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THERMOSTABILITY OF DIETARY ANTIOXIDANT ANTHOCYANIN: IMPLICATION FOR FOOD AND NUTRITION

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ABSTRACT

Study was made to assess the thermostability of dietary antioxidant anthocyanin in red rice. Red rice samples of five different paddy landraces were subjected to pressure cooking and boiling for 25 minutes at $100^0C \pm 2^0C$. Following this anthocyanin content were measured by taking absorbance at $\lambda 280$ for both cooked and uncooked sample. One value added product, rice flakes (*chira*) which is consumed uncooked was also studied since it receive heat treatment during preparation. In all the cases except one there were marginal decline in anthocyanin due to cooking and boiling implying that anthocyanin of red rice is fairly thermostable.

Key words: Thermostability, antioxidant, Anthocyanin, Red rice

INTRODUCTION

Understanding thermostability of nutritional components and nutraceutical components of food is of critical importance from academic view point as well as nutrition and food processing industry. Most food items are generally cooked in various manners according to cultural practice except fruits and few vegetables which are used as salad. For practical purpose cooking mean high temperature treatment and it is a well documented fact that at high temperature many biomolecules of nutritive and nutraceutical value degrade-like denaturation and hydrolysis of proteins, vitamins etc. However, contrary to general perception for many bomolecules there are qualitative and quantitative change and increase upon high temperature treatment as revealed by many recent works.

As people are becoming more food conscious, dietary antioxidants are gaining importance and also receiving increased attention from researchers. Since they are natural compounds there is no biosafety concern unlike synthetic compounds like butylated hydroxyl toluene (BHT), butylated hydroxyl anisole (BHA) etc. These are raising biosafety concern because of their toxicity (Buxiang and Fukuhara, 1997) and carcinogenicity (Hirose et.al 1998). Prominent dietary antioxidants are-phenolics, anthocyanin, flavonoids, carotenoids, ascorbic acid, alpha tocopherol, etc. (Lata and Tamala,2006). Among them anthocyanin is of particular interest because it is found in impressive amount in “Red rice” particularly deep water paddy (Loying et.al 2008). This is the staple food for millions of rural people in Assam, Bangladesh, and some South East Asian countries. Understanding thermostability of anthocyanin is of great importance because it has implication for nutritional benefit.

Many antioxidants particularly phenolic compounds are covalently bonded to insoluble polymers and heat treatment liberate then resulting in increase in quantity with concomitant increase in antioxidant activity. In contrast total phenolic content and antioxidant capacity of tomato decrease due to boiling, baking or frying (Sahlin et.al, 2004). Similar observation were recorded in Broccoli due to microwave heating (Zhang and Hamauzu, 2004), garlic due to drying and steaming (Wangcharoen and Marasuk, 2009) etc. Hence, no generalisation can be made as to whether heating and cooking by various mean increase or decrease the antioxidants and antioxidant activities of food. The present work was undertaken to study whether cooking or heat treatment impact the stability of anthocyanin in red rice.

MATERIALS AND METHODS

The study material comprised of 6 cultivars of deep water paddy with red kernel. Another sample was rice flakes (Chira in Assamese language) prepared by traditional method from red rice cultivar Gotha bao. Rice flake is typically consumed raw after soaking in water and blending with curd or milk, sugar or molasses and occasionally ripe banana. As per traditional practice Chira (Rice flake) receive heat treatment during preparation. The paddy grain is soaked in water for 2 to 3 days depending upon cultivar to ensure maximum imbibition of water. Subsequently excess water is drained off and roasted in big frying pan. Thereafter it is pounded in a traditional “Dheki” (Foot operated wooden morter) or such mechanical device. Another method is to partly boil the grain, draining off excess water and again roasting to dehydrate.

