

Ruby of Cereals in Taiwan — the Functional Value of Djulis and Its Development

Introduction

Djulis (*Chenopodium formosanum* Koidz.) is a traditional cereal plant in Taiwan. However, the bitterness and browning of the hull make it less acceptable and limit its usage. Very few Djulis products can be seen on the market in recent years. Therefore, the characteristics, functional ability or applications of different varieties of this ethnic crop remained unknown until we started our investigation 2006. Besides the analysis of its nutrients and functional compounds, we also tried to develop its application in functional foods. Hopefully, Djulis may become an economical crop with high profit.

The general nutrients compounds in Djulis

Results showed that the nutrients in Djulis are much higher than that of general cereal plants. For example, Djulis contain starch over 50% and protein may reach 19.3% (similar to beef). Djulis also possesses dietary fiber around 14-22%, which is 3 or 6 fold greater than that of oat or sweet potato. For the fatty acids (FA), more than 70% was unsaturated FA, and poly-unsaturated FA was more than half of the total. They also contain essential amino acid such as lysine, valine and histidine, which are little in common cereals. They are also rich in minerals such as calcium, iron, potassium,

magnesium, zinc etc. Among them, the contents of K, Ca and Mg are higher than that in soybean. The rare elements (Se or Ge) may also be found in Djulis. As mentioned above, Djulis is abundant in nutrients and very healthful. The dietary fiber may improve intestine function,

prevent constipation, obesity and cardiovascular disease. Moreover, Djulis, being easy to plant and fast growing, may become a good solution for the food crisis owing to its high content of starch and protein.



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Table 1, The comparison of the nutrients in Djulis with other foods

Nutrient	Djulis	Sweet potato	Wheat	Rice	Oat	Soybean	Beef
Starch (%)	55.7	28.6	68.4	77.2	66.2	25.3	-
Dietary fiber (%)	17.5	2.4	11.3	0.3	5.1	13.0	-
Protein (%)	17.7	1.0	14.0	7.5	11.5	36.8	19.6
Lipid(%)	3.2	0.3	1.6	0.5	10.1	18.0	21.1
Ca (ppm)	2523	340	290	50	390	1710	90
Fe (ppm)	55.6	5.0	28.0	2.0	32.0	57.0	30.1
Mg (ppm)	2523	280	1380	190	1120	2120	190
Na (ppm)	238	440	20	20	50	220	650
K (ppm)	35280	2900	3350	860	2950	15700	3390
P (ppm)	4607	530	1600	550	1600	3960	2050
Zn (ppm)	24.5	3	26	11	22	20	61

- : not detectable

The functional compounds in Djulis

Various kinds of functional compounds including betanin, superoxide dismutase (SOD), γ - aminobutyric acid (GABA) and polyphenols have been found in the Djulis. Betanin, as we know, may exhibit a powerful antioxidant capacity and act as anticancer or anti-inflammation. Polyphenols, an important antioxidant, may inhibit pathogens, LDL oxidation and arteriosclerosis. Polyphenols are also good in maintaining the elasticity of blood vascular wall and anti-cancer. As to SOD, they act as a powerful antioxidant enzyme, may have anti-inflammation activity, anti-tumor effects and protect the cell to resistant superoxide. GABA, a non-protein amino acid, may act as a major inhibitory neurotransmitter in the

central nervous system. Besides modifying blood pressure, it also improves the quality of sleep. Furthermore, the saponin in Djulis may be extracted to use as natural detergent or skin cleaning.

Products developed from Djulis

We start the research project of Djulis (Named as *Chenopodium formosanum* in 2008) on the behalf of COA (Council of Agriculture, Executive Yuan) since 2006. During this period, we have published 20 papers and about 20 kinds of products. We also applied for 6 patents related to Djulis products. The product of Djulis Yogurt was regarded as an excellent work in the competition [2009 Crazy Idea], held by Industrial Develop Bureau, Ministry of Economical Affairs.

We developed the products in three directions, healthy food, leisure food and facial care products. The products have been developed are as followings: (1). General foods include waffles, puff, moa-chi, oat biscuit, rice roll, fried potato ball and rice cake. (2) Healthy foods include instant Djulis beverage, cereal milk, Djulis capsule, Djulis GABA tea, Djulis probiotics, Djulis SOD and yogurt. (3) Facial care products include clay facial mask and moisturizing essence. (4) Others such as preservative solution for Djulis cut flowers or Djulis pain patch. Since the global market of healthy foods based on cereals keeps growing, we believe that Djulis with its superior nutrients and functional compounds will be highlighted in the future.

