{\text{total esterified ferulic acid}}$), which corresponds to 0.13 ± 0.02 % ($w_{\text{ferulic acid}}/w_{\text{dry corn fibre}}$). When using a hydrothermal pre-treatment at a temperature of 140 °C for 40 min, prior to the use of the same enzymatic hydrolysis procedure, the recovery yield of esterified ferulic acid increased to 28.94 ± 2.40 % ($w_{\text{recovered ferulic acid}}/w_{\text{total esterified ferulic acid}}$), which corresponds to 4.9 ± 0.3 % ($w_{\text{ferulic acid}}/w_{\text{dry corn fibre}}$). The use of this pre-treatment leads not only to the highest yield of ferulic acid, but also to the lowest concentration of furfural and hydroxymethylfurfural, without the formation of formic and levulinic acid (not detected). All pre-treatments tested led to an improved quality of the extract in terms of bioactivity.

1. Introduction

Ferulic acid is a highvalue compound that can be used as a nutraceutical ingredient due to its reported therapeutic properties (antioxidant, anti-inflammatory, antiatherogenic, antidiabetic, antiageing, neuroprotective, radioprotective, hepatoprotective, antiproliferative (ElKhazendar et al., 2019; Ou and Kwok, 2004; Srinivasan et al., 2007)),

and as a substrate/precursor for bio-vanillin production (Ma and Dauligis, 2014). Ferulic acid may also be used as a crosslinking agent of polymeric films (Cao et al., 2007; Mathew and Abraham, 2008). The market for ferulic acid from natural sources is increasing, along with the global nutraceuticals' market (which is expected to increase from \$184, 092 in 2015 to \$302,306 in 2022 (Prasad, 2016)) and the bio-vanillin production (for example, the production of Solvay® (Brussels,

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