Rice grains were manually dehusked in a wooden mortar and divided into three lots. One lot was subjected pressure cooking in a commercial pressure cooker used for domestic purpose. Another lot was boiled in boiling water at $100^0C\pm2^0C$ for 25 minutes. A third lot was left uncooked. Anthocyanin estimation was done on dry weight basis as per the method described by Loying et al. (2008). The cooked rice was spread on petri plate and partially dehydrated using hot air blown. Subsequently all the rice samples along with rice flakes were dried in an oven at $50^0C\pm2^0C$ till constant weight was recorded. Anthocyanin extraction was done with 80% methanol supplemented with 0.2% HCl. 300mg dry powdered samples were homogenised in a magnetic shaker and then centrifuged to obtain the supernatant. The residue was washed twice with the solvent and supernatant were pooled. The final volume was made 10 ml and UV spectra were taken in UV-VIS spectrophotometer Aquamate Plus, Thermo Scientific in the wavelength range 220 to 600 nm.

RESULTS AND DISCUSSION

The findings of the present study shows that following cooking ,either pressure cooking or boiling, there were mostly insignificant decline in anthocyanin content. To exemplify, in case of Kokua bao, for uncooked rice absorbance value was 1.696 which marginally declined to 1.586 following pressure cooking (**Table1**). The loss of anthocyanin is statistically insignificant. Likewise following boiling at 100^0C, there were insignificant loss of anthocyanin. For other rice cultivars also, the trend was identical. The exception was noticed in Maguribao where there were some losses of anthocyanin for both pressure cooking and boiling which were found to be significant at 5% probability level. However the most notable observation was in case of rice flakes where there were only marginal loss of anthocyanin with respect to rice sample from where it is prepared. **(Figure 1)**

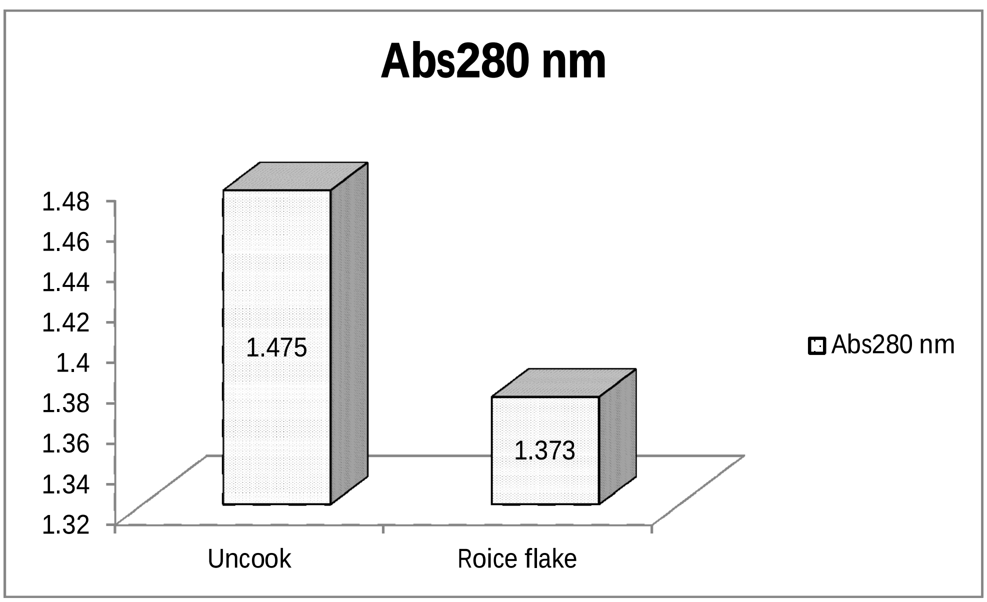

Fig. 1. Anthrocyanin content of uncooked red rice of land race Gotha bao and its value added product - rice flake

