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Nutritional, sensory and storage studies of instant multigrain porride mix

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Instant multigrain porridge mix was developed from buckwheat and barley grits along with apricot powder in the ratios of 100:0:0::BWG:BG:AP, 0:100:0::BWG:BG:AP, 80:10:10::BWG:BG:AP, 70:20:10::BWG:BG:AP, 60:30:10::BWG:BG:AP and 50:40:10::BWG:BG:AP. During the current investigation, it was observed that incorporation of barley grits and apricot powder to buckwheat grits in all the formulations increased mean values of iron and zinc contents from 4.51 to 6.31 mg/100g and 1.66 to 3.02 mg/100g, respectively, however, there was a decrease in calcium content from 63.62 to 59.28 mg/100g. On organoleptic testing, increase in taste, body and overall acceptability scores and decrease in colour score were observed with the substitution of incorporates. The developed porridge mix was stored for 150 days under ambient conditions during which afore mentioned parameters were found to be declined however the product was microbiologically safe for consumption.

Key Words : Buckwheat, Barley, Apricot, Pseudo-cereal, Instant porridge mix, Sensory evaluation

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INTRODUCTION

Convenience foods are foods requiring minimal preparation. They are significant because they save cooking time, provide variety, reduce food wastage and provide seasonal foods throughout the year (Martine *et al*., 2004). The technological advance, urbanisation, mechanization, migration, increased women employment away from homes and several other factors have a profound influence on habitual food preparation. The traditional foods are replaced with modern ready to use/ready to eat foods (Pattan *et al*., 2001). Porridge is one of the ready to use food product which is now-a-days gaining much importance among the mass. Currently, instant porridge is one of Asia's most popular breakfast foods. It is widely consumed in several Asian countries. In recent years, a wide range of processed foods in ready-to-eat form have been marketed with increased interests in health foods. Consumers also now believe in health benefits or nutrition as being desirable food qualities. Breakfast cereals have potential to contribute as nutritious food because of dietary fibre and other health significant bioactive compounds in whole grains. Apart from health significance, convenience is also a recent trend in international as well as Indian food market. Convenience products are quick and easy to prepare, thus, saves cooking time and requires few cooking skills.

In addition to whole grain benefits, multigrain concept can provide breakfast foods with number of benefits

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associated with these grains (Mandge *et al*., 2011). This multigrain blends helps to mix different whole grains to maximize their nutritional, functional and sensory properties. Keeping in view, the benefits of multigrain approach, underutilized crops of Ladakh, *i.e*. buckwheat and barley along with apricot, were selected for the current investigation to assess the nutritional constituents, organoleptic parameters and storage stability of the developed products.

METHODOLOGY

Materials:

Raw grains of buckwheat (*Fagopyrum esculentum*) and barley (*Hordeum vulgare*) and dried apricot (*Prunus armeniaca*) were procured from Leh, Ladakh, India. Fresh milk and cane sugar were purchased from local market of Jammu. Cane sugar was grounded into fine powder using grinder (Philips, Model: HL 1632, New Delhi, India). Aluminium laminated pouches used for packaging of instant multigrain porridge mix were obtained from Vishwas Traders, Jammu.

Manufacture of instant multigrain porridge mix:

Processing of grains:

The grains were cleaned manually by removing the diseased and foreign materials, washed thoroughly under tap water to remove dust and then dried in shade. The dried grains of buckwheat and barley were coarse grinded in a laboratory mill (Philips, Model: HL 1632). The grinded grains were sieved through ISI Mesh No. 20 (0.833 mm) for medium fractions (grits). The washed, destoned and dried apricots were converted into powder. The method of Kikafunda *et al*. (2006) was followed for developing multigrain porridge mix. Grits of buckwheat and barley and apricot powder were blended separately in different ratios with each other for making different formulations as F_1(100:0:0::BWG:BG:AP), F_2(0:100:0::BWG:BG:AP), F_3(80:10:10::BWG:BG:AP), F_4(70:20:10::BWG:BG:AP), F_5(60:30:10::BWG:BG:AP) and F_6(50:40:10::BWG:BG:AP).

