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Enhancement of rice based pancake mix with nutrient dense ingredients

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Abstract
A study was undertaken to develop Nutri-dense pancake mixes by substituting 50 per cent of the traditional rice based pancake mix with amaranth seed flour, soybean seed flour in four proportions along with mushroom and garden cress seed powder each at 5-20 per cent as well as four combinations of mushroom and garden cress seed powder at 5-15 per cent and compared with a control made with 100 per cent rice flour. Out of the twelve proportions, three best pancake mix proportions, one from each group *viz.*, PM_1, PG_1 and PMG_2 were selected based on sensory evaluations of the pancakes made from the mixes. Results revealed that pancake mix with mushroom powder incorporation recorded the highest crude protein content (16.93±0.03 g/100g), whereas, pancake mix with combination of mushroom and garden cress seed powder incorporation resulted in highest content of crude fat (6.69±0.01 g/100g), crude fibre (3.48±0.02 g/100g), total mineral (2.56±0.03 g/100g), calcium (111.50±1.3 mg/100g) and iron (16.4±0.33 mg/100g). Colour parameters, i.e., L* value and hue value were found to be more in control pancake mix only with rice flour, a* value with mushroom powder incorporated pancake mix, b* value and chroma value were in pancake mix with incorporation of garden cress seed powder. In terms of functional properties, pancake mix with combination of mushroom and garden cress seed powder incorporation was found to be best in respect of bulk density (1.70±0.002 g/ml), water absorption capacity (160.07±0.55%) and oil absorption capacity (112.27±0.25%). There was no significant difference found in terms of physical properties among all the variations of mixes along with the control.

Keywords: Ingredients, nutrient dense, pancake mix, rice-based

Introduction
Adequate nutrition for maintaining a good nutritional status mainly comes from a healthy diet rich in all macronutrients and micronutrients (Troesch *et al.*, 2015) [28]. Change in diets and dietary habits has led to an increasing number of health related diseases. The dietary pattern of Indian people mainly focusses on the consumption of calorie rich sources such as cereals and not enough protein or other micronutrient rich sources. This has led to an increase in demand for nutrient dense diet or nutrient dense products which will help to achieve optimal amount of nutrition for an individual. It is very pertinent that either new products with appropriate and adequate nutrient levels are to be developed or products which are normally consumed in day to day life are to be enhanced by incorporating nutrient rich ingredients.

Rice is the most commonly consumed cereal grain in Assam and a wide variety of rice based dietary snacks are prepared and consumed. The traditional snacks (*pitha*) are special food items that are served as breakfast. Among all the *pitha* preparations, one of the most common and easiest form of *pitha* is the *kholasapori pitha*, which is also known as *Bhurbhuria pitha* (Dey, 2016) [10]. It is a thin pancake prepared with plain watery rice flour batter and shallow fried on both sides with a bit of oil (Borthakur, 2021) [4]. This snack can be made nutrient dense by formulating it with ingredients which are rich sources of macro and micro-nutrients. The nutritious grains like soybean, amaranth seeds and nutrient dense ingredients like mushroom and garden cress seeds can be used to prepare new products or for incorporating in the existing conventional food items or snacks for enhancing their nutritional composition as well as for reducing the disease burden in our population (Rajamani and Rajeswari, 2016) [23].

In view of the above facts, a research study was planned to develop nutri-dense pancake mixes by substituting 50 per cent of rice flour with flours of amaranth, soyabean, garden cress seed and mushroom powders in different proportions for their nutritional composition, functional properties and physical parameters.

Materials and Methods

Raw ingredients

Selection of ingredients were done based on the nutrient content such as protein and carbohydrate along with micronutrients iron and calcium to enhance their utilization in traditional snacks to improve their nutritional value. Rice based pancake is generally prepared from white rice with intermediate amylose content between 20-25 per cent (Panesar and Kaur, 2016) [21]. In the present study, an intermediate amylose containing high yielding rice variety, '*Mulagabharu*', with 20±1.08 mg/100g (Chatterjee and Das, 2019) [6] was selected and procured from Regional Agricultural Research Station (RARS), Titabor, Assam. It was processed to flour following the methods given by Udomrati *et al.*, 2020 [29] with slight modification. Soybean seeds were purchased from local market of Jorhat, Assam and processed to flour with the method given by Venkateswari and Parameshwari (2016) [30]. Flours of amaranth seeds and oyster mushroom were purchased through online mode along with garden cress seeds, processed to flour using the method proposed by Rajshri and Haripriya (2018) [24]. All the flours were stored at refrigerated temperature of 4 ºC. Analysis of raw ingredients were done in terms of their nutritional composition such as moisture, crude fat, crude protein, crude fibre by A.O.A.C. (2010) [1], total minerals, energy and carbohydrates by Gopalan *et al.*, 2000 [13] and total starch by Verma and Srivastav (2017) [31] and depicted in Table 1.

