It first entered the Thai market over ten years ago, and today Riceberry rice is known amongst consumers for its distinctive appearance, nutritional value and numerous health benefits. Developed at Kasetsart University’s Rice Science Centre in Thailand with the help of Apichart Vanavichit’s research team, consumption of the whole grain promises a sustainable solution to several non-communicable diseases, namely food related chronic diseases. Its rich purple pigment, like most super foods, is associated with the abundance of phytochemicals, in this case over 80 antioxidant compounds.

Whole grain Riceberry rice entered the Thai rice market over ten years ago and is well known for its distinctive appearance, nutritional value and numerous health benefits. Very popular among vegetarian, vegan, and health-conscious consumers, it is positioned as an organic food and has excelled in premium markets, gaining a high price. An ideal source of complex carbohydrates, dietary fibre, vitamins, minerals and antioxidants, Professor Apichart Vanavichit and his research team at the Rice Science Center, Kasetsart University show that the wholegrain offers many additional health benefits.

The researchers initially developed Riceberry with the aim of boosting nutritional values, fragrance and the taste of rice. Riceberry was developed from a cross between two renowned Thai rice strains: Jao Hom Nin, a Thai non-glutinous purple rice, and Khao Dawk Mall 105 (Thai Homnali rice). The purple-black coloured grain was developed by Prof Vanavichit’s team in 2002 and several years of integrated research into its nutritional properties, anthocyanin stability, and physical and cooking properties followed. To date, there are 45 research projects focused on Riceberry with 39 patent applications and 18 endorsed patents. Notably, Riceberry bran is loaded with powerful antioxidants, anti-inflammatory agents and vital health-promoting compounds that can help to lower the risks from disease.

Certified organic Riceberry rice valleys have been established in 12 focus areas around the north and northeast of Thailand where the climate is favourable for the growth of high-quality rice. Today, there are approximately 20,000 Rai of Riceberry rice registered to a variety of organic certification programmes including transitional, organic Thailand, IFOAM, EU, COR, and USDA11. The investment return for this farmland estimated at 6,500 Thai Baht (THB) per Rai with the benefits averaging 32,500 THB per season (1,354 $ per hectare). In total, the return of research investment was estimated to be approximately 600 million THB.

Riceberry has been endorsed under the plant variety protection law since 2017 and trademarks have been registered successfully both in Thailand and internationally under the Department of Intellectual Properties since 2011. Whilst these are owned by public institutes, they can be licensed for use in the global market.

Riceberry is popular amongst farmers as it doesn’t require commercial rice milling but is sold in its whole grain form. Consumers are spoilt for choice with over 108 brands of Riceberry rice on supermarket shelves. With a smaller acreage than Thai Homnali Rice (THM), Riceberry has been used to develop over 66 products. When compared to other products developed from THM, red rice, and other purple rice, Riceberry products have seen a rise in sales beginning in 2013, outperforming THM between 2017 and 2018. The Riceberry farmer stands to gain an average of 10-20 THB more per kg of Riceberry sold. This successful product development has been attributed to its appealing taste and vibrant purple colour as well as its biochemical properties and potential medical benefits.

Nutritious and Delicious

Rice bran contains a variety of flavonoid pigments in differing compositions that are responsible for the many shades of rice. Red and purple bran rice have significantly higher total and flavonoid concentrations and antioxidant compounds than light-coloured bran rice or other cereals due to their higher concentrations of proanthocyanidins and anthocyanins, respectively. The concentrations of the bound phenolic and flavonoid levels accounts for approximately half of those in light-coloured bran rice, but are lower than those in purple and red bran rice10.

Light brown rice bran contains leucoanthocyanidin; red rice holds cyanidin-3-glucoside anthocyanidin; and navy blue rice has delphinidin-3-glucoside anthocyanin. The bran is also rich in other compounds including dietary fibre, proteins, lipids, phytosterols, vitamins, minerals, antioxidants, anthocyanin, and polyphenols. This has made it a subject of research as scientists aim to discover new biologically active compounds or phytochemicals hidden within the thin cell layers wrapped around the endosperm of the rice bran. The extraction of these bioactive compounds can be carried out with the use of solvents, enzymes and a variety of ultrasound assisted methods.

