Plant Archives Vol. 24, No. 1, 2024 pp. 1187-1194 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.1.165

QUALITY EVALUATION OF INSTANT *KHICHDI* MIX FORMULATED FROM BROWN RICE AND DEHULLED MUNGBEAN

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(Date of Receiving 04-12-2023; Date of Acceptance-07-03-2024)

ABSTRACT

The experiment was conducted for quality evaluation of instant *khichdi* mix. Six composites were formulated by taking different proportions of instant brown rice and dehulled mungbean in the ratios of T_1 (100:00::IBR:IDM), T_2 (90:10:: IBR:IDM), T_3 (80:20::IBR:IDM), T_4 (70:30::IBR:IDM), T_5 (60:40::IBR:IDM) and T_6 (50:50::IBR:IDM). The prepared mix was packed and stored for analysis. Results revealed that colour analysis L* and b* values reported an increase with the increasing levels of instant dehulled mungbean from 55.81 to 67.95 and 23.71 to 27.00, respectively. The highest crude fibre and ash content of 3.22 and 2.31 per cent were recorded in treatment T_6 (50:50:: IBR:IDM).

Key words : *Khichdi*, Brown rice, Dehulled mungbean, Composite, Instant.

Introduction

Khichdi is termed as super food because it contains very high nutritional density. This means it provide a substantial amount of nutrients and very few calories. It is high in fibre, protein, vitamins and anti-inflammatory properties. In Ayurveda, *khichdi* classifies as '*Sattvic*' food. This means that it nourishes, purifies and strengthens both the body and mind (Shetti, 2022). *Khichdi* is a dish from Indian subcontinent made with a mixture of rice and legumes, which is loaded with wholesome goodness, easy to digest and free of gluten, but the process is slight time consuming (Rahangdale *et al*., 2015). However, the process of making *khichdi*, using the instant mix involves bringing to boil the appropriate quantity of water, adding the mix to it and lightly heating. Due to ease in cooking, saving in time and labour, it provides convenience to consumers (Durgarao, 2017).

Rice (*Oryza sativa* L.) is the most important cereal crop which belongs to family "*Poaceae*" and consumed as a staple food by approximately one-half of the world's population. It is harvested as paddy comprising approximately 20 per cent hull, 8-12 per cent bran and embryo and 70-72 per cent endosperm (Gujral *et al*., 2012). Paddy after removal of husk gives brown rice, which is further polished to remove the bran and germ resulting in white rice. Among the variety of rice, brown rice has been receiving great interest as a nutritional and functional ingredient since the market for healthy foods has been widely grown (Kim *et al*., 2015). Brown rice is whole grain rice with intact bran layer and the inedible outer hull removed. It is the unmilled rice containing the pericarp, the seed coat and nucellus, the germ or embryo and the endosperm (Zhou *et al*., 2002). The nutritious, high fibre bran coating gives it a light tan colour, nut like flavour and chewy texture. The nutritional components in brown rice mainly exist in the germ and bran layers, which are mostly removed by polishing as an outcome (Mir *et al*., 2016). It has a low glycemic index which indicate low digestibility of starch. Brown rice is an excellent source of functional components, bioactive components, vitamins and minerals (Babu *et al*., 2009). Thus, the utilization of brown rice in convenience foods could be a good strategy to exploit its nutritional value and also take out the burden of long cooking time (Mir *et al*., 2020).

Mungbeans are a small, oval type of green bean that is high in fibre and when the bean is split in half it is referred to as dehulled mungbean or moong dal.

Mungbean is the seed of *Vigna radiata* and is native to the Indian subcontinent (Singh *et al.*, 2017). The bean is green with the husk and yellow when dehusked. Mungbeans are a high source of nutrients including manganese, potassium, folate, copper, zinc, magnesium and various B vitamins. They are also high in resistant starch, dietary fibre, protein and amino acid especially lysine and thus can supplement cereal based human diets (Paul *et al*., 2011). Mungbean is also an excellent source of phenolics, flavonoids and other antioxidants (Gujral *et al*., 2013). In addition, mungbean is lower in phytic acid than pigeon pea, soybean and cereals. Because of their high nutrient density, they are considered useful in defending against several chronic and age-related diseases (Singh *et al*., 2017).

