

Available at www.sciencedirect.com

ScienceDirect

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

A local Thai cultivar glutinous black rice bran: A source of functional compounds in immunomodulation, cell viability and collagen synthesis, and matrix metalloproteinase-2 and -9 inhibition

Pornpimpa Phetpornpaisan^{a,1}, Patcharaporn Tippayawat^{b,1}, Michael Jay^c, Khaetthareeya Sutthanut^{a,*}

^aFaculty of Pharmaceutical Sciences, Khon Kaen University, Khon Kaen, Thailand

^bFaculty of Associated Medical Sciences, Khon Kaen University, Khon Kaen, Thailand

^cUNC Eshelman School of Pharmacy, University of North Carolina, NC, USA

ARTICLE INFO

Article history:

Received 23 September 2013

Received in revised form

17 December 2013

Accepted 19 December 2013

Available online 17 January 2014

Keywords:

Rice bran

Anthocyanins

Phenolics

Matrix metalloproteinases

Wound healing

Immunomodulation

ABSTRACT

The rice bran from Kamklaing, a selected local Thai glutinous black rice cultivar (KRB), has gained interest for its nutraceutical composition and beneficial health effects. The ethanolic extract of KRB was prepared, analysed by HPLC and investigated for its biological effects. The results demonstrated that the KRB extracts had a high content of cyanidin-3-glucoside, caffeic acid and ferulic acid and possessed antioxidation and wound healing effect. This was associated with increasing migration and collagen synthesis in normal human dermal fibroblast cells when compared to the controls, MMP-2 and MMP-9 inhibitory effects in gelatin zymography, and immunomodulation with concentration-dependent bimodal effects in human monocytes. These results suggest that Kamklaing rice bran is a promising by-product that contains functional ingredients which may be useful in the control of skin aging and chronic disease development.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

'Good foods for good health' is a quote indicating the significant role of nutrients on the state of health of individuals. Besides being a source of energy and nutrients, foods are expected to be sources of nutraceuticals and bioactive compounds that can exert biofunctional effects to promote the efficient homeostasis of physiological systems (Affuso,

Ruvolo, Micillo, Saccà, & Fazio, 2010; Nguemeni, Gouix, Bourourou, Heurteaux, & Blondeau, 2013) and to prevent tissue degeneration and development of chronic diseases. Through a number of factors and complex physiological pathways that result in excessive production of free radical species with subsequent impaired immunity, chronic inflammation and tissue degeneration, the aging process and chronic diseases are advanced (Bosma-den Boer, van Wetten, & Pruimboom,

* Corresponding author. Address: Faculty of Pharmaceutical Sciences, Khon Kaen University, Khon Kaen 40002, Thailand. Tel.: +66 43202378x1416.

E-mail address: khaesu@kku.ac.th (K. Sutthanut).

¹ These author contributed equally to this work.

1756-4646/\$ - see front matter © 2013 Elsevier Ltd. All rights reserved.

<http://dx.doi.org/10.1016/j.jff.2013.12.020>

2012). Therefore, the functional foods containing bioactive compounds with good antioxidative, antiinflammatory, tissue healing, and health adaptive effects are now being explored. Interestingly, a number of phytochemicals and plant materials are reported to have health promoting and chronic disease preventing effects such as cancer through collagen synthesis, inflammatory inhibition (Nizamutdinova et al., 2009), and immunostimulation (Chen, Choi, Kozukue, Kim, & Friedman, 2012; Chen et al., 2006; Wang & Stoner, 2008). For example, the anthocyanins cyanidin-3-glucoside and peonidin-3-glucoside found in whole grain rice (Min, Gu, McClung, Bergman, & Chen, 2012) were shown to prevent the development and progression of breast cancer by suppressing of gene expression of both matrix metalloproteinase enzymes (MMPs) and urokinase-type plasminogen activator (uPA) (Hui et al., 2010).

MMPs are zinc-containing endopeptidases, multi-domain enzymes, generally consisting of a pro-domain, a catalytic domain, a hinge region, and a haemopexin-like domain that are involved in remodeling of the extracellular matrix (ECM) of tissues. They play a central role in many biological processes, such as embryogenesis, normal tissue remodeling in gastric ulceration, wound healing and angiogenesis, and in chronic diseases such as atheroma, arthritis, and cancer cell invasion (Visse & Nagase, 2003). MMP-2 and MMP-9 are the two major enzymes in the MMPs family playing important roles in skin photo-aging and metastatic process in breast cancer (Polito et al., 2012). Therefore, the MMP-2 and MMP-9 inhibition from a number of plant extracts containing phenolics, vitamin E and anthocyanins are currently interested in benefits for anti-aging and cancer therapy (Kim, Park, Paik, & Chang, 2011).