Nutri-dense pancake mix

Formulation

Twelve different formulations of nutri-dense pancake mixes (Table 2) were prepared using the processed flours of the ingredients where 50 per cent of the principle ingredient rice flour was substituted by soybean flour, amaranth seed flour along with mushroom flour and garden cress seed flour in four variations each and combination of mushroom flour and garden cress seed flour in four different variations. A baseline pancake mix was kept as a control using only rice flour (100%) for comparison of each of the three categories.

Determination of the best variations of the nutri-dense pancake mixes

Out of the twelve different formulated nutri-dense pancake mixes (Table 3), three best variations, *viz.* PM_1, PG_1 and PMG_2, one from each of the formulated sets of mixes were chosen through organoleptic evaluation and physico-chemical analysis of pancake mixes, *viz.* moisture, crude fat, crude protein, crude fibre, energy, total carbohydrate and total minerals using A.O.A.C. (2010) [1] methods along with a control using only rice flour.

Results and Discussion

Sensory evaluation of pancake mixes

The nutri-dense pancake mixes in different combinations of ingredients were prepared in the form of pancakes and presented to the semi-trained panelist for evaluation of the developed product. The scores obtained by sensory evaluation of the developed nutri-dense pancakes are presented in Table 3.

The overall acceptability of the developed pancakes with mushroom powder showed that the control pancakes had the highest score of 7.8±0.42 followed by PM_1, PM_2, PM_3 and PM_4 pancakes. The highly acceptance of control pancake because of its texture and bright white colour as compared to other pancakes prepared with increasing proportions of mushroom powder which imparted a darker colour. Similar result was observed by Krishnamoorthy *et al.*, 2013 [19]. Comparative analysis of all the characteristics of pancakes incorporating different levels of mushroom powder showed that PM_1 was found to be the best out of all the treatments with mushroom powder incorporation. Similar findings were recorded by Prodhan *et al.*, 2015 [22] and Bello *et al.*, 2017 [3] in biscuits with mushroom flour incorporation.

Amongst the pancakes prepared with garden cress seed powder, PG_1 with 5 per cent level of incorporation was found to be the best with highest acceptability score of 7.6±0.52 in terms of the sensory attributes such as appearance, taste and texture (Table 3). However, there was no significant difference between the control and PG_1 as well as PG_1 and PG_2. Incorporation of garden cress seed powder upto 5 per cent in muffin was also found to be the best as reported by Rajshri and Haripriya (2018) [24] and in *kheer* preparation by Dashora and Choudhary (2016) [9]. Pancakes prepared from combination of mushroom and garden cress seed powder incorporation showed that PMG_2 with 10 per cent of both the ingredients was found to be the best out of all the treatments with a score of 7.6±0.52. Increasing level of garden cress seed powder incorporation above 10 per cent developed a tangy taste which decreased the scores significantly. Similar findings were reported by Jain *et al.*, 2016 [17] in ready to eat supplementary food preparation using garden cress seed and Das *et al.*, 2020 [8] in sponge cake supplemented with oyster mushroom powder at 10 per cent level.

Nutritional composition of the best variations of pancake mixes

The proximate composition of the three best variations of pancake mixes with control are presented in Table 4.

Moisture content (%) of the best variations of mixes ranged from 9.38±0.02 to 11.06±0.02 per cent. The highest moisture content of 11.06±0.02 per cent was observed in control followed by PM_1, PMG_2 and PG_1. However, the difference between PM_1 and PMG_2 as well as PMG_2 and PG_1 was not significant. Similar non-significant variation of moisture content of pancake mixes were observed by Sneha and Haripriya (2018) [26] on amaranth grain based *dosa* mix.

There was significant variation of crude protein content due to different mixes of pancake. The highest protein content of 16.93±0.03 g/100g was recorded in PM_1 followed by PG_1, PMG_2 and control. The increase in crude protein content in PM_1 was due to the presence of mushroom powder in addition to soybean seed flour. Similar result was reported by Farzana *et al.*, 2017 [12] in soy-mushroom health drink powder.