Brown rice and dehulled mungbean are considered as an excellent source of functional components which contains important nutrients such as bioactive components, B-complex vitamins, dietary fibre and minerals which can provide and promote human health. So, they can be processed into further forms to utilize them in the preparation of various value added food products.

Materials and Methods

Collection of raw materials

Brown rice was purchased from Jatinder Rice Mill, R.S. Pura, Jammu. Dehulled mungbean was purchased from local market of Jammu and used for experimentation. Basic raw materials used for the preparation of instant *khichdi* were garlic, ginger, onion, potato along with spices (black pepper powder, coriander powder, cumin powder, turmeric powder, red chilli powder) and salt. All the raw materials were transported to pilot plant of Division of Food Science and Technology, SKUAST-Jammu for further processing.

Sample preparation

Instant brown rice and Instant dehulled mungbean

The procured brown rice grains were cleaned manually and sorted to remove any foreign matter. The rice grains were then washed and soaked in water with a ratio of rice to water of 2: 3 (w/v) at room temperature for 3 hours. After that, the samples were drained and cooked in pressure cooker with a ratio of brown rice to water of 1:3 w/v for about 30 minutes (Toan and Vinh, 2018) followed by microwave drying. The procured dehulled mungbean was cleaned manually by removing stones and other extraneous materials. It was then washed with tap water and soaked in water with a ratio of dehulled mungbean to water of 1: 2 (w/v) for 15 minutes at room temperature. After that, dehulled mungbean was drained and cooked in pressure cooker for about 5-10 minutes (Durgarao, 2017). After cooking, dal was subjected to microwave drying. For microwave drying, cooked brown rice and dehulled mungbean were frozen at -20^{0}C for 24 hours. The frozen brown rice and dehulled mungbean were then thawed and placed inside the microwave oven (Samsung CE137NEL) in the form of a thin layer on rotating glass plate with a diameter of 400 mm and dried at 900 W till the required moisture content (below 10%) was achieved. Moisture loss of the sample was recorded at 5 minutes interval using an electronic moisture analyzer (Citizen MB 50C). The dried brown rice and dehulled mungbean obtained from microwave drying were packed separately in air tight containers for further use.

Instant vegetables (onion, potato, ginger and garlic)

Healthy vegetables (onion, potato, ginger and garlic) were selected. The prepared vegetables were subjected to blanching at 95 for 2-3 minutes followed by cooling and surface drying at room temperature. After blanching, all the vegetables were subjected to hot air drying at 60 (Ninthiya *et al*., 2014) until the required moisture content was achieved. The dried vegetables were packed in air tight containers and stored for further use.

Formulation of Instant *Khichdi* mix

For formulation of instant *khichdi* mix, brown rice and dehulled mungbean were mixed together in different proportions as per the treatment combinations given in Table 1.

Table 1 : Treatment details for instant *khichdi* mix.

Treatment	Instant brown rice (IBR)(%)	Instant Dehulled mungbean (IDM)(%)
T_1	100	—
T_2	90	10
T_3	80	20
T_4	70	30
T_5	60	40
T_6	50	50

The instant *khichdi* mix was prepared from instant brown rice, dehulled mungbean, vegetables and spice mixture as per the procedure given by Durgarao (2017) with slight modifications. Six composite instant *khichdi* mixes were formulated along with other ingredients including dried garlic, onion flakes, potato cubes and spice mixture.

Standardization of Instant *Khichdi* mix

Preliminary study was conducted by mixing 100 g of prepared instant *khichdi* mix with 50, 100 and 150 ml of potable water followed by boiling for 4-5 minutes to assess the best suitable blend. On the basis of preliminary study, 100 g of instant *khichdi* mix gave best results in 100 ml of potable water.

