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Development of millet based composite flour

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Abstract

Millet is a group of small seeded species of cereal crops, widely grown around the world for food and fodder. They possess good nutritional properties and exhibit many health benefits. A study was undertaken with an objective to develop millet composite flour. Composite flour was developed by conducting 6 trials using ingredients like wheat, foxtail millet, finger millet, little millet, soy and fenugreek flour. Results revealed that Millet composite flour with 50 g of Wheat, 10g Foxtail millet, 20g Little millet, 10g Finger millet, 10g Soybean and 1g of Fenugreek seed was found to be the best formulation. This combination can be used in the preparation of various food products.

Keywords: Millet, composite flour, minor millet

1. Introduction

Millet is a group of small seeded species of cereal crops, widely grown around the world for food and fodder. The word 'mil' refers to thousands of grains that can be held in a handful and millets are called small, coarse or minor millets. The group includes millets such as little millet (*Panicum miliare*), foxtail millet (*Setaria italica*), kodo millet (*Paspalum scrobiculatum*), common millet (*Panicum miliaceum*), barnyard millet (*Echinochloa frumentacea*), pearl millet (*Pennisetum glaucum* L.) and finger millet (*Eleusine coracana*). The millets have immense production potential with minimum inputs. India is the world's leading producer of millets. However, in India, the area under millets including jowar, bajra, ragi and small millets is lesser (18.57 Mha) compared to staple cereals, namely rice (45.53 Mha) and wheat (27.75 Mha). Similarly, total production of millets is 18.62 Mt and is much lower than rice and wheat which accounted to 99.12 Mt and 80.67 Mt, respectively in the year 2008-09. Traditionally millets were important staple foods in the diets of Asians and Africans. Millets are the basic cereals in India and eaten by a large section of the poor community residing in the areas where these millets are grown.

Minor cereals consisting of maize, sorghum, Pearl millet, Finger millet and other millets constitute a little less than 25 percent of the total food grain production in India. The millet productivity in all India is 565 kg/ha, where as highest is in Uttarakhand 1222 kg/ ha, followed by Tamil Nadu 1210 kg/ ha while in Karnataka 500 kg/ ha and lowest in Chhattisgarh. However they are generally regarded as coarse grains, their potential for augmenting the grain supplies and bridging the protein gap is increasingly realized in the countries like India, America and other European countries. Besides being staple food, they are also the raw materials for the preparation of various foods including fast foods and industrial products. Hence underutilized minor millet was used in the study with an objective to Formulate High Fibre Millet composite flour.

Materials and methods

1. Procurement of raw materials

Raw materials namely foxtail millet, little millet (2-3 times polished) were procured in bulk from Haveri district. Finger millet were procured from Kumbhapur from Dharwad. Wheat, fenugreek seeds and soy bean were procured in bulk from local market, Dharwad.

2. Formulation

All the ingredients were cleaned and soybean was defatted by roasting. The blends were prepared by mixing wheat with foxtail, little and finger millet with fenugreek seeds and defatted soy bean at various levels to provide atleast 12- 15 g of fibre (Table 1 and 2).

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3. Standardization for product formulation

The different composite flour blends were used for chapatti preparation and organoleptic evaluation was carried out by using 9 point hedonic scale. The most accepted composite flour was selected for the further study.

4. Sensory evaluation of the formulated composite flour

The sensory evaluation of the different formulated composite flour was carried out in the form of chapatti using 9 point hedonic scale (Appendix-) employing a panel of trained judges drawn from staff and students of the department of food science and nutrition. Parameters evaluated were appearance, colour, flavor, taste, texture and overall acceptability.

Table 1: Development of composite flour by using different blends

Materials	Variations		
	1	2	3
Wheat	30	40	50
Foxtail millet	20.33	16.66	13.33
Little millet	20.33	16.66	13.33
Finger millet	20.33	16.66	13.33
Soy bean	10	10	10
Fenugreek seed	1	1	1

Table 2: Different proportions of composite flour (double the little millet compared to other two millets)

Materials	Variations		
	1	2	3
Wheat	50	40	30
Foxtail millet	10	12.5	15
Little millet	10	25	30
Finger millet	10	12.5	15
Soy bean	10	10	10
Fenugreek seed	1	1	1

The formulation with high fibre content was accepted.

Results

Six different trials were conducted for formulation of millet composite flour and organoleptic evaluation for the same was done. The most acceptable formulation was selected.