The highest crude fat content of 6.69±0.01 g/100g was observed in PMG_2 followed by PG_1 and PM_1. Control treatment recorded the lowest crude fat content (1.24±0.12). The increase in the fat content of PMG_2 pancake mix was due to the presence of garden cress seed powder (Shetty and Akhilender, 2018) [25]. Similar result was also observed by Sneha and Haripriya (2018) [26] in amaranth grain based instant dosa mix.

Crude fibre content of 3.48±0.02 g/100g was recorded in PMG_2 followed by PM_1, PG_1 and control. The reason for increase in crude fibre content of PMG_2 as compared to other pancake mixes was due to increasing amount of mushroom powder incorporation. Similar trend was observed by Ibrahium and Hegazy (2014) [15] in biscuits preparation.

The highest total carbohydrate content of 80.02±0.39 g/100g was observed in control followed by PM_1, PG_1 and PMG_2. However, there was no significant difference between PG_1 and PM_1. Carbohydrate content of control pancake mix with only rice flour was found to be higher as reported by Mahalakshmi *et al.,* 2014 [20] in nutri ball formulated for sports person. The highest calcium content of 111.50±1.32 mg/100g, iron content of 16.4±0.33 mg/100g and total mineral (ash) content of 2.56±0.03 g/100g was observed in PMG_2 over the other pancake mixes (Table 4). The lowest value in all cases was observed in control. Similar findings were reported by Elizabeth and Poojara (2014) [11] in calcium content on garden cress seed incorporated cookies at 10 per cent level, Gurjar and Mogra (2018) [14] in case of iron content of the flour formulated with wheat, pearl millet, rice flour and garden cress seed powder. There was significant difference among all the pancake mixes in respect of energy. Energy (kcal/100g) value of 359.79±1.31 was found to be highest in control followed by PM_1, PG_1 and PMG_2. Similar result was observed by Krishnamoorthy *et al.,* 2013 [19] on rice *dosa* and Mahalakshmi *et al.,* 2014 [20] on rice flakes incorporated nutri-ball.

Functional properties of the best variations of pancake mixes

Functional properties such as bulk density, water absorption capacity and oil absorption capacity of the best variations of nutri-dense pancake mixes are presented in Table 5.

Bulk density mainly depends on factors such as method of analysis, particle size of the flours used, surface properties and solid density of the ingredients as well as depends on the moisture content of the flour (Iwe *et al.,* 2016) [16]. Bulk density of the nutri-dense pancake mixes showed that there was no significant difference between control and PM_1 as well as between PG_1 and PMG_2. The highest bulk density was found in PMG_2, i.e., 1.70±0.002 g/ml. Bulk density of the pancake mixes increased with increasing incorporation of flours and increased moisture content which resulted in higher bulk density of PMG_2 pancake mix. The result was similar to the studies conducted by Sneha and Haripriya (2018) [26] in instant soup mix.

Water absorption capacity was found to be significant among the best variations of pancake mixes recording highest in PMG_2 and lowest in control. Variation of water absorption capacity among the pancake mixes may be due to different protein concentration, their degree of interaction with water and conformational characteristics (Butt and Batool, 2010) [5]. The highest capacity in PMG_2 may be attributed to many hydrophilic components in the mixes such as carbohydrate in the form of rice flour and amaranth seed flour and protein in mushroom powder and soybean seed flour which have high affinity for water molecules (Sreerama *et al.,* 2012) [27].

Oil absorption capacity is an essential functional property that contributes to enhancing mouthfeel along with retaining the flavour of food products (Awuchi *et al.,* 2019) [2]. The highest oil absorption capacity value was found in PMG_2 due to presence of higher amount of garden cress seed powder which contains higher amount of fat as compared to all other flours in the mix. Another possible reason for increase in the oil absorption capacity may be due to variation in the presence of non-polar side chain, i.e., protein in the form of mushroom flour which might bind the hydrocarbon side chain of the oil among the mixes (Kaushal *et al.,* 2012) [18].

Physical parameters of the best variations of pancake

Physical parameters such as weight per pancake, diameter, thickness and spread ratio are presented in Table 6. Significant differences were not observed in respect of all the physical parameters of developed nutria-dense pancakes using the best variations. However, highest weight per pancake and thickness were observed in PMG_2 (53.83±1.61 g) and lowest in control. Similar result was observed by Vijayakumar and Mohankumar (2011) [32] in dosa mix from composite flour. The highest diameter of pancake using the variation of nutri-dense mix in PG_1 and spread ratio in control were observed though the effect was not significant.