Sample analysis

Physico-chemical parameters of Instant *khichdi* mix

Colour analysis (L*, a*, b*)

The colour analysis of roasted and unroasted samples was done by using a Hunter's colour analyzer (Hunter Lab Color Flex Reston VA, USA). The equipment was calibrated using white and black standard ceramic tiles (Vargas *et al*., 2009). The sample was uniformly placed in clean petri plates with lid. In the Hunter's lab calorimeter, the colour of a sample is denoted by the three dimensions *viz*., L*, a*, b*. L* refers to lightness of the colour of the sample and ranges from black = 0 to white = 100. A negative value of a* indicates a green colour whereas the positive value indicates red-purple colour. A positive value of b* indicates a yellow colour and negative value indicates a blue colour.

Moisture

The moisture content in the samples was determined by standard AOAC (2012) method by following the oven drying method as the loss in weight due to evaporation from sample at a temperature of 105^0C till constant weight was achieved. The weight loss in each case represented the amount of moisture present in the sample.

$$\text{Moisture \%} = \frac{\text{Loss in weight (g)}}{\text{Weight of sample (g)}} \times 100$$

Crude protein

The crude protein content was determined by micro Kjeldahl method, using the factor 6.25 for converting nitrogen content into crude protein (Sadasivam and Manickam, 2008). Weighed sample of 2 g was digested with concentrated sulphuric acid (2 ml) and 2 g of catalyst mixture (K_2SO_4, $CuSO_4$ and SeO_2) in a long neck Kjeldahl flask for 2 hours till free from carbon. The contents were cooled and transferred to 100 ml volumetric flask and volume was made to 100 ml with distilled water. Measured aliquot was distilled with 40 per cent sodium hydroxide and liberated ammonia was collected through a condenser in a flask containing 10 ml (4%) boric acid solution and few drops of mixed methyl red and bromocresol green indicator and was titrated against standardized 0.1 N sulphuric acid and crude protein content was calculated using the equation below. A blank sample was also run along with the sample.

$$\text{Nitrogen \%} = \frac{\text{Titre value} \times 0.00014 \times \text{Volume made}}{\text{Aliquot taken (ml)} \times \text{Weight of sample (g)}} \times 100$$

Per cent crude protein = Nitrogen % × 6.25

Crude fat

Crude fat was determined by the Soxhlet extraction technique (AOAC, 2012). Fat content of the sample (5 g) was easily extracted into organic solvent (petroleum ether) at 60-80°C in Soxhlet extraction apparatus and followed to reflux for 6 hours. After extraction, the thimble was dried in hot air oven to a constant weight, cooled in a desiccator and weighed. The loss in weight of thimble indicated the amount of fat content in the sample.

$$\text{Crude fat \%} = \frac{\text{Amount of evaporated residue (g)}}{\text{Weight of sample (g)}} \times 100$$

Crude fibre

Two g fat free dried sample was taken in a beaker to which 200 ml of 1.25 per cent sulfuric acid was added (AOAC, 2012). Beaker along with contents was placed on hot plate and boiled for 30 minutes. After boiling, the contents of the beaker were filtered through Whatman filter paper no. 4. The filter paper was then transferred in a beaker containing 200 ml of 1.25 per cent sodium hydroxide. The contents weighed again were allowed to digest for 30 minutes then filtered and washed again with hot water and alcohol thrice till free for alkali. The residue was then transferred in pre-weighed silica crucibles followed by drying in hot air oven at 100^0C. The crucibles were then kept in muffle furnace and ignited for 30 minutes at 600+210^0C followed by cooling and weighing. The loss in weight after ignition represents the crude fiber and was calculated as follows:

$$\text{Crude fibre \%} = \frac{\text{Loss in weight on ignition (g)}}{\text{Weight of sample (g)}} \times 100$$

