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Quality Assessment and Evaluation of Ragi for Development of Multipurpose Mix

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ABSTRACT

A study was conducted at Zonal Agricultural Research Station, V. C. Farm, Mandya during 2013-14, to evaluate the nutritional composition of late kharif ragi variety, KMR-204 (Achala) and to evaluate the feasibility of ragi flour incorporation in the preparation of ready-to-cook mix which can be used for the preparation of conventional products such as *vada, thalipattu* and *dosa*. The nutritional composition of the variety indicated that it contains ash (2.87 g), calcium (344.59 mg), magnesium (353.94 mg), phosphorus (292.95 mg) and potassium (191.05 mg), which were significantly more compared to check variety (GPU-48). Among the different levels of ragi flour incorporation, the 50 per cent ragi flour incorporated multipurpose mix was found to be statistically superior in sensory scores of products such as *vada, dosa* and *thalipattu*. The developed mix was found to contain protein (13.87g), crude fiber (3.21 g), ash (4.52 g), calcium (260.80 mg) and iron (4.22 mg). The rating of products in terms of their liking indicated that children and adolescents (43.34 and 43.12 %) liked the product *vada* followed by *thalipattu* (33.33 and 36.20 %) and *dosa*. On the contrary, in case of adults *thalipattu* was liked by maximum number of consumers (37.31 %) followed by *vada* (32.84 %) and *dosa* (29.85 %).

RAGI or Finger millet (*Eleusine coracana* Gaertn) is a major food crop of the semi arid tropics of Asia as well as Africa, and has been an indispensable component of dry farming system. On account of various advantages of finger millet due to its composition, can be exploited for nutritional and other health benefits. Ragi has best quality protein along with the presence of essential amino acids, vitamin A, B and phosphorus (Gopalan *et al*., 2004). Thus, ragi found to be a good diet for growing children, women, old age people and patients. Ragi is considered to be ideal food for diabetic individuals due to its low sugar content and slow release of glucose/sugar in the body (Kang *et al.,* 2008 and Lakshmi and Sumathi, 2002). Finger millet has gained importance in the recent past mainly because of its functional components such as slowly digestible and resistant starch (Wadikar *et al*., 2007).

Malnutrition is considered as an impediment in national development and hence assumes the status of national problem. For solving the problem of deep-rooted food insecurity and malnutrition, dietary quality should be taken into consideration. Diversification of food production must be encouraged both at national and household level in tandem with increasing yields. Growing of traditional food crops suitable for the area is one of the possible potential successful approaches for improving household food security. Cereals along with pulse combinations constitute an important part of human diet in many parts of the world because of easy availability, low cost, long shelf life and nutritional balance. Finger millet is usually used for preparation of flour, pudding, porridge and roti (Chaturvedi and Srivastava, 2008). With the change in scenario of utilization of processed products and awareness of the consumers regarding health benefits of finger millet, tremendous potential exists finger millet attracts urban as well as rural consumers in the way of convenience foods. Today's women find it difficult to cook many of our traditional recipes due to shortage of time. Hence, convenience foods such as ready-to- cook or ready to serve (instant mixes) normally in dry form need to be mixed with water before consumption and require only few minutes of cooking in boiling water or steaming or frying can suitably serve the purpose. Hence, an attempt has been made in this regard to analyze the nutritional composition of newly released ragi variety KMR-204 and to assess the feasibility of ragi flour incorporation for the preparation of ready-to-cook mix, which can be used for the preparation of conventional products such as *vada*, *thalipattu* and *dosa* with a prime objective to spread the awareness regarding nutritional qualities of ragi and to popularize the recipes that can be easily prepared and marketed by rural and urban mass using available resources.

Material and Methods

Analysis of Nutritional Composition : The grains of ragi variety KMR-204 (Achala) and GPU-48 (Check) were supplied from AICSMIP (Small millets), Zonal Agricultural Research Station V. C. Farm. The varieties as well as developed mix were analyzed for proximate composition (Anon., 1995). Carbohydrate content was estimated by difference (Livesey, 1995). For mineral estimation the samples were prepared by dissolving the ash obtained after ashing the samples in a Muffle furnace in dilute hydrochloric acid (1:1 v/v). Calcium and phosphorus contents were estimated according to standard procedure of Anon. (1995), iron by Wong's method (Wong, 1928), while, magnesium and potassium were estimated by the methods of Versanate titration and Ranganna (1986), respectively.

