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Qualitative analysis of multigrain mid-day meal premix

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Abstract
Multigrain Mid-Day Meal premix is an astonishing breakfast meal, that is packed with minerals, vitamins, an amazing amount of protein, energy, carbohydrates and dietary fibre. The different formulations of Multigrain Mid-Day Meal Premix were prepared (F_1, F_2, F_3 and F_4). The different formulations contained varying amount of proteins, carbohydrates, fats, vitamins, minerals and fibre. Multigrain premix (F_1) (Wheat 70%, Rice 10% legumes 2.5% each, soya mince 12.5%) was the best formulated multigrain premix which provides 17.41% protein, 2.02% fat, 8.27% fibre and 62.62% carbohydrates. Also the sensory properties were determined using 9-point hedonic scale and all the formulations obtained satisfactory scores. Hence, it can be concluded that this Multigrain Mid-Day Meal premix in addition to being delicious is a rich source of essential nutrients necessary to mitigate malnutrition from India.

Keywords: Multigrain Mid-Day Meal premix, Formulations, Proximate composition, Sensory properties

Introduction
Hunger in India is a complex issue. India is home to a quarter of the undernourished population in the world. India continues to have serious level of widespread hunger forcing it to be ranked a lowly 97 among 118 countries by the Global Hunger Index 2016 [3]. The share of under 5 children who are 'wasted' is about 15% while the share of children who are 'stunted' is a staggering 39%. This reflects widespread and chronic lack of balanced food. The under 5 mortality rate is 4.8% in India, partially reflecting the fatal synergy of inadequate nutrition and unhealthy environment (Global Hunger Index 2016) [3]. This is the scenario of nutritional standards of the country's population which is a serious concern for all of us. The right to food is right to every person. A vast majority of the population do not have access to the healthy food to sustain a healthy life.

A healthy food is well balanced with respect to quality and quantity of ingredients from different food groups and not just concentrating on one food group, giving rise to a concept of multigrain foods. Whole grains are reported to be rich in nutrients, nutraceuticals, and have number of health beneficial effects. They have high concentration of dietary fibres, resistance starch, and oligosaccharides. They are also rich in antioxidants including trace minerals and phenolic compounds and these compounds have been linked to disease prevention. Whole grain feeding studies in human subjects also found improvement in biomarkers such as weight loss, blood lipid improvement and antioxidant protection (Hameeda *et al.*, 2012) [4].

The multigrain premix is prepared by using wheat as a base ingredient. The rice and other legumes such as Bengal gram, green gram and lentil were used. Soya mince is also added to the premix in order to have good mouth feel and protein content. The Wheat and Rice are the prime source of carbohydrates both simple and complex where legumes are the proteins and mineral source. The flavouring of spices is added to improve the taste and acceptability of the product. The premix prepared is high in content of micronutrient, high in energy density, adequate in protein content. It has high protein quality and availability and also should have appropriate fat quality. It has low content of antinutrient, low risk of contamination, acceptable taste and texture. It is culturally acceptable, easy to prepare and affordable and available.

It is therefore, felt logical to seek its potentiality for developing a multigrain premix and to evaluate the qualitative properties of the premix for serving the undernourished population.

Materials and methods
Raw Materials: The raw materials required such as Wheat, Rice, Lentil, Bengal gram, Green gram, soya mince, spice etc. were procured from local market of Parbhani.

Preparation of multigrain premix: All the raw grains were sorted and cleaned. The grains were subjected to roasting and size reduction to appropriate fraction size.

The spices were cleaned and roasted and grounded to powder form and packed separately. Fig. 1 describes the complete technology required for the preparation of multigrain premix.