Total ash

Ash content of the sample was determined by method as described in AOAC (2012). A known quantity (2g) of ground, moisture free sample was taken in a pre-weighed silica crucible and preliminary ashing was done by slow heating on flame to allow smoking off fat without burning (Wijewardana *et al*., 2016). Once the smoke stopped evolving from the sample, the crucible with the sample was ignited at 600°C for 3 hours in a muffle furnace. When muffle furnace was slightly cooled, the crucible with ash was taken out, kept in desiccator to cool down and constant weight was taken. The difference between the weight of the silica crucible as empty and the ash was the amount of total ash. The percent ash content was calculated by using the following equation:

$$\text{Ash (\%)} = \frac{\text{Weight of ash (g)}}{\text{Weight of sample (g)}} \times 100$$

Carbohydrates

The carbohydrate content was estimated by the difference method. It was calculated by subtracting the sum of percentage of moisture, crude fat, crude protein and ash contents from 100 according to AOAC (2012). The carbohydrate content was determined using the following equation:

Carbohydrates (%) = 100 – [Moisture (%) + Crude fat (%) + Crude protein (%) + Total ash (%)]

Total energy

The total energy content was estimated as per the method given by Surendar *et al*. (2018). The energy value of the sample was calculated by multiplying protein, fat and carbohydrate values obtained from analysis by 4, 9 and 4 respectively and expressed in Kcal per 100g. The formula is shown in the following equation:

Total energy (Kcal/100g) = [(crude protein % × 4) + (crude fat % × 9) + (available carbohydrates × 4)]

Statistical analysis

All the experiments were performed in triplicates and the data is expressed as the mean values standard deviation derived from triplicate determination values. The statistical analysis of the experimental data was done by using the software IBM SPSS Statistics 26.0.

Results and Discussion

Colour values (L*, a* and b* values)

The statistical results regarding colour values is presented in Table 2. The results indicated that L*, a* and b* values varied significantly among treatments and storage period. The mean L* and b* values followed an increasing trend with the incorporation of instant dehulled mungbean in instant *khichdi* mix, which might be due to higher L* (lightness) and b* (yellowness) values possessed by instant dehulled mungbean whereas, a* (redness) value decreased significantly with the increase in proportion of instant dehulled mungbean, which contained less redness. Jan *et al*. (2018) also reported similar colour value trend in rice and mungbean based weaning food.

Storage studies of instant *khichdi* mix revealed a significant decrease in L* value from 62.07 to 61.67 whereas, a* and b* values increased from 8.63 to 8.90 and 25.19 to 25.52, respectively. This might be due to the degradation of colour pigments resulting in increase in formation of brown pigments (melanoidins) by Maillard reaction that led to the darkening of the product during storage (Kaur *et al*., 2018). Our results have been supported by the findings of Bazaz *et al*. (2016), who reported decrease in L* value and increase in b* value during storage of hypoallergenic weaning food. Similar behaviour of a* value have also been observed by Tizazu *et al*. (2010) in sorghum based weaning food. Parnsakhorn and Langkapin (2013) also reported an increase in b* value during storage of brown rice.

Table 2 : Effect of treatment and storage intervals on colour values (L*, a* and b* values) of instant *khichdi* mix.