Development of Multipurpose mix: Wheat semolina (suji,) wheat flour, soya flour, onion, red chilli, coriander and curry leaves were purchased in bulk from local market. Ragi flour (KMR-204) in the ratio of 50, 60 and 70 per cent was mixed with other ingredients such as red chilli, onion, curry leaves which were used for mixing after dehydration. The dehydration of vegetables includes water blanching of curry, coriander leaves and onion for three min, and were dehydrated at a temperature of 50^0 C in a hot air oven and powdered as described by Singh and Kulshrestha (2008) with slight modification. The flours and suji were dry roasted at 80^0 C for five min (Fig. 1). Three different levels of ragi flour were mixed with other ingredients and the multipurpose mix was reconstituted according to Premavalli (2000) with suitable modifications. For *vada* preparation, developed mix (100 g) in three different levels was reconstituted with 10 grams of warm oil along with 60 ml of water so as to get hard dough consistency. The dough was conditioned for 5 minutes; made into small balls, pressed on a papad presser to get round shaped vadas and were deep fried in cooking oil on a medium flame till they turned to brown colour. For *dosa* preparation, 100 g of the mix was added with 160 ml of water and conditioned for 3 hrs and baked on a heated thava with 3-4 ml of oil. For *thallipattu* preparation, 100 g of mix was added with 60 ml of water in order to prepare a ball of hard dough followed by conditioning

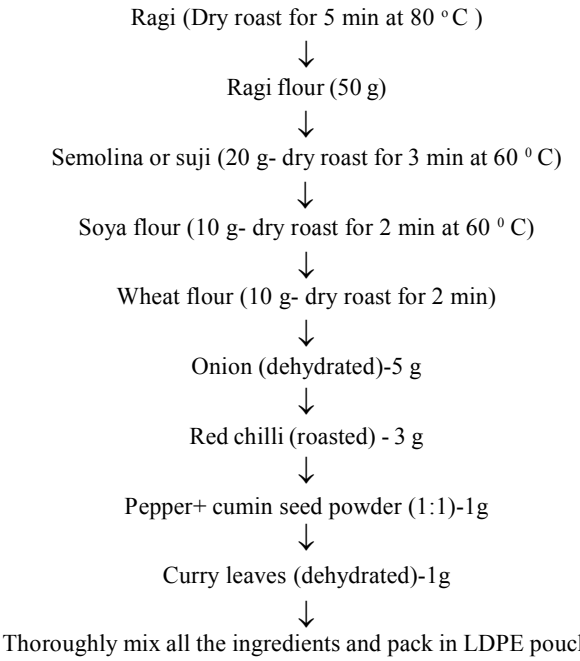

Fig. 1 **:** Standardized recipe of ragi multipurpose mix

for five minutes. The small pieces from this ball were taken and pressed on a papad presser using polythene cover to get round shaped *thallipattu* (can be rolled using pin and rolling board or can be pressed by hands) and baked on iron thava using oil.

Sensory evaluation: The developed products were evaluated for their acceptability by a panel of 21 semi trained judges using 5-point Headonic scale(Ranganna, 1986). Scores were allotted to appearance, taste, flavor, texture and overall acceptability (OAA) in all the products in order to judge the best level of ragi flour incorporation.

Consumer acceptability: The general acceptability of the products such as *vada*, *thallipattu* and *dosa* prepared out of multipurpose mix was carried out by serving three products to different age group people such as children (6-12 years), adolescents (12-21 years) and adults (>21 years) and asked to put (√) mark below the product which they liked the most among three products.

Statistical Analysis: Analysis of variance (ANOVA) test was used to know the significant differences among different levels of ragi flour incorporation.

Results and Discussion

The Table I revealed the nutritional composition of two ragi varieties. Among the two varieties, KMR 204 is relatively good in terms of ash (2.87 g), calcium (344.59 mg) magnesium (353.94 mg) and iron contents (5.16 mg) compared to check variety (GPU-48). Similar variation in nutritional composition of malted and unmalted ragi flour was reported by Desai *et al.* (2010), wherein the values for protein, ash and phosphorus contents for unmalted ragi flour were found to be less compared to KMR-204. The protein content of KMR - 204 (10.08 g) was found to be more than the Indaf (5,7,8,9,11,15) and MR series (1,2,5,6) as reported by Ravishankar *et al.* (2005). Further, Vadivoo *et al*. (1998) analysed 36 genotypes of finger millet and reported their protein content in the range of 6.7 to 12.3 g with a mean of 9.7 g / 100 g and the authors even reported that the protein content of brown seeded types was higher than white seeded type. Similar findings were reported by Samantaray and Samantaray (1997). The carbohydrate content of KMR-204 was 72.03 g which was more (70.81 g) than the check (GPU-48). Similar variation in carbohydrate content of finger millet has been reported to be in the range of 72 to 79.5 g (Pore and Magar, 1979; Hulse *et al.,* 1980; Joshi and Katoch, 1990; Bhatt *et al.,* 2003). The fat content of KMR - 204 was 2.04 g which was more than check as well as Indaf and MR series. Higher fat content (2.1 g) in finger millet was also reported by Antony *et al*. (1996). Total ash content is higher in finger millet grains compared to commonly consumed cereal grains. The ash content has been found to be nearly 1.7 (Rao, 1994) to 4.13 g (Rao *et al.,* 1973) in finger millet. Our study indicated that the ash content of KMR-204 was 2.87 g, which was more than the check (2.29 g). Most of the studies have showed that the ash content was in the range of 2.1 to 2.7 g (Samantaray and Samantaray, 1997; Bhatt *et al.,* 2003; Mushtari begum, 1998; Malleshi and Desikachar, 1986; Lupien, 1990). Even the studies of Singh and Srivastava (2006) showed that the total ash content of sixteen varieties of finger millet varities ranged between 1.47 to 2.58 g with a mean value of 2.11 g / 100 g.