CHEMOPROTECTIVE COMPOUNDS IN PURPLE RICE

Dichloromethane and methanol extraction of Riceberry rice reveals the presence of chemoprotective compounds in Riceberry bran including beta-carotene and lutinin, which are not found in white rice. Additional compounds - polyphenol, tannin and catechin levels in Riceberry were found to be 3-10 times higher than those in normal brown rice. Most impressive of all are the high levels of vitamin B1, B2, B3 and B9 in dark purple Riceberry. Notably, 100g of Riceberry contains 48 µg folate (vitamin B9). Flavones found in Riceberry such as apigenin, phytosterols, and triterpenes like lupenol have been shown to confer chemoprotective properties in a variety of human cancer cell lines including Caco-2 (colon cancer), MCF-7 (breast cancer) and HL-60 (leukemia) with the most notable effects being on the HL-60 cell line15. Specifically, the compound crassin is shown to prevent acute myelogenous leukaemia (AML) cell proliferation which in turn protects the dysfunctional immune system of leukaemic mice by enhancing transcription signal controlling proliferation and functions of hematopoietic cells in the spleen. Together with IFN-g, crassin efficiently facilitates leukaemic mice immune system modulation leading to an improvement of the AML condition12.
In addition to cancer prevention, studies reveal that the supplementation of Riceberry bran (up to 41%), w/w, in streptozotocin-induced diabetic rats fed a high-fat diet ameliorates hyperglycaemia, hyperlipidaemia, oxidative stress and inflammation as proven by effects on biochemical parameters such as blood glucose and insulin levels. It is proposed that these INHIBITORY EFFECT OF HYDROLYSED RICEBERRY RICE BRAN EXTRACT ON COLON CANCER CELL LINE

HRBRE has been shown to specifically inhibit the colon cancer cell lines growth rather than normal cell line (human fibroblast). HRBRE's effect was shown to occur in a dose- and time-dependent manner, and had different cytotoxic on the different cell types. The MTT assay result at 72 hours after treatment showed that our extract has less cytotoxicity on the different cell types. The MTT assay indicated by the white arrow heads.

Fig. A Cellular senescence inducing effect of HRBRE on HT-29 cells after treated with 0 mg/ml (A), 0.5 mg/ml (B), 1 mg/ml (C), 2.5 mg/ml (D), and 5 mg/ml (E) for 24 h compared to 0.5 mg/ml Mitomycin C treatment (F). The blue stained cells with flattened and enlarged cell morphology represented the cellular senescence status indicated by the white arrow heads. HRBRE: Hydrolysed Riceberry rice bran extract HT-29: non-metastatic colon cancer cell line.

Fig. B Cellular senescence inducing effect of HRBRE on SW-620 cells after treated with 0 mg/ml (A), 0.5 mg/ml (B), 1 mg/ml (C), 2.5 mg/ml (D), and 5 mg/ml (E) for 24 h compared to 0.5 mg/ml Mitomycin C treatment (F). The blue stained cells with flattened and enlarged cell morphology represented the cellular senescence status indicated by the white arrow heads. SW-620: metastatic colon cancer cell line.

Whole grain Riceberry rice entered the Thai rice market over ten years ago and is well known for its distinctive appearance, nutritional value and numerous health benefits.

ANTIOXIDANTS AND TREATMENT OF METABOLIC DISEASES

In addition to cancer prevention, are the effect of increased antioxidant levels on insulin tolerance and reduced B cell apoptosis which subsequently improve liver and pancreas function 5,6.