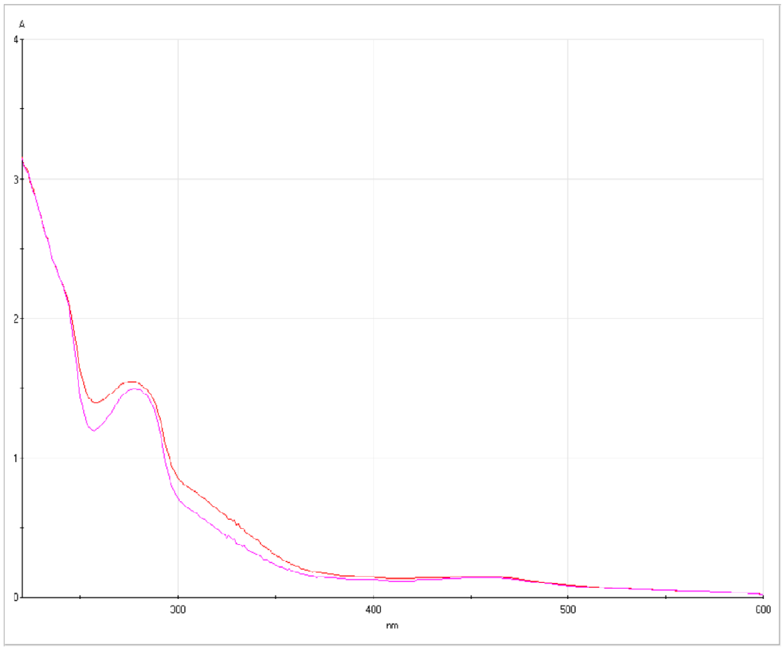

Fig. 2. A. Absorbtion spectra for anthocyanin for uncooked and cooked (Pressure cooking) rice of Kokua bao

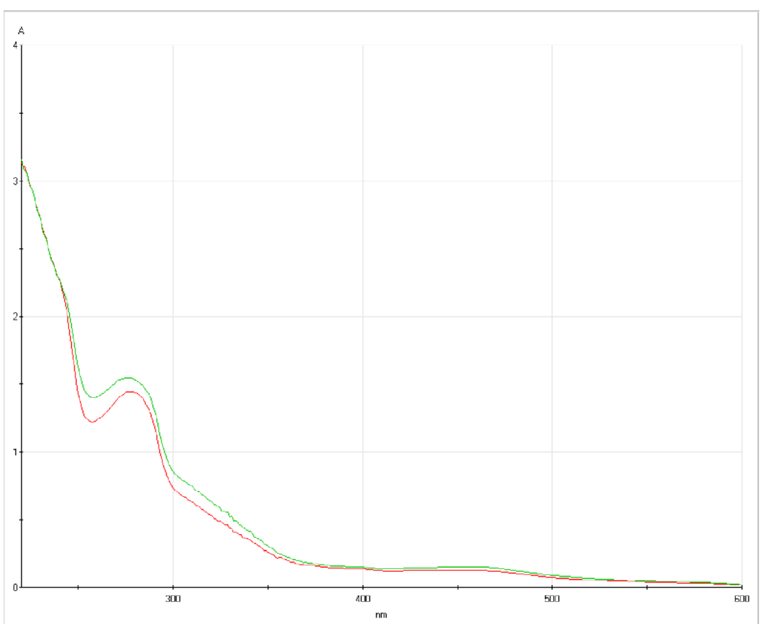

Fig. 2.b. Absorbtion spectra for anthocyanin for uncooked and cooked (boiling) for Buruli bao