Table I
Nutritional composition of KMR-204 compared to check

Parameters	KMR 204	GPU 48
Moisture (%)	10.25 ± 0.043 [a]	10.05 ± 0.05 [b]
Protein (g)	10.08 ± 0.06 [a]	10.28 ± 0.05 [a]
Fat (g)	2.04 ± 0.14 [a]	1.95 ± 0.04 [a]
Carbohydrate (g)	72.03 ± 0.50 [a]	70.81 ± 0.044 [b]
Energy (k.cal)	344.9 ± 0.84 [a]	340.12 ± 0.32 [a]
Fibre (g)	3.23 ± 0.06 [a]	4.39 ± 0.01 [a]
Ash (g)	2.87 ± 0.05 [a]	2.29 ± 0.02 [b]
Calcium (mg)	344.59 ± 0.49 [a]	331.53 ± 0.50 [b]
Phosphorous (mg)	292.95 ± 0.31 [a]	283.92 ± 0.27 [a]
Magnesium (mg)	353.94 ± 0.58 [a]	307.5 ± 0.5 [b]
Potassium (mg)	191.05 ± 0.41 [a]	177.10 ± 0.50 [b]
Iron (mg)	5.16 ± 0.45 [a]	4.09 ± 0.40 [b]

Values indicate mean of three replications ± SD, values with different letters differed significantly.

The Calcium content of KMR-204 was 344.59 mg which was on par with check (331.53 mg). The calcium content reported by Bhatt *et al*. (2003) was as high as 344 mg / 100 g. The average calcium content (329 mg) in white varieties was considerably higher than the brown (296 mg) varieties as reported by Anon. (2001). Iron content of KMR-204 was 5.16mg, while it was 4.09 mg in check variety. Singh and Srivastava (2006) reported the iron content of 16 finger millet varieties ranged from 3.61 mg to 5.42 mg with a mean value of 4.40 mg / 100 g. Variations in iron content of finger millet varieties ranged from 3.3 to 14.8 mg (Babu *et al*., 1987). According to Vijayakumari *et al.* (2003), finger millet is the richest source of calcium and iron. Calcium deficiency leading to bone and teeth disorder, iron deficiency leading to anemia can be overcome by introducing finger millet in our daily diet. However the mineral composition of millet grains particularly finger millet is highly variable. The genetic factors, environmental conditions prevailing in growing region and fertilizer application affect the mineral content of food grains.

The standardized multipurpose mix at three levels of ragi flour incorporation (50, 60 & 70 %) was subjected to sensory evaluation. The results of the sensory evaluation of three products (*Thalipattu, vada,* and *dosa*) are depicted in Table II, III and IV,

TABLE II
Sensory evaluation of thalipattu prepared out of ragi multipurpose mix

Sensory Characteristics	Ingredient variations			Statistical analysis		
	50 %	60 %	70 %	f-Value	SEm±	CD at 5 %
Appearance	3.40	3.30	3.00	1.11	NS	NS
Colour	3.60	3.20	2.60	8.14	0.25	0.51
Texture	3.70	3.10	2.50	10.23	0.27	0.54
Flavour	3.50	3.20	3.10	1.67	NS	NS
Taste	3.60	2.60	2.50	13.68	0.23	0.48
OAA	3.60	2.50	2.30	18.90	0.23	0.47

Score pattern: 1- poor; 2 - fair; 3 - good; 4 - very good; 5 - excellent

Table III
Sensory evaluation of vada prepared out of ragi multipurpose mix

Sensory Characteristics	Ingredient variations			Statistical analysis		
	50 %	60 %	70 %	f-Value	SEm±	CD at 5 %
Appearance	4.40	2.70	2.30	50.86	0.22	0.45
Colour	4.50	2.80	2.70	27.09	0.27	0.56
Texture	3.80	3.20	2.70	7.25	0.29	0.59
Flavour	4.20	2.90	3.20	12.39	0.27	0.56
Taste	4.20	3.30	2.80	12.03	0.29	0.59
OAA	3.80	2.70	2.50	12.97	0.27	0.56