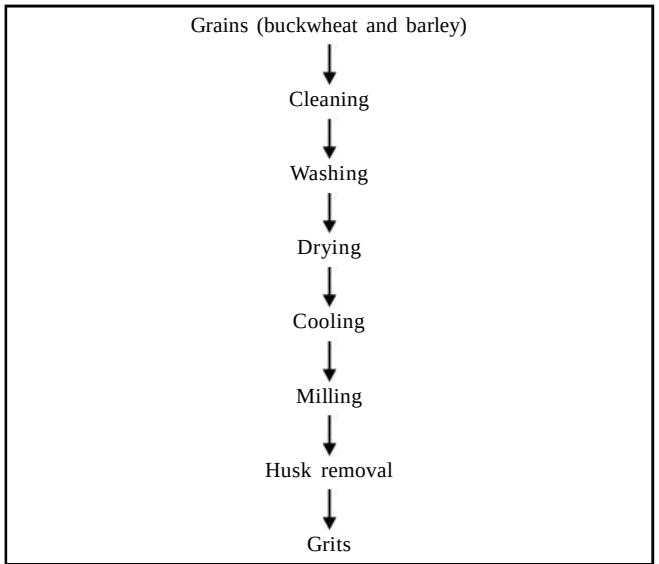

Fig. A : Flow chart for preparation of grits

Storage:

The blended mixture of each treatment was packed in aluminium laminated pouches and stored for the shelf-life study of 150 days at ambient temperature (32 ± 2 ºC). The samples were analysed for various chemical constituents and organoleptic evaluation at an interval of 30 days following the standard procedures.

Reconstitution of instant multigrain porridge mix:

On the basis of preliminary study, 35 g of porridge mix gave the best results in 100 ml of milk and 5 g of sugar. The ratio was standardized after several preliminary trials conducted by mixing 15, 25, 35 and 45 g of prepared porridge mix with 100 ml milk and 5 g sugar followed by boiling for 2-4 minutes to assess the best suitable blend.

Methods:

Mineral matters were determined following procedure of Chapman and Pratt (1961) by dry ashing method using atomic absorption spectrophotometer. Cooked multigrain porridge was served hot and evaluated for sensory attributes (colour, texture/body, taste and overall acceptability) through a panel of semi-trained judges using 9 point hedonic scale assigning scores 9-like extremely to 1-dislike extremely. A score of 5.5 and above was considered acceptable (Amerine *et al.*,1965). Spread plate technique, described by Palczar and Chan, 1991, was followed for microbial evaluation. All the experiments were performed in triplicates. Data collected from aforesaid experiments was subjected to ANOVA (statistical analysis) with the help of Factorial Completely Randomized Design (Gomez and Gomez, 2010) and using the OP Stat software package.

Nutritional characteristics:

As far as, nutritional parameters of multigrain porridge mix were concerned, overall mean calcium decreased significantly from 63.62 to 59.28 mg/100g, whereas, iron and zinc contents increased from 4.51 to 6.31 and 1.66 to 3.02 mg/100g, respectively, with the incorporation of barley (Tables 1-3) which might be due to lower quantity of calcium and higher levels of iron and

Table 1: Effect of formulations and storage period on calcium content (mg/100g) of multigrain porridge mix

Formulations	Storage period (days)						
	0	30	60	90	120	150	Mean
F_1 (100:0:0::BWG:BG:AP)	64.23	64.11	63.96	63.64	63.20	62.63	63.62
F_2 (0:100:0::BWG:BG:AP)	49.25	49.14	48.94	48.66	48.26	47.64	48.64
F_3 (80:10:10::BWG:BG:AP)	63.32	63.24	63.00	62.70	62.30	61.72	62.71
F_4 (70:20:10::BWG:BG:AP)	61.64	61.54	61.37	61.01	60.65	60.00	61.03
F_5 (60:30:10::BWG:BG:AP)	60.33	60.22	60.04	59.75	59.32	58.70	59.72
F_6 (50:40:10::BWG:BG:AP)	58.89	60.8	60.63	60.28	57.87	57.24	59.28
Mean	59.61	59.84	59.65	59.34	58.60	57.98	