Collagen is the extracellular matrix protein synthesized from fibroblasts in the dermis layer of skin and has very important role in wound healing and skin rejuvenating processes. As a result, the synthesis and degradation of collagen strongly influence these events which involve multiple factors that result in excessive production of reactive oxygen species (ROS), over expression of MMP-2 and MMP-9, and dermatological cell damage. For example, exposure to ultraviolet light (UV) from sunlight may lead to stimulation of collagen degradation and subsequent photoaging of skin (dry and flat skin with deep wrinkles (Choi et al., 2010; Ryu, Qian, Kim, Nam, & Kim, 2009)). Therefore, for aesthetic purposes, the regulation of collagen synthesis in dermal fibroblasts and extracellular collagen degradation by using chemicals or phytochemicals is now an effective strategy to enhance the skin rejuvenating and to retard the skin aging process. Using an *in vitro* human fibroblast model, the effects of selected compounds on collagen synthesis in comparison to the retinols or ascorbic acid, which are recognized as collagen synthesis stimulators, are frequently conducted (Chua, Lee, Abdullah, & Sarmidi, 2012). The activity of various plant materials and phytochemicals have been observed, but there is limited evidence about the activity of rice and rice bran extract. Moreover, via immunomodulation, phenolic compounds and anthocyanins have been demonstrated to regulate T lymphocyte proliferation in autoimmune disease and transplantation (Hushmendi et al., 2009).

Among abundant evidence of the health benefits of natural resources, rice and rice bran are currently proposed as a

potential source of bioactives for health and cosmetic applications with a variation in potency and mechanism of action among different cultivars (Manosroi, Ruksiriwanich, Kietthanakorn, Manosroi, & Manosroi, 2011). The chemical composition and contents of such bioactives vary widely between different cultivars and sample preparation methods. Among the cultivars and phenotypic differences of rice, the rice cultivars with black, purple, and red pigments were found to contain large amounts of antioxidative pigments as anthocyanins and carotenoids when compared to non-coloured rice samples.

Of all existing rice cultivars, particularly those used commercially, only a few have been examined thoroughly for their bioactive compositions and biofunctions. In Thailand, besides the commercially exported rice cultivars, there is a group of non-commercial local rice cultivars that are locally cultivated and used within limited communities. The lack of information on these cultivars is a significant barrier of their introduction to the market. It is important that scientific data on these local rice cultivars be obtained to properly promote their use by the public as well as for their widespread cultivation.

Rice bran, a by-product of rice milling, is currently reported as a rich source of various phytochemicals possessing high antioxidative effects (Kang, Nam, & Nam, 2005), and ability to prevent cancer development (Shih et al., 2011) and to inhibit colon cancer cell growth (Forster et al., 2013). They also possess antiinflammatory, immunomodulation effects (Khan, Monagas, Urpi-sarda, Llorach, & Andres-Lacueva, 2013), and immune-stimulation (Park et al., 2013) mediated by oryzanol, vitamin B, vitamin E, phytosterols, and phenolics (Qureshi, Sami, & Khan, 2002). Therefore, among the diversity of rice cultivars, those that deliver the highest quality rice bran in terms of high content of health promoting molecules need to be explored for their proper introduction to the market for health and cosmetic applications as well as the development of economically valuable functional foods and products thereof.

The purple-black rice grain, fine bran part, and thick shell delivered from milling process of rice grain of a local Thai black rice cultivar from the Loei province of Thailand; known as 'Kamklaing' has drawn much attention for its potential health benefits. Preliminary studies have revealed the high content of phenolics and dietary fibres in Kamklaing rice bran (KRB) (Phetpornpaisan, Rattanathongkom, & Sutthanut, 2012). The aim of this study was to investigate the chemical composition and to examine its biological effects related chronic diseases of the KRB extract as a selective local Thai black rice cultivar. The result so obtained is expected to support the proper introduction and application of this local rice cultivar to the market.

2. Materials and methods

2.1. Materials

Black colour rice cultivar (Kamklaing) was procured from the Dansai district of Loei province in Northeastern Thailand. Reagents including sodium azide, Triton X-100, porcine-skin gelatin, bromophenol blue, coomassie brilliant blue R-250,

Download English Version:

<https://daneshyari.com/en/article/7625674>

Download Persian Version:

<https://daneshyari.com/article/7625674>

[Daneshyari.com](https://daneshyari.com)