Treatment	Colour values (L*, a* and b* values)					Mean (treatment)
	Storage period (days)					
		0	30	60	90	
T_1 (100:00::IBR:IDM)	L*	56.02	55.89	55.74	55.58	**55.81**
	a*	10.12	10.20	10.28	10.37	**10.24**
	b*	23.56	23.64	23.75	23.87	**23.71**
T_2 (90:10:: IBR:IDM)	L*	58.41	58.28	58.16	58.03	**58.22**
	a*	9.51	9.57	9.65	9.74	**9.62**
	b*	24.19	24.28	24.39	24.51	**24.34**
T_3 (80:20:: IBR:IDM)	L*	60.85	60.74	60.61	60.47	**60.67**
	a*	8.90	8.98	9.07	9.18	**9.03**
	b*	24.87	24.96	25.08	25.20	**25.03**
T_4 (70:30:: IBR:IDM)	L*	63.27	63.15	63.03	62.86	**63.08**
	a*	8.34	8.42	8.51	8.60	**8.47**
	b*	25.51	25.60	25.71	25.83	**25.66**
T_5 (60:40:: IBR:IDM)	L*	65.73	65.60	65.47	65.32	**65.53**
	a*	7.75	7.83	7.92	8.02	**7.88**
	b*	26.20	26.29	26.40	26.52	**26.35**
T_6 (50:50:: IBR:IDM)	L*	68.14	68.02	67.90	67.74	**67.95**
	a*	7.16	7.26	7.35	7.46	**7.31**
	b*	26.83	26.93	27.05	27.18	**27.00**
Mean (Storage)	**L***	**62.07**	**61.95**	**61.82**	**61.67**	
	a*	**8.63**	**8.71**	**8.80**	**8.90**	
	b*	**25.19**	**25.28**	**25.40**	**25.52**	

Effects	**C.D$_{(p\leq 0.05)}$** **L* value**	**a* value**	**b* value**
Treatment (T)	0.04	0.04	0.02
Storage (S)	0.04	0.03	0.01
Treatment x Storage	0.09	0.07	0.03

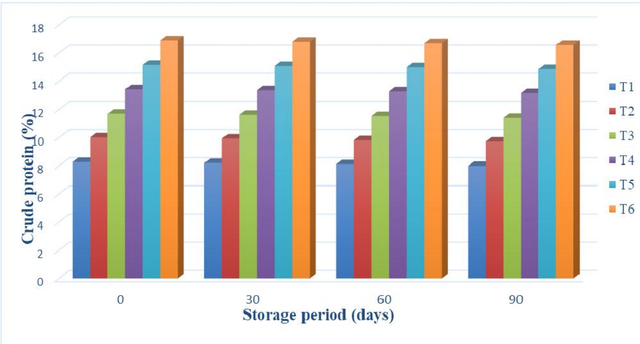

Fig. 1 : Effect of treatment and storage intervals on crude protein content (%) of instant *khichdi* mix.

Table 3 : Effect of treatment and storage intervals on moisture content (%) of instant *khichdi* mix.

Treatment	Moisture (%) Storage period (days)				Mean (treatment)
	0	30	60	90	
T_1 (100:00::IBR: IDM)	6.47	6.56	6.67	6.78	**6.62**
T_2 (90:10:: IBR: IDM)	6.69	6.77	6.86	6.98	**6.83**
T_3 (80:20:: IBR: IDM)	6.93	7.02	7.12	7.23	**7.08**
T_4 (70:30:: IBR: IDM)	7.18	7.27	7.38	7.50	**7.33**
T_5 (60:40:: IBR: IDM)	7.42	7.53	7.65	7.78	**7.60**
T_6 (50:50:: IBR: IDM)	7.68	7.76	7.87	7.98	**7.82**
Mean (Storage)	**7.06**	**7.15**	**7.26**	**7.38**	
Effects	**C.D$_{(p\leq0.05)}$**				
Treatment (T)	0.02				
Storage (S)	0.02				
Treatment × Storage	0.05				

Table 4 : Effect of treatment and storage intervals on crude fat (%) of instant *khichdi* mix.