Effects	C.D. ($P \leq 0.05$)
Formulation	0.02
Storage	0.01
Formulation x storage	0.01

Table 2 : Effect of formulations and storage period on iron content (mg/100g) of multigrain porridge mix

Formulations	Storage period (days)						
	0	30	60	90	120	150	Mean
F_1 (100:0:0::BWG:BG:AP)	04.80	04.80	04.71	04.55	04.32	03.90	04.51
F_2 (0:100:0::BWG:BG:AP)	09.02	09.01	08.93	08.78	08.54	08.10	08.73
F_3 (80:10:10::BWG:BG:AP)	05.32	05.28	05.19	05.06	04.8	04.41	05.01
F_4 (70:20:10::BWG:BG:AP)	05.72	05.71	05.63	05.47	05.24	04.80	05.42
F_5 (60:30:10::BWG:BG:AP)	06.21	06.17	06.12	05.95	05.71	05.29	05.09
F_6 (50:40:10::BWG:BG:AP)	06.60	06.58	06.51	06.36	06.12	05.73	06.31
Mean	06.27	06.25	06.18	06.02	05.78	05.37	

Effects	C.D. ($P \leq 0.05$)
Formulation	0.02
Storage	0.01

Table 3: Effect of formulations and storage period on zinc content (mg/100g) of multigrain porridge mix

Formulations	Storage period (days)						
	0	30	60	90	120	150	Mean
F_1 (100:0:0::BWG:BG:AP)	1.84	1.8	1.74	1.67	1.58	1.36	1.66
F_2 (0:100:0::BWG:BG:AP)	3.62	3.55	3.52	3.43	3.33	3.10	3.42
F_3 (80:10:10::BWG:BG:AP)	2.00	1.95	1.89	1.83	1.74	1.55	1.82
F_4 (70:20:10::BWG:BG:AP)	2.38	2.35	2.29	2.23	2.15	1.96	2.22
F_5 (60:30:10::BWG:BG:AP)	2.81	2.76	2.71	2.64	2.53	2.29	2.62
F_6 (50:40:10::BWG:BG:AP)	3.20	3.16	3.11	3.00	2.92	2.73	3.02
Mean	2.64	2.59	2.54	2.46	2.37	2.16	

Effects	C.D. ($P \leq 0.05$)
Formulation	0.02
Storage	0.01

Table 4 : Effect of formulations and storage period on taste score of multigrain porridge mix

Formulations	Storage period (days)						
	0	30	60	90	120	150	Mean
F_1 (100:0:0::BWG:BG:AP)	06.98	06.87	06.73	06.42	05.93	05.22	06.35
F_2 (0:100:0::BWG:BG:AP)	07.35	07.28	07.09	07.00	06.80	06.13	06.94
F_3 (80:10:10::BWG:BG:AP)	07.12	07.00	06.79	06.53	06.00	05.31	06.45
F_4 (70:20:10::BWG:BG:AP)	07.44	07.32	07.13	06.77	06.31	05.62	06.76
F_5 (60:30:10::BWG:BG:AP)	07.69	07.61	07.38	07.13	06.57	05.91	07.04
F_6 (50:40:10::BWG:BG:AP)	07.72	07.60	07.43	07.12	06.58	05.93	07.06
Mean	07.38	07.28	07.09	06.82	06.36	05.68	

Effects	C.D. ($P \leq 0.05$)
Formulation	0.02
Storage	0.01
Formulation x storage	0.03