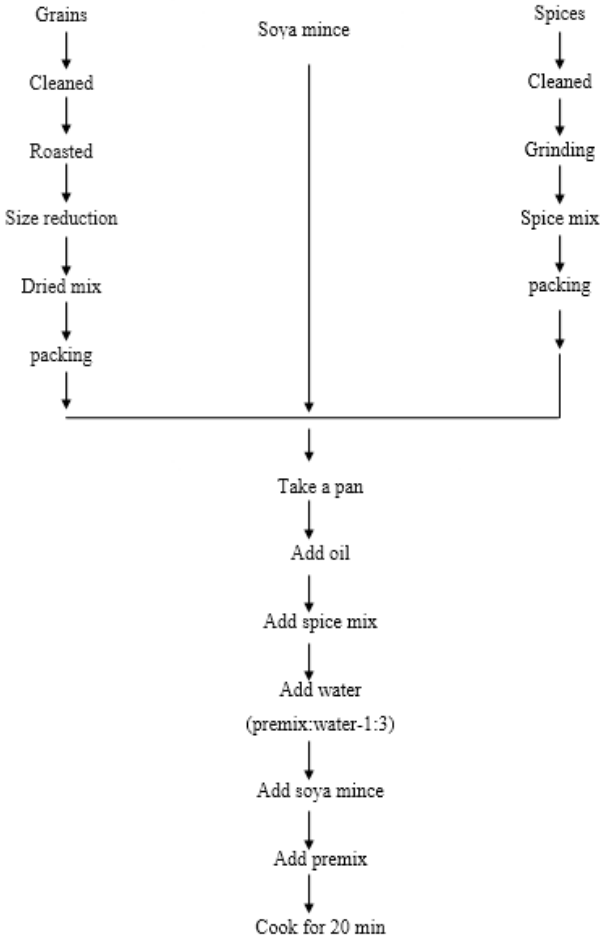
Formulation and multigrain premix preparation

The following formulation shown in Table 1 consisting of several varying concentration of grains were followed for the preparation of multigrain premix.

Table 1: Formulation for Development of Mid-Day Meal premix

Ingredient	Multigrain premix (%)				
	Control	F_1	F_2	F_3	F_4
Wheat	100	70	60	50	40
Rice	0	10	20	30	40
Bengal gram	0	2.5	2.5	2.5	2.5
Green gram	0	2.5	2.5	2.5	2.5
Lentil	0	2.5	2.5	2.5	2.5
Soya mince	0	12.5	12.5	12.5	12.5
Spice mix	5	5	5	5	5

Flow Sheet 1. Preparation of Multigrain Premix



Proximate composition

Moisture content: Moisture determination will be made through hot air oven method at 105±5oC until constant weight was obtained (AOAC, 2016) [1].

Crude fat: It will be determined using Soxhlet extractor with petroleum ether as solvent. The resultant ether extract was evaporated and crude fat was calculated (AOAC, 2016) [1].

Crude protein: Per cent nitrogen will be determined by the Micro-Kjeldhal method which will be then multiplied by 6.25 factor for conversion into protein (AOAC, 2016) [1].

Ash content: Ash determination was done through gravimetry after incineration in the muffle furnace at 550oC until constant weight was obtained (AOAC, 2016) [1].

Crude fiber: The moisture and fat free sample was treated with H2SO4 and then filtered and washed with hot water. The same process was repeated using NaOH. Then sample was dried and incinerated in muffle furnace for 550oC till constant weight. The difference in weight after drying and incineration gave the total crude fibre (AOAC, 2016) [1].

Total carbohydrate: Carbohydrates will be calculated by difference method as follows.

Carbohydrates = 100 - % (Moisture + Crude Fat + Crude Protein + Ash +Crude Fiber)

Organoleptic evaluation of developed product

Freshly prepared samples of Multigrain premix were evaluated for sensory characteristics like appearance, colour, taste, flavour, viscosity and overall acceptability by 10 semi-trained panel members comprised of faculty of College of Food Technology, Parbhani on 9- point Hedonic scale (Meilgaard *et al.*, 1999) [5].

Statistical analysis

All processing equipments and analysis of samples were run in triplicate. Analysis of variance was calculated using standard ANOVA procedure. The data obtained for various treatments was recorded and statistically analyzed by complete randomized design (CRD) to find out the level of significance as per the method proposed by Panse and Sukhatme (1957) [6]. The analysis of variance revealed at significance at $P< 0.05$ level. The standard error (SE) and critical difference (CD) at 5 % level were mentioned where required.