Table 3 represents the computed nutrient value for millet composite flour Trial 1, which is composed of 50 g of wheat, 39.9 g of total millets and equal quantity of 13.33 g each of foxtail millet, little millet and finger millet, 10g of soybean and 1g of fenugreek. It shows that total dietary fibre was 19.06 g, energy 349.97 Kcal, protein 14.47 g, calcium 100.72 mg, phosphorous 352.67 and iron 6.08 mg /100 g of the composite millet mix.

Table 4 represents the computed nutrient value for millet composite flour Trial 2, which is composed of 40 g of wheat, 48.98 g of total millets and equal quantity of 16.66 g each of foxtail millet, little millet and finger millet, 10 g of soybean and 1 g of fenugreek. It shows that total dietary fibre was 20.33g, energy 351.52 Kcal, protein 13.95g, calcium 110.1 mg, phosphorous 346.8 and iron 5.7 mg /100 g of the composite millet mix.

Table 5 represents the computed nutrient value for millet composite flour Trial 3, which is composed of 30 g of wheat, 60 g of total millets and equal quantity of 20 g each of foxtail millet, little millet and finger millet, 10 g of soybean and 1 g of fenugreek. It shows that total dietary fibre was 21.61 g, energy 350.33 Kcal, protein 13.67g, calcium 118.4 mg, phosphorous 337.8 and iron 5.83 mg/100 g of the composite millet mix.

The total dietary fibre provided by 66 g of millet composite flour was calculated in Trial 1, 2 and 3 and was found to be 12.5 g, 13.41 g and 14.26 g respectively. However, it is lower when compared to the 1/3 rd RDA for sedentary male (15.46), sedentary female (12.66), moderate male (18.2) and moderate female (14.86) [RDA is 40 g Fibre/ 2000Kcal]. Hence, to increase the total dietary fibre, the quantity of little millet was increased in the following trials.

Table 6 shows the mean sensory scores of Trial 1, 2 and 3. The overall acceptability was higher in Trial 1 (7.79 ± 0.80), compared to Trial 2 (7.14 ± 0.66) and Trial 3 (6.42 ± 1.22). The appearance was higher in Trial 1 (8.29 ± 0.73), compared to Trial 2 (7.07 ± 0.83) and Trial 3 (6.43 ± 1.34). The colour was higher in Trial 1 (8.82 ± 0.61), compared to Trial 2 (6.93 ± 0.99) and Trial 3 (6.29 ± 1.38). The texture was higher in Trial 1 (7.79 ± 0.80), compared to Trial 2 (7.21 ± 0.80) and Trial 3 (6.64 ± 1.28). The flavour was higher in Trial 1 (7.86 ± 0.66), compared to Trial 2 (7.07 ± 0.91) and Trial 3 (6.57 ± 1.22). The taste was higher (7.71 ± 0.83) in Trial 1, compared to Trial 2 (7.21 ± 0.80) and Trial 3 (6.57 ± 1.40).

Table 7 represents the computed nutrient value for Millet composite flour Trial 4, which is composed of 50 g of wheat, 40 g of total millets and equal quantity of 10 g each of foxtail millet, little millet and finger millet, 10 g of soybean and 1 g of fenugreek. It shows that total dietary fibre was 20.45 g, energy 353.63 Kcal, protein 14.13 g, calcium 90.05 mg, phosphorous 351.5 g and iron 6.08 mg/100 g of the composite millet mix.

Table 8 represents the computed nutrient value for Millet composite flour Trial 5, which is composed of 40 g of wheat, 50 g of total millets and equal quantity of 12.5 g each of foxtail millet and finger millet, little millet 25g, 10 g of soybean and 1 g of fenugreek. It shows that total dietary fibre was 22.06 g, energy 352.55 Kcal, protein 13.78.13 g, calcium 95.92 mg, phosphorous 341.32 g and iron 6.21 mg/100 g of the composite millet mix.

Table 9 represents the computed nutrient value for Millet composite flour Trial 6, which is composed of 30 g of wheat, 60 g of total millets and equal quantity of 15 g each of foxtail millet and finger millet, little millet 30g, 10 g of soybean and 1 g of fenugreek. It shows that total dietary fibre was 23.66 g, energy 351.48 Kcal, protein 13.45 g, calcium 101.35 mg, phosphorous 331.15 g and iron 6.36 mg/100 g of the composite millet mix.