Table 5 : Effect of formulations and storage period on colour score of multigrain porridge mix

Formulations	Storage period (days)						
	0	30	60	90	120	150	Mean
F_1 (100:0:0::BWG:BG:AP)	8.25	8.13	7.92	7.67	7.55	6.93	7.74
F_2 (0:100:0::BWG:BG:AP)	6.70	6.62	6.41	6.04	5.76	5.42	6.15
F_3 (80:10:10::BWG:BG:AP)	8.17	8.06	7.85	7.48	7.33	6.86	7.62
F_4 (70:20:10::BWG:BG:AP)	8.00	7.91	7.77	7.56	7.19	6.57	7.50
F_5 (60:30:10::BWG:BG:AP)	8.10	7.97	7.76	7.39	6.81	6.77	7.46
F_6 (50:40:10::BWG:BG:AP)	7.96	7.88	7.67	7.30	6.68	6.42	7.31
Mean	7.85	7.76	7.56	7.24	6.88	6.49	

Effects	C.D. ($P \leq 0.05$)
Formulation	0.02
Storage	0.01
Formulation x storage	0.03

Table 6: Effect of formulations and storage period on body score of multigrain porridge mix

Formulations	Storage period (days)						
	0	30	60	90	120	150	Mean
F_1 (100:0:0::BWG:BG:AP)	6.45	6.37	6.28	6.04	5.86	5.69	6.11
F_2 (0:100:0::BWG:BG:AP)	7.30	7.22	7.10	6.95	6.70	6.58	6.96
F_3 (80:10:10::BWG:BG:AP)	6.72	6.64	6.54	6.30	6.08	5.93	6.36
F_4 (70:20:10::BWG:BG:AP)	7.21	7.09	7.03	6.84	6.60	6.45	6.87
F_5 (60:30:10::BWG:BG:AP)	7.33	7.21	7.14	6.90	6.70	6.56	6.97
F_6 (50:40:10::BWG:BG:AP)	7.34	7.24	7.12	6.97	6.70	6.52	6.98
Mean	7.05	6.96	6.86	6.66	6.44	6.28	

Effects	C.D. ($P \leq 0.05$)
Formulation	0.02
Storage	0.01
Formulation x storage	0.03

zinc contents in barley than in buckwheat. Findings of Dhingra and Jood (2006) in the blends of barley flour and wheat flour supported the current results. With the advancement of storage period of 150 days, the overall mean calcium, iron and zinc contents decreased from 59.61 to 57.98 mg/100g, 6.27 to 5.37 mg/100g and 2.64 to 2.16 mg/100g, respectively. The decrease in mineral contents might be due to interaction of these with other components like protein and carbohydrate. Our findings are in conformity with the findings of Rubin *et al*. (1997) who studied the effect of micronutrient addition to cereal grain products. Misfa *et al*. (2000) reported decreasing trend in mineral content in wheat *Atta* fortified with elemental iron used for chapatti production and Sikandra and Boora (2009) reported similar trend while conducting nutritional evaluation of sorghum and chickpea incorporated value added products.

Organoleptic evaluation:

Taste:

Table 4 referred to the results of taste score of the multigrain instant porridge. Taste score of 100 per cent buckwheat porridge F_1 (100:0:0::BWG:BG:AP) was found to be 6.35, while in 100 per cent barley porridge F_2 (0:100:0::BWG:BG:AP) it was found to be 6.94. Comparing the evaluated taste mean among the formulations/treatments, highest taste score of 7.06 was found in F_6 (50:40:10::BWG:BG:AP) and the taste score increased significantly ($p \leq 0.05$) in the corresponding blends, as the barley and apricot proportion increased in the blend. The taste scores in the blends F_3 (80:10:10:: BWG:BG:AP), F_4 (70:20:10::BWG:BG:AP) and F_5 (60:30:10:: BWG:BG:AP) were found to be 6.45, 6.76 and 7.04, respectively. Moreover, there was a significant influence of formulations over storage and on their interactions on taste score of multigrain porridge. During storage of 150 days, the mean taste score decreased significantly from 7.38 to 5.68.