Colour measurement of the best variations of pancakes

Colour measurements and change of colour in the developed nutri-dense pancakes in terms of Hunter Colour Lab values are presented in Table 7 and Fig.1 respectively. It was observed that all the colour analysis values were significant due to variations of mixes in preparation of pancakes.

Lightness value (L*) was found to be highest in the control, i.e., 80.92±0.28 due to white colour of rice flour followed by PG_1 with incorporation of 5 per cent garden cress seed powder, PM_1 with 5 per cent mushroom powder and PMG_2 with 10 per cent each of mushroom and garden cress seed powder. The values of L* decreased with increasing incorporation of other flours.

The redness values (a*) ranged from 0.70±0.04 to 5.55±0.04 with highest value observed in PM_1 due to additional incorporation of 5 per cent mushroom powder which resulted in reddish brown colour of the pancake. Similar observation was also reported by Correia *et al.,* 2017 [7] in pasta formulation.

Yellowness values of the pancakes (b*) ranged from 2.51±0.17 to 17.1±0.48 and was found to be highest in PG_1 with 5 per cent garden cress seed powder addition followed by PMG_2, control and PM_1. The highest b* value was found in PG_1 due to the presence of garden cress seed powder and lowest in PM_1 due to mushroom powder incorporation as reported by Correia *et al.,* 2017 [7].

The hue value was found to be highest in control (85.76±7.61) without significant difference with PG_1 (84.82±4.23). The lowest value was recorded in PM_1 (24.33±0.45). The highest and lowest chroma value was observed in PG_1 and PM_1, respectively.

Table 1: Nutritional composition of raw ingredients

Ingredients	Moisture (%)	Energy (Kcal/100 g)	Crude protein (g/100 g)	Crude fat (g/ 100 g)	Crude fibre (g/100 g)	Total carbohydrate (g/100 g)	Total mineral (g/100 g)	Total starch (mg/100g)
Rice flour	11.06 ± 0.20	359.79 ± 1.31	12.80 ± 0.26	1.24 ± 0.12	1.59 ± 0.03	80.02 ± 0.39	1.01 ± 0.01	61.19 ± 1.22
Soybean flour	4.34 ± 0.04	351.12 ± 0.42	36.35 ± 1.41	19.89 ± 0.18	3.42 ± 0.15	21.47 ± 0.95	4.60 ± 0.02	10.14 ± 0.12
Amaranth seed flour	10.17 ± 1.35	315.76 ± 0.87	14.71 ± 0.26	6.05± 0.20	2.93 ± 0.10	65.97 ± 0.50	2.03 ± 0.01	49.26 ± 1.10
Mushroom powder	11.41 ± 0.77	255.39 ± 7.65	30.31 ± 0.66	1.83 ± 0.06	11.22 ± 0.59	40.73 ± 1.53	7.08 ± 0.24	0.04 ± 0.01
Garden cress seed powder	6.69 ± 1.26	416.22 ± 0.33	22.11 ± 0.98	26.93 ± 0.18	6.56 ± 0.45	34.56 ± 0.78	4.94 ± 0.12	9.37 ± 0.36
$CD_{(0.05)}$	1.64	6.37	1.51	0.28	0.58	1.68	0.22	1.37

Table 2: Formulation of the rice based pancake mixes with different nutrient dense ingredients

Treatment	Level of incorporation				
	***Mulagabharu* rice flour (g)**	**Soybean seed flour (g)**	**Amaranth seed flour (g)**	**Mushroom powder (g)**	**Garden cress seed powder (g)**
Control	100	-	-	-	-
PM_1	50	10	35	05	-
PM_2	50	10	30	10	-
PM_3	50	10	25	15	-
PM_4	50	10	20	20	-
PG_1	50	10	35	-	05
PG_2	50	10	30	-	10
PG_3	50	10	25	-	15
PG_4	50	10	20	-	20
PMG_1	50	10	30	05	05
PMG_2	50	10	20	10	10
PMG_3	50	10	20	05	15
PMG_4	50	10	20	15	05

PM- Pancakes with mushroom powder; PG- Pancakes with garden cress seed powder;
PMG- Pancakes with mushroom powder and garden cress seed powder combination.