The dietary fibre received from Trial 4, 5 and 6 was 20.45, 22.06 and 23.66 g per 100 gram of the millet composite flour. Table 10 shows the mean sensory scores of Trial 4,5 and 6. The overall acceptability was higher in Trial 4 (7.57 ± 0.65), compared to Trial 6 (7.07 ± 0.91) and Trial 7(6.79 ± 1.37). The appearance was higher (7.86 ± 1.29) in Trial 4, compared to Trial 5 (7.21 ± 1.05) and Trial 6 (6.43 ± 1.34). The colour was higher (7.86 ± 1.17) in Trial 4, compared to Trial 5 (7 ± 0.96) and Trial 6 (6.78 ± 1.42). The texture was higher (7.71 ± 0.82) in Trial 4, compared to Trial 5 (6.93 ± 0.92) and Trial 3 (6.79 ± 1.52). The flavour was higher (7.64 ± 1.08) in Trial 4, compared to Trial 5 (6.86 ± 0.77) and Trial 6 (7 ± 1.41). The taste was higher (7.5 ± 0.65) in Trial 1, compared to Trial 2 (7 ± 0.88) and Trial 3 (6.93 ± 1.39).

Discussion

Initial trials for development of millet composite flour were based on equal proportion of foxtail millet, little millet and finger millet (39.99, 48.98 and 60%), 10 percent of soybean and 1 g of fenugreek, along with 50 g, 40 g and 30 g of wheat

respectively. However it was required to increase the total dietary fibre. Hence the little millet quantity was doubled in comparison with foxtail millet and little millet. The organoleptic evaluation was carried out for trial 4, 5 and 6 (Table 8) with 40, 50 and 60 percent of millet composite flour. With 60 percent of millet composite flour it was slightly difficult to roll a good quality chapati. The over all acceptability score with trial 4 and trial 5 was 7.57 and 7.07 respectively. However to get at least one third of the RDA (12-15 g) for total dietary fibre with one serving size it was possible with trial 5, ie 50 percent of millet composite flour. Sixty six gram of 50 percent millet composite flour provided 14.55 g of total dietary fiber and was also having over all acceptability score of 7.07. The score for appearance, color, texture, flavor and taste were 7.12, 7.0, 6.93, 6.86 and 7.0. Hence the trial no 5 was finally selected for further studies.

Similar studies for development of composite flour was developed by Chhavi and Sarita *et al.*, (2012) [1] reported that breads formulated 70 percent refined wheat flour and 30

percent millet flour were most acceptable.

Singh and Srivastav (2008) [4], evaluated the quality of biscuit and reported that finger millets up to 70g can be successfully incorporated to formulate iron rich biscuit mixes. Indrani *et al.*, (2010) [2] studied the effect of replacement of whole wheat flour with multi grain blend (m g b) (chick pea split without husk, barley, soya bean and fenugreek seed) at 10 g, 20g, 30 g, and 40 g per 100 g on rheological characteristics of whole wheat flour and quality of north Indian Parata.

Kadam *et al.*, (2012) [3], developed and evaluated composite flour for missi roti/ chapatti, using wheat flour, chick pea, soybean and methi leaves powder. Four types of blends with different proportions were used to make good quality chapatti, viz, 'A' wheat flour: chick pea flour (80:20), 'B' wheat flour : full fat soya flour (90:10), 'C' wheat flour : chick pea flour : soya flour (80:10:10) and 'D' wheat flour : chick pea flour : soya flour : methi leaves powder (75:10:10:05). All the four types blends were acceptable.

Table 3: Nutrition composition of millet composite flour trial 1

	Wheat	Foxtail millet	Little millet	Finger millet	Soy bean	Fenugreek seed	Total
Quantity (g)	50	13.33	13.33	13.33	10	1	
Total Dietary Fibre (g)	6.24	3.29	5.18	1.57	2.4	0.48	19.06
Energy (Kcal)	173	44.12	45.45	43.72	43.2	3.33	349.97
Protein (g)	6.05	1.63	1.02	0.97	4.32	0.26	14.47
Calcium (mg)	24	4.13	2.26	45.85	24	1.6	100.72
Phosphorus (mg)	177.5	38.65	29.32	37.72	69	3.7	352.67
Iron (mg)	2.45	0.37	1.23	0.51	1.04	0.06	6.08

Table 4: Nutrition composition of millet composite flour trial 2

	Wheat	Foxtail millet	Little millet	Finger millet	Soy bean	Fenugreek seed	Total
Quantity (g)	40	16.66	16.66	16.66	10	1	
Total Dietary Fibre(g)	4.99	4.11	6.48	1.97	2.3	0.48	20.33
Energy (Kcal)	138.4	55.14	56.81	54.64	43.2	3.33	351.52
Protein (g)	4.84	2.04	1.28	1.21	4.32	0.26	13.95
Calcium (mg)	19.2	5.16	2.83	57.31	24	1.6	110.1
Phosphorus (mg)	142	48.31	36.65	47.14	69	3.7	346.8
Iron (mg)	1.96	0.46	1.54	0.64	1.04	0.06	5.7

