

Research Paper

***In vitro* protein digestibility and bioavailability of iron in Mid Day Meals in comparison with balanced meal**¹Usha Ravindra, ²Nayana, P. and ³Veena, B.M.¹ Associate Professor and ^{2&3} Ph.D. students, Dept. of Food Science and Nutrition, University of Agricultural Sciences, GKVK, BangaloreEmail: drusha227@gmail.com**Abstract**

In Vitro Protein digestibility and bioavailability of iron was estimated in selected rice and meal samples. In vitro protein digestibility was highest in KRH-4 (87.43%) rice sample. Among the meals prepared, from KRH-4 based balance meal had significantly highest (94.50%) in vitro protein digestibility followed by BPT-5204 (90.75%) and lower values were recorded in all the three school meals. Bioavailability of iron of rice samples varied significantly. BPT-5204 had highest bioavailable iron than other two genotypes. Among the meals BPT-5204 recorded significantly highest bioavailable iron followed by KRH-2 (67.50%) followed by KRH-4 (64.50%) and significantly lower values are recorded in meals procured from schools. Hence it could be concluded that balanced meal prepared from KRH-4 and BPT-5204 showed higher protein digestibility and bioavailable of iron than the school meals which needs to be improved with addition of iron sources.

Keywords: Rice, Mid-day meal, balanced meal, protein, bioavailability of iron.**INTRODUCTION**

Rice is one of the important food grains consumed in higher extent in developing countries where, malnutrition has been a serious problem, mostly in South and South East Asia. Over three billion people suffer from micronutrient malnutrition. However, scientists have recognized that, deficiency of micronutrients and their bioavailability plays an important role in disease prevention and management.

Protein and iron deficiencies have egregious societal costs including learning disabilities among children, increased morbidity and mortality rates, lower working capacity and productivity is added to high health care costs. All of these diminish human potential, felicity and national economic development. In recent years, attention has paid towards strategies for improving human protein, vitamin and mineral nutrition, especially protein, iron and zinc using food based interventions [6].

The rice is a major cereal included in the diet of majority of population throughout the world. Even in India it is an inseparable part of daily dietary. Whether it is 'Carry on Meal' or Mid Day Meal Programme, rice is the major staple selected for distribution and consumption. Releasing of rice genotypes having better nutritional qualities and its distribution through Mid Day Meal Programme will surely help to overcome micronutrient deficiencies. However, availability of important nutrients such as protein, iron, calcium, etc., is the key issues related to the health and nutrition of the children who consumes mostly rice based diets in

the rural areas. Hence, a study was undertaken on *In vitro* protein digestibility and bioavailability of iron of rice genotypes in comparison with Mid Day Meals and balanced meal.

MATERIAL AND METHODS

Sample collection: Three rice samples- KRH-2, KRH-4 and BPT-5204 were collected from Zonal Agricultural Research Station, VC Form, Mandya, Karnataka. Three meals of Mid Day Meal Programme from three Government Schools-Bhashettihalli, Guddadahalli and Karsbag of Bangalore rural district were collected. Three balanced meals were prepared using above rice genotypes. Selected rice genotypes, combined meals from three schools and standard balanced meal prepared in the laboratory were compared and used for analysis.

In Vitro Protein digestibility

In-vitro protein digestibility of rice and meal samples was carried out using enzymatic method of [3].

Bioavailability of iron

Bioavailability of iron of rice and meal samples was estimated by using [4].

The estimation was done in triplicates and data was tabulated and analyzed statistically using one way ANOVA.

RESULTS AND DISCUSSION

In Vitro Protein digestibility of rice based meals

The results of experiment are presented in Table-1 and Fig-1. Among the three rice samples, meals and balanced meals there was significant difference existed for *in vitro* protein digestibility. Balanced meals prepared with KRH-4 rice recorded significantly highest *In- vitro* protein digestibility of 94.50 per cent followed by BPT 5204 (90.75 %), KRH-2 (89.50 %).

Among the rice samples also KRH -4 had the highest protein digestibility followed by BPT 5204 recorded 86.00 per cent of protein digestibility least by KRH-2 (82.50 %). With reference to meals collected from schools, KAS recorded very low digestibility of protein (77.25 %) than the rest of the meals. The difference in *In vitro* protein digestibility is due to genetic variability, cooking, ingredients used in preparing the meal and their processing techniques. Cooking could have destroyed the anti-nutritional factors present in rice and rendered rice protein more digestible [7] and [8] reported an increase from 37 to 52 per cent digestibility of protein; cellulase treatment of raw rice also increased its *in vitro* digestibility. These results support the point that increased protein digestibility of aleurone cells is dependent on breakage of the cell wall. Similar study was conducted by [2] showed that, increase in protein digestibility of the aleurone layer and grain coat to the extent of 65 per cent in cooked rice, due to disruption of the cellulosic cell walls at 100°C. Cooking methods and particular variety of rice will definitely contributes to the enhanced protein bioavailability to the school children and protecting them from protein malnutrition which directly affects the learning.

Table I. *In vitro* digestibility of protein of rice genotypes, balanced meals in comparison with Mid Day Meal samples

Rice samples	Protein (gm)	<i>In vitro</i> digestibility of protein (%)
KRH-2	12.33	82.50
KRH-4	14.00	87.43
BPT 5204	12.22	86.00

Meals from schools		
BA**	8.37	79.00
GUD**	7.77	80.75
KAS**	8.10	77.25
Balanced meals prepared from genotypes		
BM [♦] (KRH-2)	24.60	89.50
BM [♦] (KRH-4)	26.27	94.50
BM [♦] (BPT 5204)	24.62	90.75
GM	14.00	83.68
F Value	*	*
SEm± (0.05)	0.08	2.52
CD (P≤0.05)	0.24	7.76
CV (%)	0.78	4.26

* Significant at 5 %

** Mid Day Meal samples from

BA – Govt. Model Higher Primary School, Bhashettihalli.