Colour and body:

The pooled data of overall treatment mean for colour and body evaluation (Table 5 and 6) revealed that F_1 (100:0:0::BWG:BG:AP) and F_6 (50:40:10::BWG:BG:AP) scored the highest score of 7.74 and 6.98 for colour and body attributes, respectively and were highly significant from rest of the formulations. F_3 (80:10:10::BWG:BG:AP) and F_4 (70:20:10::BWG:BG:AP) with scores of 7.62 and 7.50 followed the above in clolour and F_5 (60:30:10:: BWG:BG:AP) and F_2 (0:100:0::BWG:BG:AP) with the scores of 6.97 and 6.96 in case of body attribute. The lowest scores of 6.15 and 6.11 was scored by F_2 (0:100:0::BWG:BG:AP) and F_1 (100:0:0::BWG:BG:AP) for colour and body, respectively. Increase in the ratios of barley and apricot in the product resulted into decrease in its colour and increase in its body attribute. On assessing the storage mean score received by different formulations for colour and body quality attributes, it was found that the scores decreased significantly from 7.85 to 6.49 and from 7.05 to 6.28 during 150 days of storage period, respectively.

Table 7 : Effect of formulations and storage period on microbial count (c.f.u/g) of multigrain porridge mix

Formulations	Storage period (days)		
	90	150	Mean
F_1 (100:0:0::BWG:BG:AP)	2.00×10^2	3.24×10^2	2.62×10^2
F_2 (0:100:0::BWG:BG:AP)	2.37×10^2	3.61×10^2	2.99×10^2
F_3 (80:10:10::BWG:BG:AP)	2.12×10^2	3.37×10^2	2.74×10^2
F_4 (70:20:10::BWG:BG:AP)	2.28×10^2	3.56×10^2	2.92×10^2
F_5 (60:30:10::BWG:BG:AP)	2.53×10^2	3.79×10^2	3.16×10^2
F_6 (50:40:10::BWG:BG:AP)	2.74×10^2	4.03×10^2	3.38×10^2
Mean	2.34×10^2	3.60×10^2	2.97×10^2

Effects	C.D. ($P \leq 0.05$)
Formulation	0.02
Storage	0.01
Formulation x storage	0.03

Overall acceptability:

A perusal of the data in Fig. 1 revealed that in multigrain porridge, the mean score evaluation ranged from 6.06 to 7.16, scoring lowest in F_1 (100:0:0::BWG:BG:AP) and highest in F_6 (50:40:10::BWG:BG:AP). It was observed that substitution of barley flour at higher level increased the sensory scores of the porridge mix. Frost *et al*. (2011) noticed that flavour of chocolate chip cookies increased with the incorporation of barley and Hou and Jimenez (2008) also reported similar trend in sensory attributes of barley fortified wheat based foods. The results of storage mean for overall acceptability score decreased significantly from the initial levels of 6.95 to 6.37 during 150 days of storage period. The decrease in sensory score of different characteristics of porridge mix, irrespective of formulations during storage might be attributed to changes in their objective characteristics. The results of our study are supported by the findings of Rao *et al*. (2008) in spray dried banana powder and Jyothirmayie *et al*. (2006) in instant raw tamarind *Chutney* powder. Above results on overall acceptability score of multigrain porridge mix evidently showed the variation regarding the effect of formulations and storage periods and their interactions on organoleptic characteristics.

Microbial evaluation (Total plate count):

After the storage period of 90 days, the mean microbial count of different formulations of porridge was found to be in the range of 2.62 x 10^2 cfu/g to 3.38 x 10^2 cfu/g. During storage of 150 days, the microbial load of the porridge increased significantly from 2.34 x 10^2 cfu/g to 3.60 x 10^2 cfu/g (Table 7) but was in safe limits. Misra and Kulshrestha (2002) observed similar findings in potato powder. The increase in microbial population with the passage of time might be due to the increase in moisture content of the product absorbed from atmosphere. Temple *et al*. (1996) reported that high moisture content in foods encourage microbial growth, hence, food spoilage occur.