Table 5: Nutrition composition of millet composite flour trial 3

	Wheat	Foxtail millet	Little millet	Finger millet	Soy bean	Fenugreek seed	Total
Quantity (g)	30	20	20	20	10	1	
Total Dietary Fibre(g)	3.74	4.94	7.78	2.37	2.3	0.48	21.61
Energy (Kcal)	103.8	66.2	68.2	65.6	43.2	3.33	350.33
Protein (g)	3.63	2.46	1.54	1.46	4.23	0.26	13.67
Calcium (mg)	14.4	6.2	3.4	68.8	24	1.6	118.4
Phosphorus (mg)	106.5	58	44	56.6	69	3.7	337.8
Iron (mg)	1.47	0.56	1.86	0.78	1.04	0.06	5.83

Table 6: Mean sensory scores of trial 1,2 and 3

Trial	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
1	8.29 ± 0.73	8.82±0.61	7.79±0.80	7.86±0.66	7.71±0.83	7.79±0.80
2	7.07± 0.83	6.93±0.99	7.21±0.80	7.07±0.91	7.21±0.80	7.14±0.66
3	6.43±1.34	6.29±1.38	6.64±1.28	6.57±1.22	6.57±1.40	6.42±1.22

Table 7: Nutrition composition of millet composite flour trial 4

	Wheat	Foxtail millet	Little millet	Finger millet	Soy bean	Fenugreek seed	Total
Quantity (g)	50	10	20	10	10	1	
Total Dietary Fibre (g)	6.24	2.47	7.78	1.18	2.3	0.48	20.45
Energy (Kcal)	173	33.1	68.2	32.8	43.2	3.33	353.63
Protein (g)	6.05	1.23	1.54	0.73	4.32	0.26	14.13
Calcium (mg)	24	3.1	3.4	34.4	24	1.6	90.05
Phosphorus (mg)	177.5	29	44	28.3	69	3.7	351.5
Iron (mg)	2.45	0.28	1.86	0.39	1.04	0.06	6.08

Table 8: Nutrition composition of millet composite flour trial 5

	Wheat	Foxtail millet	Little millet	Finger millet	Soy bean	Fenugreek seed	Total
Quantity (g)	40	12.5	25	12.5	10	1	
Total Dietary Fibre(g)	4.99	3.08	9.73	1.48	2.3	0.48	22.06
Energy (Kcal)	138.4	41.37	85.25	41	43.2	3.33	352.55
Protein (g)	4.84	1.53	1.92	0.91	4.32	0.26	13.78
Calcium (mg)	19.2	3.87	4.25	43	24	1.6	95.92
Phosphorus (mg)	142	36.25	55	35.37	69	3.7	341.32
Iron (mg)	1.96	0.35	2.32	0.48	1.04	0.06	6.21

Table 9: Nutrition composition of millet composite flour trial 6

	Wheat	Foxtail millet	Little millet	Finger millet	Soy bean	Fenugreek seed	Total
Quantity (g)	30	15	30	15	10	1	
Total Dietary Fibre(g)	3.74	3.70	11.67	1.77	2.3	0.48	23.66
Energy (Kcal)	103.8	49.65	102.3	49.2	43.2	3.33	351.48
Protein (g)	3.63	1.84	2.31	1.09	4.32	0.26	13.45
Calcium (mg)	14.4	4.65	5.1	51.6	24	1.6	101.35
Phosphorus (mg)	106.5	43.5	66	42.45	69	3.7	331.15
Iron (mg)	1.47	0.42	2.79	0.58	1.04	0.06	6.36

Table 10: Mean sensory scores of trial 4, 5, and 6

Trial	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
4	7.86±1.29	7.86±1.17	7.71±0.82	7.64±1.08	7.5±0.65	7.57±0.65
5	7.21±1.05	7±0.96	6.93±0.92	6.86±0.77	7±0.88	7.07±0.91
6	6.86±1.51	6.78±1.42	6.79±1.52	7±1.41	6.93±1.39	6.79±1.37

Conclusion

Millet composite flour with with 50 g of Wheat, 10g Foxtail millet, 20g Little millet, 10g Finger millet, 10g Soybean and 1g of Fenugreek seed was found to be the best formulation. This combination can be used in the preparation of various food products.

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