Treatment	Crude fat (%) Storage period (days)				Mean (treatment)
	0	30	60	90	
T_1 (100:00::IBR: IDM)	2.38	2.31	2.23	2.12	**2.26**
T_2 (90:10:: IBR: IDM)	2.27	2.19	2.10	1.98	**2.14**
T_3 (80:20:: IBR: IDM)	2.16	2.07	1.96	1.83	**2.01**
T_4 (70:30:: IBR: IDM)	2.09	2.00	1.90	1.78	**1.94**
T_5 (60:40:: IBR: IDM)	1.98	1.89	1.77	1.63	**1.82**
T_6 (50:50:: IBR: IDM)	1.87	1.78	1.69	1.56	**1.73**
Mean (Storage)	**2.13**	**2.04**	**1.94**	**1.82**	
Effects	**C.D$_{(p\leq0.05)}$**				
Treatment (T)	0.03				
Storage (S)	0.02				
Treatment × Storage	0.06				

Moisture

The data illustrated in Table 3 shows the effect of treatment and storage on the moisture content of instant *khichdi* mix. It is evident from the results that there was an increase in mean moisture content from 6.62 (T_1) to 7.82 per cent (T_6) with the increasing proportions of instant dehulled mungbean which might be due to higher moisture content in dehulled mungbean as compared to brown rice. Similar findings have been reported by Jan *et al.* (2018) who reported similar moisture trend in rice and mungbean based weaning food.

The mean moisture content of instant *khichdi* mix increased from 7.06 to 7.38 per cent during 90 days of storage which might be due to hygroscopic nature of dried product and storage environment (temperature, relative humidity). The results are in accordance with the findings of Monika (2017), who observed maximum gain of moisture in rice and rajmash convenient mix during 3 months of storage. Huq *et al.* (2008) also reported increased moisture in instant food product Nutri-mash prepared from legumes during six months of storage and Rahangdale *et al.* (2015) also reported gain of moisture in kodo millet fortified *khichdi* during 90 days of storage.

Crude protein

A perusal of data in Fig. 1 revealed significant variation in crude protein per cent with respect to treatment and storage duration. The highest mean crude protein content of 16.74 per cent was recorded in treatment T_6 (50:50:: Instant brown rice: Instant dehulled mungbean), whereas the lowest mean crude protein content of 8.13 per cent was recorded in treatment T_1 (100:00:: Instant brown rice: Instant dehulled mungbean).

The mean value of crude protein decreased from 12.57 to 12.28 per cent during storage period of 90 days. The decrease in crude protein content during storage might be due to hydrolysis of peptide bonds with the help of protease enzyme that causes splitting of protein molecules, denaturation and degradation of protein into amino acids during storage (Bhat *et al.*, 2014). Similar results have been reported by Monika (2017) in rice and rajmash blended convenient mix during storage period of 3 months and Rahangdale *et al.* (2015) in kodo millet fortified *khichdi* during 90 days of storage.

Crude fat

The data pertaining to crude fat content in Table 4 revealed that the treatment and storage significantly influenced the crude fat content of instant *khichdi* mix. With the incorporation of dehulled mungbean, a decrease

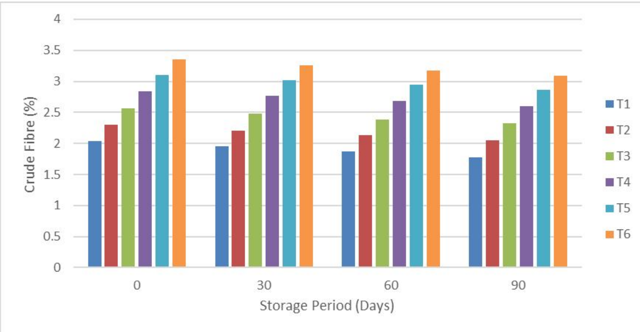

Fig. 2 : Effect of treatment and storage intervals on crude fibre content (%) of instant *khichdi* mix.