Although rice bran contains 8-10% oil, it is a major source of highly lipid-soluble antioxidants such as tocopherols, gamma oryzanol, vitamin E, beta-carotene, and lutein. Hyperlipidaemia is a major risk factor for heart disease and a symptom of many metabolic disorders including diabetes and obesity. Studies have demonstrated that the use of Riceberry bran oil (RBBO) raises the levels of higher density lipoprotein (HDL or good cholesterol) and decreases low density lipoprotein (LDL or bad cholesterol) in streptozotocin-induced diabetic rats. One study revealed that after 12 weeks, RBBO significantly decreased malondialdehyde and restored antioxidant defences, catalase, glutathione peroxidase, coenzyme Q10 and Oxygen Radical Absorbance Capacity (ORAC) levels in diabetic rats 7.

RECOVERING ORGAN PATHOLOGY

Another effect of the antioxidants found in Riceberry bran is the attenuation of the antioxidant glutathione peroxidase, catalase and glutathione peroxidase, coenzyme Q10 and Oxygen Radical Absorbance Capacity (ORAC) levels in diabetic rats 7.

INHIBITORY EFFECT OF HYDROLYSED RICEBERRY RICE BRAN EXTRACT ON COLON CANCER CELL LINE

HRBRE has been shown to specifically inhibit the colon cancer cell lines growth rather than normal cell line (human fibroblast). HRBRE's effect was shown to occur in a dose- and time-dependent manner, and had different cytotoxic on the different cell types. The MTT assay indicated by the white arrow heads.

Fig. A Cellular senescence inducing effect of HRBRE on HT-29 cells after treated with 0 mg/ml (A), 0.5 mg/ml (B), 1 mg/ml (C), 2.5 mg/ml (D), and 5 mg/ml (E) for 24 h compared to 0.5 mg/ml Mitomycin C treatment (F). The blue stained cells with flattened and enlarged cell morphology represented the cellular senescence status indicated by the white arrow heads. HRBRE: Hydrolysed Riceberry rice bran extract HT-29: non-metastatic colon cancer cell line.

Fig. B Cellular senescence inducing effect of HRBRE on SW-620 cells after treated with 0 mg/ml (A), 0.5 mg/ml (B), 1 mg/ml (C), 2.5 mg/ml (D), and 5 mg/ml (E) for 24 h compared to 0.5 mg/ml Mitomycin C treatment (F). The blue stained cells with flattened and enlarged cell morphology represented the cellular senescence status indicated by the white arrow heads. SW-620: metastatic colon cancer cell line.

Whole grain Riceberry rice entered the Thai rice market over ten years ago and is well known for its distinctive appearance, nutritional value and numerous health benefits.

ANTIOXIDANTS AND TREATMENT OF METABOLIC DISEASES

In addition to cancer prevention, are the effect of increased antioxidant levels on insulin tolerance and reduced B cell apoptosis which subsequently improve liver and pancreas function 5,6.

Although rice bran contains 8-10% oil, it is a major source of highly lipid-soluble antioxidants such as tocopherols, gamma oryzanol, vitamin E, beta-carotene, and lutein. Hyperlipidaemia is a major risk factor for heart disease and a symptom of many metabolic disorders including diabetes and obesity. Studies have demonstrated that the use of Riceberry bran oil (RBBO) raises the levels of higher density lipoprotein (HDL or good cholesterol) and decreases low density lipoprotein (LDL or bad cholesterol) in streptozotocin-induced diabetic rats. One study revealed that after 12 weeks, RBBO significantly decreased malondialdehyde and restored antioxidant defences, catalase, glutathione peroxidase, coenzyme Q10 and Oxygen Radical Absorbance Capacity (ORAC) levels in diabetic rats 7.

RECOVERING ORGAN PATHOLOGY

Another effect of the antioxidants found in Riceberry bran is the attenuation of the antioxidant glutathione peroxidase, catalase and glutathione peroxidase, coenzyme Q10 and Oxygen Radical Absorbance Capacity (ORAC) levels in diabetic rats 7.

INHIBITORY EFFECT OF HYDROLYSED RICEBERRY RICE BRAN EXTRACT ON COLON CANCER CELL LINE

HRBRE has been shown to specifically inhibit the colon cancer cell lines growth rather than normal cell line (human fibroblast). HRBRE's effect was shown to occur in a dose- and time-dependent manner, and had different cytotoxic on the different cell types. The MTT assay indicated by the white arrow heads.