Results and Discussion

Proximate composition of Multigrain Premix

The data presented in Table 2 describes the proximate composition of various formulations used in the preparation of multigrain premix. The minimum moisture content was found in control sample (7.52%), whereas maximum was found in F_4 formulated multigrain premix (8.47%). Other formulation F_1, F_2 and F_3 was observed to contain moisture amount of (7.74%), (7.92%) and (8.22%) respectively. Where the formulation F_1 found to have nearest moisture content with the controlled sample. The moisture content may be lower to higher from control to progressive formulations due to high fibre content. Similar findings have been supported by Sharma and Chawala (2011) [8] in oat-supplement product.

Table 2: Proximate composition of Multigrain Premix

Trials	Parameters (g/100gm)					
	Moisture	**Fat**	**Protein**	**Carbohydrates**	**Crude fibre**	**Ash**
Control	7.52	2.41	12.91	63.64	11.31	2.07
F_1	7.74	2.02	17.41	62.62	8.37	1.88
F_2	7.92	1.85	16.69	64.61	7.32	1.78
F_3	8.22	1.73	15.88	66.87	6.42	1.71
F_4	8.47	1.61	14.06	69.98	5.44	1.60
SE	0.0943	0.0931	0.8563	0.6831	0.6242	0.0771
CD at 5%	0.2838	0.2802	2.5779	2.0564	1.8790	0.2321

*Each value is an average of three determinations.

The fat content of samples observed variations from top to bottom in table 5. Controlled sample was observed to have fat (2.41%) which is nearer with formulation F_1 (2.02%). The fat content of control wheat sample decreased gradually among supplemented multigrain premix. However the significant decrease was observed in F_4 where as wheat contributed 40% and rice 40%. The fall in fat content may be due to increasing amount of rice to wheat in formulation keeping all other things constant. The result obtained are in order with the findings of Rana *et al*., (2015) [7].

The protein content increased with incorporation of legumes and soya mince. Result showed that maximum protein content was found in F_1 (17.41%) formulated multigrain premix whereas minimum was found in F_4 (14.06%) multigrain premix. The control Wheat sample reported to have (12.71%) of protein content. Other formulations have observed to posses moderate level of protein amount in between control sample and F_1 formulated premix. Combination of multigrain premix with 70% Wheat, 10% Rice, 7.5% legumes and 12.5 % soya mince was significantly superior than other formulated multigrain premixes. This could be due to the Wheat to Rice ratio and legumes contribution towards protein. Similar pattern was observed in Rana *et al*., (2015) [7].

The data showed that carbohydrate content was increased with formulation of high rice and other legumes in various multigrain premixes. Maximum was found in F_4 (69.98%) where as minimum was F_1 (62.62%). Carbohydrate content have been increased may be due to increase in rice percentage in different formulations, as rice is among richest source of carbohydrates. Whereas the formulation F_1 has lowest contribution of rice (10%) thus it could have lesser amount of carbohydrates as compare with other formulation. Similar findings have been supported by Donkar *et al*., (2012) [2].

The table showed that fibre content of the premixes have been seen falling from top to bottom. The highest fibre amount was observed in control sample (11.31%) then lower followed by F_1 (8.37%) which is nearer to the control sample among other formulations, F_2 (7.32%) and F_3 (6.42%) are moderate in fibre whereas the least fibre amount was seen in F_4 (5.44%). The trend of decreasing fibre amount in various formulations have observed due to the contribution of fibre into the product by its raw material used. Here wheat is dominant in fibre content than rest of the ingredient thus control sample is lead in fibre amount followed by F_1 which is having 70% of wheat portion and it goes on reducing as the portion of wheat is gradually curtailed from rest of the formulations.