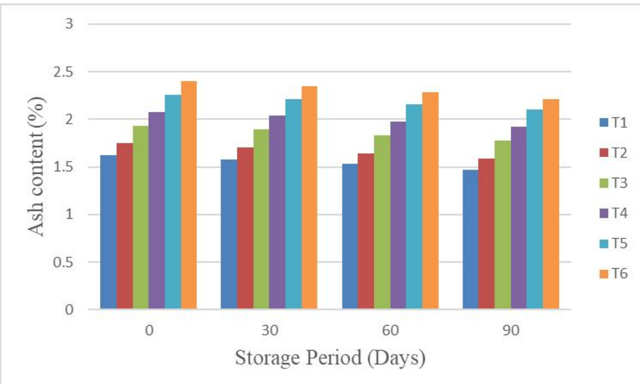

Fig. 3 : Effect of treatment and storage intervals on ash content (%) of instant *khichdi* mix.

in crude fat content from 2.26 to 1.73 per cent was observed. The supplementation of instant dehulled mungbean decreased the crude fat content of instant *khichdi* mix which might be attributed to the fact that crude fat content of dehulled mungbean is less in comparison to brown rice. The results of present study are in agreement with the findings of Durgarao (2017) in rice and green gram based *khichdi*. Similar results have also been reported by Basim *et al*. (2021), who observed decrease in crude fat content in rice and mungbean based food meal.

During storage period of 90 days, the mean crude fat content decreased from 2.13 to 1.82 per cent in instant *khichdi* mix. The decrease in crude fat content might be due to the increase in relative humidity which stimulates the activity of lipase and causes breakdown of fat into fatty acid and glycerol (Zahra *et al.*, 2020). The results are in accordance with the values reported by Zeb *et al*. (2017) in rice and mungbean based complementary mix during storage of 180 days. Rahangdale *et al*. (2015) also reported decrease in crude fat content in kodo millet fortified *khichdi* during storage period of 90 days.

Crude fibre

The instant *khichdi* mix formulated from higher levels of brown rice depicted lower values of crude fibre in contrast to instant *khichdi* mix formulated from higher levels of dehulled mungbean. The highest mean crude fibre content of 3.22 per cent was recorded in T_6 (50:50:: Instant brown rice: Instant dehulled mungbean) whereas T_1 (100:00:: Instant brown rice: Instant dehulled mungbean) exhibited lowest mean crude fibre content of 1.91 per cent (Fig. 2). With the incorporation of instant dehulled mungbean, the crude fibre content increased which might be due to the presence of higher crude fibre content in instant dehulled mungbean. Similar findings have been reported by Bazaz *et al*. (2016) in complementary foods made from rice and green gram flour, Jan *et al*. (2018) in rice and mungbean based weaning food and Basim *et al*. (2021) in rice and mungbean based food meal.

With the advancement in storage period, the mean crude fibre content decreased from 2.70 to 2.45 per cent which might be due to degradation of structural polysaccharides and hemicelluloses during storage. Also heat and moisture solubilizers can degrade pectic substances leading to the decrease in the fibre content (Sharon and Usha, 2006). Similar results have been reported by Huq *et al*. (2008) in instant food product Nutri-mash prepared from legumes during 3 months of storage and Slathia *et al*. (2016) in mungbean based noodles during 3 months of storage.

Total ash

The data in Fig. 3 illustrates the effect of treatment and storage on the ash content of instant *khichdi* mix. Among treatments, T_6 (50:50:: Instant brown rice: Instant dehulled mungbean) recorded the highest mean ash content of 2.31 per cent, whereas treatment T_1 (100:00:: Instant brown rice: Instant dehulled mungbean) recorded the lowest mean ash content of 1.55 per cent. The supplementation of instant dehulled mungbean increased the ash content of instant *khichdi* mix, which might be due to the higher ash content present in dehulled mungbean. Similar results have been recorded by Bazaz *et al*. (2016) in complementary foods made from rice and green gram flour and Jan *et al*. (2018) in rice and mungbean based weaning food.

During storage, the mean ash content of instant *khichdi* mix decreased from 2.01 to 1.85 per cent. The decrease in ash content might be due to the mineral losses from binding of minerals by Maillard reaction products during storage (Nadarajah and Mahendran, 2015). Similar results have been observed by Kour (2014) in multigrain supplementary powders from cereals and legumes and Rahangdale *et al*. (2015) in kodo millet fortified *khichdi* during storage period of 90 days.

