



Black rice: The emerging concept in nutraceutical

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Importance of rice : There is booming demand for rice in Asia and other part of the world due to intense rise in world's population. To feed the huge population the production of rice must be increased by 60-70 per cent over the next two decades (Chauhan *et al.*, 2017). The consumption of colored rice is increasingly becoming popular in many Asian countries where black rice is often mixed with non-colored rice prior to cooking to enhance the flavor (Juliano, 1993). In addition, red rice is commonly used as a food colorant e.g. in bread, ice cream and liquor in several Asian countries.

Black rice : Black rice is a range of rice types of the species *Oryza sativa* L., which are high in nutritional value and is a source of iron, vitamin E, and antioxidants. The bran layer of black rice contains one of the highest levels of anthocyanin. The grain has a similar amount of fiber to brown rice and, like brown rice, has a mild, nutty taste. In China, black rice is claimed to be good for the kidney, stomach, and liver. Black rice has a deep black color and usually turns deep purple when cooked (Nakamura *et al.*, 2017). Its dark purple color is primarily due to its anthocyanin content, which is higher by weight than that of other colored grains. In addition, pigmented rice composed of high content of phenolic compounds with notable antioxidant activities. Antioxidants prevent cell damage by reactive oxygen species. These compounds are a part of the everyday diet and can also be used as medicines or supplements. According to agricultural statistics from the Ministry of Agriculture and Cooperatives in Thailand, in 2008 the categories glutinous rice and husked rice accounted together for 4.9% and contain as well coloured rice cultivars.

Phytochemicals present in black rice:

Anthocyanin : It is the class of flavonoids responsible for the color of rice. The most abundant anthocyanins in colored rice were identified as cyanidin-3-glucoside and to a minor extent, peonidin-3-glucoside. In black rice, contents up to 631 mg/100 g cyanidin-3-glucoside and 363 mg/100 g peonidin-3-glucoside have been reported. Compared to black rice, significantly lower total anthocyanin levels have been reported for red rice ranging from 1.5 to 9.4 mg/100 g. Owing to several health-promoting impacts associated with anthocyanins, such as anti-oxidative, anti-inflammatory and anti-cancer effects black rice is considered as a functional food and food ingredient in many Asian countries. The pigment from black rice contains two major anthocyanins: cyanidin-3-glucoside and peonidin-3-glucoside. Anthocyanins are naturally occurring phenolic compounds that provide the color of many fruits (especially berries) and vegetables and they have several valuable effects (de Lima



et al., 2017). Anthocyanins can decrease the risk of coronary heart diseases, inflammatory process, and atherosclerosis through their antioxidant, anti-platelet and anti-inflammatory activities (Hu *et al.*, 2003). Foods that are rich in anthocyanins or anthocyanins per se have health benefits. The functional properties of anthocyanins in black rice have been demonstrated in numerous nutritional studies.

Antioxidants : Black rice contains a high level of several phytochemicals, e.g., gamma-oryzanol, tocopherols, tocotrienols and phenolic compounds. It has been reported that phenolic compounds exhibit high antioxidant activity against scavengers of singlet oxygen and inhibit high hydrogen peroxide-induced damage to cellular DNA in human lymphocytes. There is evidence that phenolic

substances act as antioxidants by preventing the oxidation of LDL-lipoprotein, platelet aggregation and damage of red blood cells. Additionally, phenolics act as: (i) metal chelators, (ii) antimutagens and anticarcinogens, (iii) antimicrobial agents and (iv) clarifying agents. These compounds are a part of the everyday diet and also used as medicines or supplements. Gamma-oryzanol is another phytochemicals that found at high concentration in rice bran, including sterols and ferulic acid, has been reported to exhibit more antioxidant activity than vitamin E as six fold and other health beneficial properties (Nakagawa and Maeda, 2017). Coloured rices are reported as potent sources of antioxidants and encouragements as viable sources of antioxidants for functional foods were made. Of these, red rice gained popularity in Japan as a functional food because of its high polyphenols and anthocyanin content. Before the health beneficial effects of pigmented rice emerged, Chaudhary (2003) saw an upcoming demand of black rice as an organic food colouring agent which has been at least partly possible due to the increased production of black rice. Black rice has a number of nutritional advantages over common rice, such as a higher content of protein, vitamins and minerals, although the latter varies with cultivar and production location. Anthocyanin pigments have been reported to be highly effective in reducing cholesterol levels in the human body. Effects of peonidin, peonidin 3-glucoside and cyanidin 3-glucoside, major anthocyanins extracted from black rice, also exerted an inhibitory effect of cell invasion on various cancer cells. The QTL for amylose, protein, and moisture content in rice has been identified that will help in implication of the more further research (Bruno *et al.*, 2017). Their important bioactivities include anti-inflammatory enhancement of the immune system, heart

disease, cardiovascular disease, glycemic control, diabetes and inhibit tumor promotion.

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