Score pattern: 1- poor; 2 - fair; 3 - good; 4 - very good; 5 - excellent

TABLE IV
Sensory evaluation of dosa prepared from ragi multipurpose mix

Sensory Characteristics	Ingredient variations			Statistical analysis		
	50 %	60 %	70 %	f-Value	SEm±	CD at 5 %
Appearance	4.00	3.90	4.30	0.90	NS	NS
Colour	4.10	3.70	3.80	1.10	NS	NS
Texture	4.20	2.40	2.20	40.79	0.24	0.49
Flavour	3.20	2.80	3.50	3.43	0.27	0.55
Taste	4.20	2.50	2.20	40.79	0.24	0.49
OAA	4.00	2.40	2.30	28.91	0.25	0.51

Score pattern: 1- poor; 2 - fair; 3 - good; 4 - very good; 5 - excellent

respectively. The sensory scores of *thalipattu* indicated that (Table II) significant difference was found with respect to taste, texture and colour of the products. The overall acceptability (OAA) of the *thalipattu* indicated that 50 per cent ragi flour incorporated product scored between good to very good (3.60) compared to 60 (2.50) and 70 per cent (2.30). Similar trend was observed with respect to *vada* (Table III). No significant difference was noticed with respect to appearance and colour of the *dosa* was observed, while other sensory characters such as texture (4.20, 2.40 and 2.20) and taste parameters (4.20, 2.50 and 2.20) differed significantly. The overall acceptability scores of *dosa* (OAA) indicates that 50 per cent ragi flour incorporated *dosa* was very good (4.0) compared to 60 and 70 per cent ragi flour incorporation. Study indicated that all the three products prepared with 50 per cent ragi flour incorporated multipurpose mix were organoleptically acceptable by the semi trained judges.

TABLE V
Nutritional composition of ragi multipurpose mix (50% of ragi flour)

Nutritional Parameters	Quantity / 100 g
Moisture (%)	9.81 ± 0.03
Protein (g)	13.87 ± 0.05
Fat (g)	4.48 ± 0.28
Carbohydrate (g)	74.0 ± 0.50
Energy (K cal)	388.8 ± 0.62
Fibre (g)	3.21 ± 0.38
Ash (g)	4.52 ± 0.34
Calcium (mg)	260.8 ± 0.76
Phosphorus (mg)	290.8 ± 0.76
Magnesium (mg)	150.5 ± 0.5
Potassium (mg)	320.5 ± 0.5
Iron (mg)	4.22 ± 0.29

Values indicate mean of three replications ± SD

Nutritional composition of the ragi multipurpose mix: The perusal of Table V indicated that the multipurpose mix prepared using 50 per cent ragi flour incorporation was good in terms of protein content (13.87 g) which may be due to addition of soya protein might have improved the nutrient composition of the mix, particularly protein. The mix was also good in terms of fiber (3.21 g), ash (4.52 g), calcium (260.8 mg) and phosphorus (290.8 mg) contents. Addition of ragi has increased the calcium content of the mix which basically contains 344 mg of calcium (Gopalan *et al.,* 2000). Phosphorous content of the mix was 290.8 mg; it was obviously because KMR - 204 contains 292.95 mg of phosphorus. Potassium and iron contents were comparatively more in ragi mix (320, 4.22 mg) which might be due to the high ash content of the mix (4.52 mg) and the kind of ingredients such as wheat semolina, soya flour, whole wheat flour must have contributed to the more ash and in turn to more minerals.

The consumer ratings (Table VI) of the products among different age group people such as children(60), adolescents (58) and adults (67) indicated that the

TABLE. VI
Consumer acceptability (rating) of products prepared out of ragi multipurpose mix

Products	Children		Adolescents		Adults	
	Number	Per cent	Number	Per cent	Number	Per cent
Vada	26	43.34	25	43.12	22	32.84
Thalipattu	20	33.33	21	36.20	25	37.31
Dosa	14	23.33	12	20.68	20	29.85
	60	100.00	58	100.00	67	100.00

maximum number of children and adolescents (43.34 and 43.12 %) liked the product *vada* followed by *thalipattu* (33.33 and 36.20 %) and *dosa* (23.33 and 20.68 %). On the contrary, in case of adults *thalipattu* was liked by maximum number of consumers (37.31 %) followed by *vada* (32.84 %) and dosa (29.85 %) which might be due to the health consciousness among adult group. However, the multipurpose mix prepared by ragi flour incorporation found to be suitable for preparation of all the three products.

Hence, the study indicated that the multipurpose mix prepared from ragi can be prepared by incorporating ragi flour at 50 per cent level was found to be suitable for preparation of conventional dietary items such as *vada*, *thalipattu* and *dosa*. The nutritional composition of the mix was good in terms of protein, ash, calcium and phosphorus contents. The rating by consumers was maximum for *vada* followed by *thalipattu* and *dosa.*

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