Carbohydrates and total energy

On analyzing the mean carbohydrate content and energy value of instant *khichdi* mix (Table 5), the highest

Table 5 : Effect of treatment and storage intervals on carbohydrates (%) and energy (kcal/100g) of instant *khichdi* mix.

	Carbohydrates (%) Storage period (days)				Mean (Treatment)	Energy (Kcal/100g) Storage period (days)				Mean (Treatment)
	0	30	60	90		0	30	60	90	
T_1 (100:00::IBR:IDM)	81.27	81.36	81.47	81.65	81.27	379.54	78.99	378.35	377.60	**378.62**
T_2 (90:10::IBR:IDM)	79.28	79.42	79.60	79.74	**79.51**	377.59	377.07	376.50	375.62	**376.70**
T_3 (80:20::IBR:IDM)	77.30	77.42	77.58	77.78	**77.52**	375.36	374.71	374.00	373.11	**374.30**
T_4 (70:30::IBR:IDM)	75.23	75.34	75.47	75.65	**75.42**	373.41	372.76	372.06	371.22	**372.36**
T_5 (60:40::IBR:IDM)	73.18	73.29	73.43	73.63	**73.38**	371.18	370.49	369.61	368.63	**369.98**
T_6 (50:50::IBR:IDM)	71.16	71.31	71.47	71.68	**71.41**	369.03	368.46	367.85	367.04	**368.10**
Mean (Storage)	**76.24**	**76.36**	**76.50**	**76.69**		**374.35**	**373.75**	**373.06**	**372.20**	

Effects	$C.D_{(p\leq0.05)}$	Effects	$C.D_{(p\leq0.05)}$
Treatment (T)	0.05	Treatment (T)	0.60
Storage (S)	0.04	Storage (S)	0.40
Treatment × Storage	0.10	Treatment × Storage	1.50

mean carbohydrate content and energy value was recorded in treatment T_1 (100:00:: Instant brown rice: Instant dehulled mungbean) whereas, treatment T_6 (50:50:: Instant brown rice: Instant dehulled mungbean) exhibited lowest mean carbohydrate content and energy value. The Carbohydrate content and energy value decreased with the increasing proportion of dehulled mungbean which might be attributed to lower carbohydrate content and energy value of instant dehulled mungbean. Similar results have been reported by Munasinghe *et al*. (2013) in weaning food prepared from mungbean, soybean and brown rice, Joshi and Srivastava (2016) in rice and millet based *khichdi* and Basim *et al*. (2021) in rice and mungbean based food meal.

During storage period, the carbohydrate content increased from 76.24 to 76.69 per cent, whereas the energy content decreased from 374.35 to 372.20 kcal per 100 g. This increase in carbohydrate is determined by calculation difference of other components (moisture, protein, fat and ash), which automatically increases the carbohydrate content (Rokhsana *et al*., 2007). The decrease in energy might be attributed to decrease in crude protein and crude fat content with increase in storage period (Regmi *et al*., 2009). Similar results have been reported by Rahangdale *et al*. (2015) in kodo millet fortified *khichdi* during storage period of 90 days and Kour (2014) in multigrain supplementary powders from cereals and legumes.

Conclusion

It is evident that the nutritional quality of instant *khichdi* mix *viz*., crude protein content, crude fibre and ash content was greatly influenced as the ratio of incorporation increased. Brown rice is rich in vitamins, minerals, fibres and antioxidants than white or milled rice and hence consumption of brown rice brings higher potential to prevent malnutrition as well as chronic diseases such as diabetes, blood pressure, heart diseases. They can be utilized as a bioactive component for the development of gluten free products which will be more beneficial to gluten intolerant persons. Hence, value added convenience products from brown rice have good consumer acceptance and can be regarded as health-promoting functional foods. Introduction of brown rice based processed products in the market would increase the diversity of functional products and thereby give good returns to the growers.

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