

High β Carotene Discovered in Kalanamak of Rice

R C CHAUDHARY^{1*}, SMRITI SINGH², RITIMA YADAV², SWAPNA DAS² AND ANJALI SAHANI¹

ABSTRACT

Kalanamak rice is a unique cultivar of *Oryza sativa* L. where β Carotene is present. In the freshly harvested grain, the β Carotene is 0.42 mg / 100 g, and in one year old sample it is 0.18g / 100 g. Total carotenoids in these samples were 0.51 and 0.31 respectively. β Carotene of Kalanamak needs to be studied further for $i\beta$ ts conversion rate into Vitamin A. Through various breeding methods, amount of β Carotene needs to be increased for remedying Vitamin A Deficiency in the human population. Along with high aroma, high Iron, high Zinc and high protein, semi-dwarf varieties of Kalanamak will be the unique rice of the world. It is non-GMO unlike Golden Rice, and thus non-controversial in consumption and promotion.

KEYWORDS

Total Carotenoids, Vitamin A Deficiency, Kalanamak rice, β carotene

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INTRODUCTION

Kalanamak is the epitome of highly aromatic rice of North-Eastern part of U.P., India (Chaudhary and Tran, 2001). Four varieties of Kalanamak (KN 3, Bauna Kalanamak 101, Bauna Kalanamak 102 and Kalanamak Kiran) have been developed by PRDF, Gorakhpur which are notified by Govt. of India (Chaudhary *et al* (2020); Kumar *et al* (2018b) , Kumar *et al* (2018a) ; Yadav *et al* (2019)). All these varieties of Kalanamak have high aroma, iron and zinc, and double amount (10.6%) of protein. Kalanamak varieties have also a low GI (Glycemic Index) of 49-52% and thus diabetic patients can consume it (Chaudhary *et al*, 2020). These intrinsic grain qualities are the blessings of Lord Buddha to Kalanamak rice. All the four notified varieties of Kalanamak rice have similar grain qualities (Yadav *et al*, 2019).

Normal rice grain is a typical caryopsis, covered with rough husk, soft bran (inner aleurone, middle tegmen and outer pericarp), large endosperm and small embryo in the lower corner (Jinseng, 2018), with no mention of β Carotene. Common varieties of unpolished rice varieties have brownish bran; some have red or black bran to give the variety a distinct colour. Unpolished rice i.e. bran of Kalanamak rice has rarest of the rare green colour to give it a false impression of being immature grain. This is unique character of all the four notified varieties Kalanamak rice. With its high yield, high nutritious quality, Kalanamak can triple farmers' income (Yadav and Chaudhary, 2019).

MATERIALS AND METHODS

Two samples of Kalanamak KN 3 were used in the study, one from Kharif 2020 crop harvest and another from Kharif

2021 harvest. Both the samples were husked to remove hull after due drying immediately following harvest. Husks were removed carefully to keep the bran intact. Total Carotenoids and β Carotene were estimated in both the samples at Regional Food Research and Analysis Centre ((R-FRAC), Lucknow using the FSSAI Manual 16.

RESULTS AND DISCUSSION

Upon testing result were amazing. Freshly harvested grains of Kalanamak KN3 had dark green colour while the one year old grains had turbid green colour. We analyzed both the samples for Total Carotenoids as well as β Carotene. The freshly harvested sample had higher Total Carotenoids and β Carotene (Table 1).

Clinical and subclinical vitamin A deficiency is still a problem in India, due to which 60,000 children alone go blind annually \$. Vitamin A capsule to prevent clinical vitamin A deficiency in developing countries, chemically synthesized vitamin A capsules have been distributed periodically to deficient populations in India. In spite of very good effect in remedying Vitamin A Deficiency, periodic supplementation programs to masses have been difficult to sustain because of high distribution costs and other operational problems. Recently, food-based interventions to increase the availability of provitamin A (β Carotene) rich foods and their consumption have been suggested as a realistic and sustainable alternative to overcome Vitamin A Deficiency. In 24 African countries, Orange-fleshed Sweet Potato has done wonders and during 2017, 2018 and 2019, the promoters won World Food Prize (http://www.worldfoodprize.org/en/laureates/20102019_laureates/).

¹ Participatory Rural Development Foundation (PRDF), 59 Canal Road, Shivpur – Shahbazganj, Gorakhpur 273014, Uttar Pradesh, India

² Home Science Department, D. D. U. Gorakhpur University, Gorakhpur 273010, Uttar Pradesh, India

*Corresponding author email: ram.chaudhary@gmail.com

Table 1: Total Carotenoids and β Carotene (mg / 100g) in freshly harvested and one year old KN3 variety of Kalanamak rice (Source: R-FRAC, Govt. of U. P., Lucknow), December 2021.

Freshly harvested Kalanamak rice		One year old sample of Kalanamak rice		Golden Rice *	
β carotene (mg/100gm)	Total carotenoids (mg/100g)	β carotene (mg/100g)	Total Carotenoids (mg/100g)	β Carotene (mg/100g)	Total Carotenoids (mg/100g)
0.42	0.53	0.18	0.34	0.39 – 0.99	0.31

* Source: Tang *et al* (2009) ; Dash *et al* (2016)

In recent years, scientists have introduced the biosynthetic pathway for provitamin a carotenoids into rice and named it Golden Rice, which contains 1.6–35 μ g β -carotene per gram of dry rice. Golden Rice–1, which was transformed with a construct containing a phytoene synthase gene from daffodil, contains 1.6 μ g carotenoids (0.8 μ g β -carotene) per gram of dry rice (17). Golden Rice–2 was transformed with a construct containing a phytoene synthase gene from maize and contains up to 35 μ g β -carotene per gram of dry rice (Jinseng (2018) Jinseng Bao, 2018). β -carotene is converted into vitamin A when metabolized by the human body. We need vitamin A for healthier skin, immune systems, and vision. 0.24–0.94 mg retinol. Thus, the conversion factor of Golden Rice β -carotene to retinol is 3.8 ± 1.7 to 1 (Tang *et al*, 2009). In studies of Golden Sweet Potato, the conversion has been reported much higher (90%). Conversion of β Carotene from Kalanamak rice to Retinol is yet to be studied but it is presumed to be much higher as the pigment is limited to bran and not embedded in the endosperm as in Golden Rice. Therefore, use of unpolished Kalanamak rice, which has high aroma, high iron, high Zinc and high protein to remedy Vitamin A Deficiency

as cheap and sustainable food source has great potential. This information is critical for the purpose of designing informed, food-based nutritional strategies for rice-eating regions throughout the world where vitamin A deficiency is common (Chaudhary and Sahani, 2017). Tang *et al* (2009) reported that the conversion factor of Golden Rice β -carotene to vitamin A (Retinol) is 30%. The highest amount of β Carotene reported in Golden Rice is 31 to 99 mg / 100g but it is imbedded in the endosperm. Therefore, the β Carotene identified in the bran of Kalanamak rice can play a key role in remedying Vitamin A Deficiency.

CONCLUSION

Present study confirm that in β Carotene content in the Kalanamak rice in fresh harvest is 0.42 μ g / 100 g, study revealed that it was drastically reduced in one year old sample it was reduced to 0.18 μ g / 100 g. It may be concluded that fresh harvested rice may contains more β Carotene hence everyone should consume fresh harvest rice especially in case of kalanamak rice.

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