Fig. A Cellular senescence inducing effect of HRBRE on HT-29 cells after treated with 0 mg/ml (A), 0.5 mg/ml (B), 1 mg/ml (C), 2.5 mg/ml (D), and 5 mg/ml (E) for 24 h compared to 0.5 mg/ml Mitomycin C treatment (F). The blue stained cells with flattened and enlarged cell morphology represented the cellular senescence status indicated by the white arrow heads. HRBRE: Hydrolysed Riceberry rice bran extract HT-29: non-metastatic colon cancer cell line.

Fig. B Cellular senescence inducing effect of HRBRE on SW-620 cells after treated with 0 mg/ml (A), 0.5 mg/ml (B), 1 mg/ml (C), 2.5 mg/ml (D), and 5 mg/ml (E) for 24 h compared to 0.5 mg/ml Mitomycin C treatment (F). The blue stained cells with flattened and enlarged cell morphology represented the cellular senescence status indicated by the white arrow heads. SW-620: metastatic colon cancer cell line.

Whole grain Riceberry rice entered the Thai rice market over ten years ago and is well known for its distinctive appearance, nutritional value and numerous health benefits.

ANTIOXIDANTS AND TREATMENT OF METABOLIC DISEASES

In addition to cancer prevention, are the effect of increased antioxidant levels on insulin tolerance and reduced B cell apoptosis which subsequently improve liver and pancreas function 5,6.

Although rice bran contains 8-10% oil, it is a major source of highly lipid-soluble antioxidants such as tocopherols, gamma oryzanol, vitamin E, beta-carotene, and lutein. Hyperlipidaemia is a major risk factor for heart disease and a symptom of many metabolic disorders including diabetes and obesity. Studies have demonstrated that the use of Riceberry bran oil (RBBO) raises the levels of higher density lipoprotein (HDL or good cholesterol) and decreases low density lipoprotein (LDL or bad cholesterol) in streptozotocin-induced diabetic rats. One study revealed that after 12 weeks, RBBO significantly decreased malondialdehyde and restored antioxidant defences, catalase, glutathione peroxidase, coenzyme Q10 and Oxygen Radical Absorbance Capacity (ORAC) levels in diabetic rats 7.

RECOVERING ORGAN PATHOLOGY

Another effect of the antioxidants found in Riceberry bran is the attenuation of the antioxidant glutathione peroxidase, catalase and glutathione peroxidase, coenzyme Q10 and Oxygen Radical Absorbance Capacity (ORAC) levels in diabetic rats 7.

INHIBITORY EFFECT OF HYDROLYSED RICEBERRY RICE BRAN EXTRACT ON COLON CANCER CELL LINE

HRBRE has been shown to specifically inhibit the colon cancer cell lines growth rather than normal cell line (human fibroblast). HRBRE's effect was shown to occur in a dose- and time-dependent manner, and had different cytotoxic on the different cell types. The MTT assay indicated by the white arrow heads.

Fig. A Cellular senescence inducing effect of HRBRE on HT-29 cells after treated with 0 mg/ml (A), 0.5 mg/ml (B), 1 mg/ml (C), 2.5 mg/ml (D), and 5 mg/ml (E) for 24 h compared to 0.5 mg/ml Mitomycin C treatment (F). The blue stained cells with flattened and enlarged cell morphology represented the cellular senescence status indicated by the white arrow heads. HRBRE: Hydrolysed Riceberry rice bran extract HT-29: non-metastatic colon cancer cell line.

Fig. B Cellular senescence inducing effect of HRBRE on SW-620 cells after treated with 0 mg/ml (A), 0.5 mg/ml (B), 1 mg/ml (C), 2.5 mg/ml (D), and 5 mg/ml (E) for 24 h compared to 0.5 mg/ml Mitomycin C treatment (F). The blue stained cells with flattened and enlarged cell morphology represented the cellular senescence status indicated by the white arrow heads. SW-620: metastatic colon cancer cell line.