GUD - Govt. Higher Primary School, Archalli, Guddadahalli.

KAS - Govt. Higher Primary School, Karsbag

BM[♦] - Balanced meal

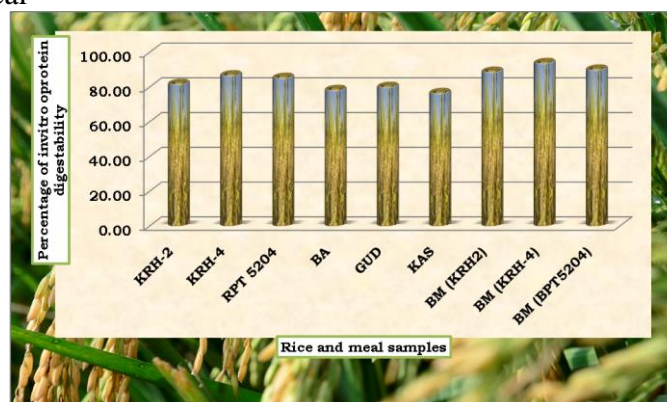


Fig. 1: *In Vitro* protein digestibility of rice genotypes in comparison with Mid Day Meal samples

Bioavailability of iron of rice based meals

The bioavailability of iron of different meals of rice genotypes varied significantly (Table 2 and Fig.2). BPT 5204 based balanced meal has recorded significantly highest bioavailable iron of 70.75per cent followed by KRH-2 (67.50 %) while, school sample - BA recorded lowest bioavailability of iron i.e. 26.25 per cent at pH 7.50. similar findings are reported by [4] who investigated the per cent ionizable iron at pH 7.5 in a number of diets for per cent iron absorption from the diets observed in the adult males. Similar study was conducted by [1] and reported that, increasing milling time and rinsing the Fe-fortified parboiled rice decreased the amount of bioavailable iron. This is due to their negative effects on the total iron concentrations in the parboiled rice grains. Similarly, [5] showed that, milling of cereals greatly affected their iron bioavailability. Iron in milled polished rice for instance, is about four times better absorbed than iron in un milled rice.

Table II: Bioavailability of iron of rice genotypes, balanced meal in comparison with Mid Day Meal samples

Rice Varieties	Iron (mg)	pH 1.35 (mg)	pH 1.35 (%)	pH 7.50 (mg)	pH (7.50) (%)
KRH-2	2.63	0.98	49.00	0.79	39.50
KRH-4	1.71	0.88	44.00	0.76	38.00
BPT 5204	2.83	1.03	51.50	0.90	45.00
Meals from schools and selected genotypes					
BA**	1.89	0.53	26.50	0.53	26.25
GUD**	1.5	0.81	31.50	0.75	26.50
KAS**	2.37	0.63	40.50	0.53	37.50
BM[♦] (KRH-2)	8.12	1.44	72.00	1.35	67.50
BM[♦] (KRH-4)	7.20	1.36	68.00	1.29	64.50
BM[♦] (BPT 5204)	8.18	1.50	75.00	1.42	70.75
GM	3.93	0.99	49.43	0.89	44.71
F value	*	*	*	*	*
SEm ± (0.05)	0.16	0.02	0.76	0.02	0.88
CD (P≤0.05)	0.51	0.05	2.33	0.05	2.71
CV (%)	2.84	2.65	2.65	3.41	3.41

* Significant at 5 %

** Mid Day Meal samples from

BA – Govt. Model Higher Primary School, Bhashettihalli.

GUD - Govt. Higher Primary School, Archalli, Guddadahalli.

KAS - Govt. Higher Primary School, Karsbag

BM[♦] - Balanced meal

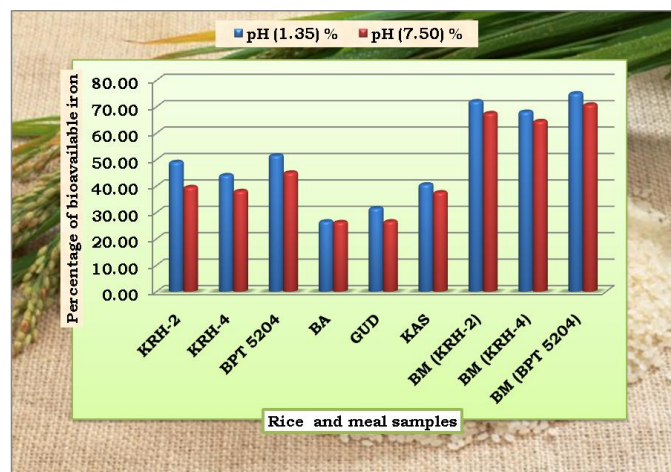


Fig. 2: Bioavailability of iron of rice genotypes in comparison with Mid Day Meal samples.

I. CONCLUSION

As per the observation, rice quality and other ingredients used for the preparation of meals plays a very important role in the Mid-Day Meal programme Bioavailability of iron and digestibility of protein will improve the nutrition status of school children. Rice based Mid Day Meal programme has direct impact on physical, psychological and learning activities. Hence, evidence indicates that balanced meal prepared using KRH-4, KRH-2 and BPT-5204 recorded the highest values. Rice genotypes showed higher *In vitro* digestibility of protein (KRH-4) and bioavailability of iron (BPT 5204) compared to rice served in Mid Day Meal Programme. Hence these can be incorporated in school Mid Day Meal programme moreover; these genotypes are having higher yield and productivity.

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