The ash content of control wheat sample was maximum and it did not remained almost same in various multigrain premixes at all level while control wheat sample and F_1 formulation were significantly closer to each other. The control sample had (2.07%) ash while F_1 formulation had (1.88%) of ash amount. This might be due to the higher wheat contribution to its formulation and lesser rice and constant legumes. As the rice contribution increases the ash amount decreases as lowest ash found in F_4 (1.60%) which have 40% of rice contribution.

Organoleptic properties of multigrain premix

Acceptance tests subjected to 9 point hedonic scale were performed for multigrain premix which were formulated by the addition of multigrain (Wheat, Rice, Green gram, Lentil, Bengal gram and Soya mince) in different proportions to know the acceptability of prepared premix. The acceptance scores were assignss for various sensory parameters-appearance, colour, flavour, taste, texture and overall acceptability. From the sensory mean score and the comments of the panellists, best combination was selected among prepared formulations.

Table 3: Sensory evaluation of multigrain premix

Sample	Sensory attributes				
	Colour and appearance	**Texture**	**Taste**	**Flavour**	**Overall acceptability**
Control	8.2	8.5	8.4	8.4	8.5
F1	8.3	8.2	8.5	8.2	8.4
F2	8.2	8.3	8.4	8.2	8.3
F3	7.1	6.5	7.2	7.0	7.0
F4	6.1	6.2	6.4	6.5	6.5
Mean	7.5	7.5	7.7	7.6	7.7
SE	0.0907	0.0856	0.0907	0.0775	0.1047
CD at 5%	0.2730	0.2578	0.2730	0.2232	0.3152

*Each value is an average of ten determinations

Control – Wheat (100%), F_1 – Wheat (70%), Rice (10%), Legumes each (2.5%), Soya mince (12.5%); F_2 - Wheat (60%), Rice (20%), Legumes each (2.5%), Soya mince (12.5%); F_3- Wheat (50%), Rice (30%), Legumes each (2.5%), Soya mince (12.5%); F_4 - Wheat (40%), Rice (40%), Legumes each (2.5%), Soya mince (12.5%);

Data obtained from the Table 3, it was recorded that the overall acceptability score awarded for sample F_1 was found higher than other samples (8.4) whereas F_4 received the lowest (6.5). The acceptance of samples depends on the ingredient variation. The sample F_1 was also reported as statistically at par with F_2 and F_3 samples and significantly superior than the

F_4 sample. The next parameter i.e., colour and appearance serves as important parameter for the acceptance of food samples. The highest score for colour of multigrain bar (F_1) was obtained as (8.3). The lowest score found in the sample F_4 score (6.1). The sample F_1 was significantly superior than the other samples. There was no significant difference between the samples in context to colour. More or less the similar results were observed by Rana *et al*. (2015) [7].

An appraisal of table 3 showed that, the formulation F_2 got the highest value in texture (8.3) against F_4 (6.1). However the most overall scored formulation F_1 got (8.2) for its texture.

The data depicted in table 3 revealed that, the mean score for taste ranged from 6.4 to 8.5. The mean scores for taste of multigrain premix were above the acceptance limit with lowest score (6.4) obtained from F_4 multigrain premix against the highest score (8.5) in F_1 formulation of multigrain premix. The control wheat sample had got means score value (8.4) it was at par with F_4 and F_2.

Flavour is one of the important sensory parameter. The flavour of multigrain bar was influenced by addition of spice mix and oil. Sample F_1 obtained the maximum value (8.2) for flavour. The overall acceptability of F_1 sample of multigrain premix was significantly superior (8.4) than the other samples. The score of sample F_2 (8.3) was followed by F_3 (7.0). F_1 sample was statistically at par with F_2 and F_3 samples significantly superior than F_4 sample.

Conclusion

Multigrain premix is a whole grain product, its key benefit lies in its nutritional value. It will be a great healthy product which will provide all the necessary nutrients to prevent malnutrition. The lab-scale formulated premix is rich in protein, carbohydrates, fats, vitamins and minerals. It is also pleasant in taste. Such kind of multigrain premixes are critical to be developed in our country because of prevalence of malnutrition.

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