Conclusion:

It can be concluded that the porridge become more nutritious with the incorporation of buckwheat and apricot. This type of convenient food can go a long way in supplying the required quantities of nutrtrients to various segments of population with greater accetability. There is not much loss of nutrients and the product is safe for consumption after the storage period of 150 days.

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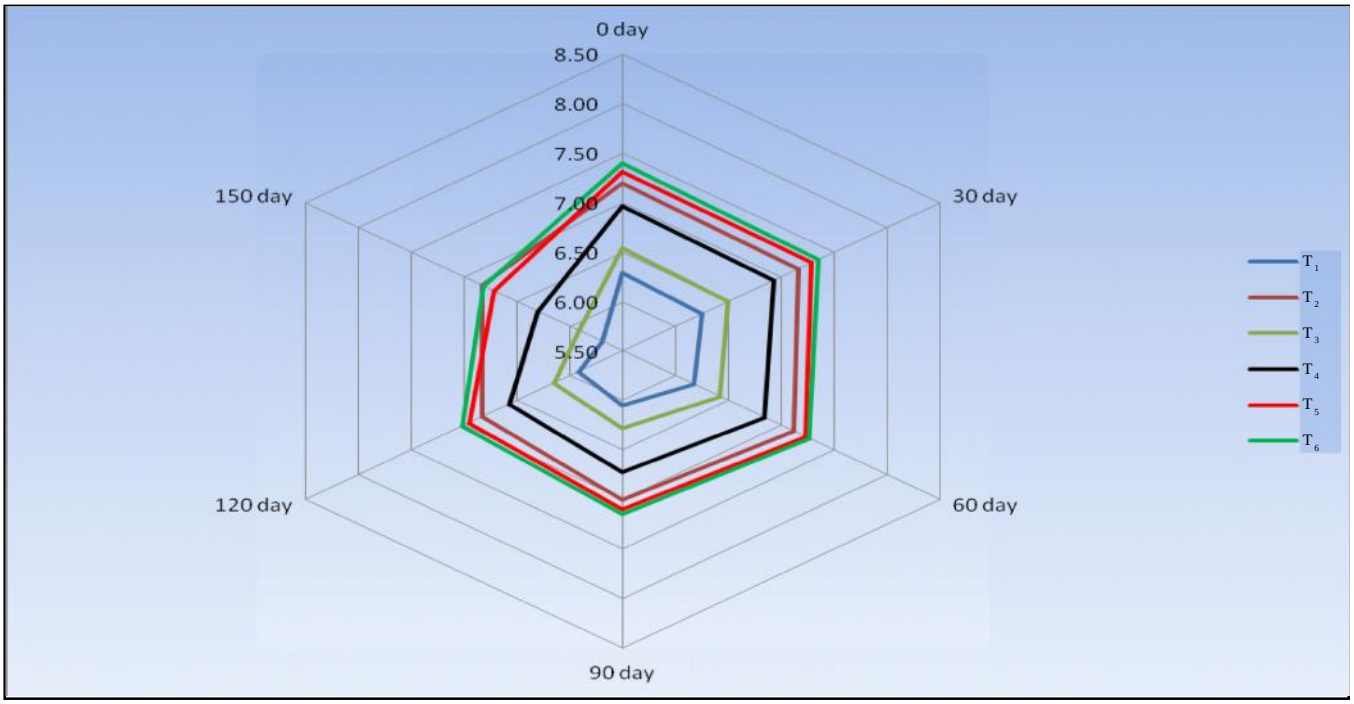

Fig. 1 : Effect of formulations and storage period on overall acceptability score of multigrain porridge mix

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