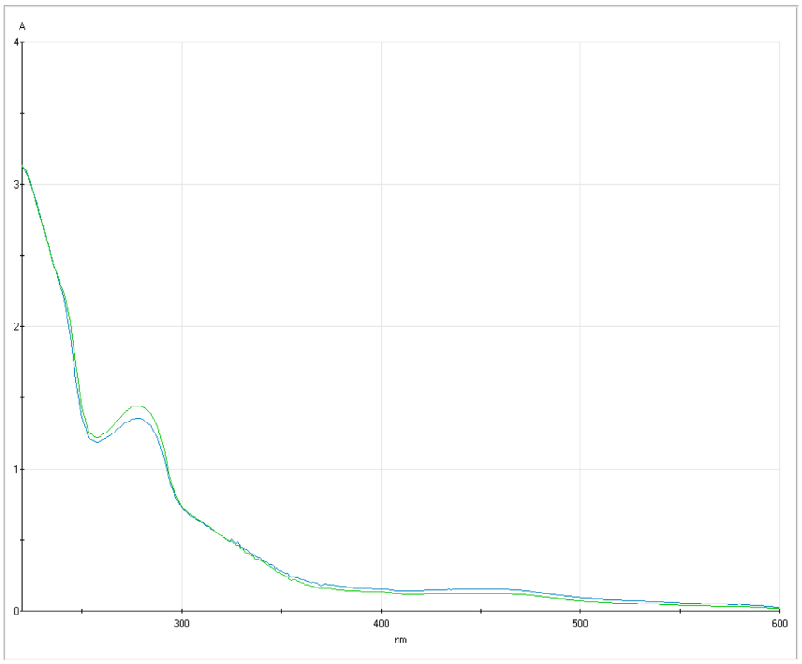

Fig. 2.c. Absorbtion spectra for anthocyanin for uncooked and cooked (boiling) for Dal bao

Table 1: Anthrocyanin content of five different land races of red rice and red rice flaks before and after cooking by two different methods. Anthrocyanin content is in terms of absorbance at λ 280 nm

Type of cooking		Abs at λ280 for paddy land race				
		Kokua	Buruli	Kahi Jool	Dal bao	Maguri
Pressure Cooker cooking	Uncooked	1.696	1.628	1.707	1.396	1.468
	Cooked	1.586	1.258	1.496	1.288	1.336
Boiling (Rice Flasks)	Uncooked	1.686	1.619	1.690	1.407	1.452
	Cooked	1.556	1.328	1.584	1.268	1.308
	CD at 5%	0.27	0.31	0.23	0.21	0.19
	CD at 1%	0.42	0.42	0.32	0.29	0.25

Thermostability of food components and compounds of nutraceutical values are of critical importance from the viewpoint of nutrition because most vitamins are degraded during cooking. The present study focussed on anthocyanin which was earlier considered to be of little biological significance except imparting red purple colouration. However anthocyanin came into prominence with the finding that it is a powerful antioxidant (Tiwary, 2001). Subsequent works by a number of workers not only confirmed this but also showed that it can significantly reduce the emergence of cardiovascular diseases (Wang, 2005), age associated oxidative stress and cancer chemo-preventive property (Bagchi et al, 2004), because of its ability to scavenge free radical. This imparts health protective and health promoting quality to anthocyanin. Because it is on record that free radical induced damage can cause about 60 different diseases in human (Vijitha and Nizar, 2009). Anthocyanin is found in relatively high amount in some vegetables, fruits (Salisbury and Ross 1986). However fruits, vegetables etc. are seasonal and consumed as food supplement. Unlike this red rice is staple food which ensures regular intake of anthocyanin as dietary antioxidant. Although no statistics is available, in many flood prone areas of upper Assam where red rice consumption is common, prevelance of degenerative diseases are far and few. Anthocyanin is a flavonoid and stable compound with 3 aromatic rings-two benzene rings A and B with O_2 containing pyran ring in the C ring. A and B ring mostly remain unaltered but substitution of C ring distinguish different class of compounds (Salisbury and Ross,1986). The present study shows that cooking only marginally decrease anthocyanin content which is insignificant. Rice flakes (Chira) is nutritionally advantageous since it is not cooked but consumed after soaking in water or warm water. However it receives some heat treatment during its preparation. The present study is preliminary but it highlights the nutraceutical potential of red rice and its value added products.

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