Table 3: Mean sensory scores for evaluation of rice based pancakes with underutilized food ingredients

Treatment	Colour	Appearance	Taste	Texture	Flavour	Overall acceptability
With mushroom powder						
*Control	7.8 ± 0.42^{a}	7.7 ± 0.48^{a}	7.7 ± 0.48^{a}	7.9 ± 0.32^{a}	7.6 ± 0.52^{a}	7.8 ± 0.42^{a}
PM_1	7.4 ± 0.52^{ab}	7.5 ± 0.53^{a}	7.3 ± 0.68^{ab}	7.6 ± 0.52^{a}	7.2 ± 0.42^{ab}	7.6 ± 0.52^{ab}
PM_2	7.4 ± 0.52^{ab}	7.6 ± 0.52^{a}	7.1 ± 0.88^{abc}	7.5 ± 0.53^{a}	7.0 ± 0.47^{b}	7.5 ± 0.53^{ab}
PM_3	7.4 ± 0.52^{ab}	7.3 ± 0.82^{a}	6.9 ± 0.57^{bc}	7.3 ± 0.82^{a}	6.7 ± 0.82^{b}	7.1 ± 0.74^{bc}
PM_4	7.1 ± 0.32^{b}	7.1 ± 0.74^{a}	6.6 ± 0.70^{c}	7.1 ± 0.74^{a}	6.8 ± 0.62^{b}	6.7 ± 1.06^{c}
$CD_{(0.05)}$	0.40	NS	0.61	NS	0.53	0.63
With garden cress seed powder						
PG_1	7.4 ± 0.52^{ab}	7.5 ± 0.53^{a}	7.4 ± 0.52^{ab}	7.5 ± 0.53^{ab}	6.9 ± 0.57^{bc}	7.6 ± 0.52^{ab}
PG_2	7.5 ± 0.53^{a}	7.3 ± 0.68^{ab}	7.1 ± 0.57^{abc}	7.4 ± 0.70^{ab}	7.1 ± 0.70^{ab}	7.1 ± 0.74^{bc}
PG_3	6.7 ± 0.68^{c}	6.8 ± 0.79^{b}	7.1 ± 0.57^{abc}	7.2 ± 0.63^{b}	6.5 ± 0.63^{cd}	6.5 ± 0.97^{cd}
PG_4	6.9 ± 0.88^{bc}	6.7 ± 0.82^{b}	6.6 ± 0.70^{c}	7.0 ± 0.82^{b}	6.3 ± 0.82^{d}	6.2 ± 0.92^{d}
$CD_{(0.05)}$	0.56	0.61	0.57	0.56	0.52	0.67
With mushroom powder and garden cress seed powder						
PMG_1	7.4 ± 0.52^{ab}	7.6 ± 0.52^{a}	7.3 ± 0.48^{ab}	7.1 ± 0.74^{bc}	7.3 ± 0.68^{ab}	7.4 ± 0.52^{ab}
PMG_2	7.2 ± 0.42^{bc}	7.3 ± 0.48^{ab}	6.9 ± 0.57^{bc}	7.5 ± 0.53^{ab}	6.9 ± 0.57^{bc}	7.6 ± 0.52^{ab}
PMG_3	7.2 ± 0.42^{bc}	7.0 ± 0.67^{bc}	6.7 ± 0.82^{c}	6.9 ± 0.74^{cd}	6.7 ± 0.68^{c}	6.8 ± 0.63^{c}
PMG_4	6.9 ± 0.74^{c}	6.7 ± 0.68^{c}	6.6 ± 0.84^{c}	6.7 ± 0.82^{d}	6.7 ± 0.68^{c}	7.1 ± 0.74^{bc}
$CD_{(0.05)}$	0.49	0.52	0.59	0.58	0.56	0.52

*Comparison for all proportion

Table 4: Nutritional composition of the best variations of nutri-dense pancake mixes.

Ingredients	Moisture (%)	Energy (Kcal/100 g)	Crude protein (g/100 g)	Crude fat (g/ 100 g)	Crude fibre (g/100 g)	Total carbohydrate (g/100 g)	Calcium (mg/100g)	Iron (mg/100g)
Control	11.06 ± 0.20^{a}	359.79 ± 1.31^{b}	12.80 ± 0.03^{d}	1.24 ± 0.12^{d}	1.59 ± 0.03^{d}	80.02 ± 0.39^{a}	15.64 ± 0.56^{d}	1.38 ± 0.20^{d}
PM_1	9.67 ± 0.03^{b}	351.12 ± 0.42^{c}	16.93 ± 0.03^{a}	4.79 ± 0.003^{c}	2.76 ± 0.02^{b}	66.93 ± 0.08^{b}	63.37 ± 0.65^{c}	3.01 ± 0.11^{c}
PG_1	9.38 ± 0.02^{c}	315.76 ± 0.87^{d}	16.54 ± 0.03^{b}	6.04 ± 0.003^{b}	2.52 ± 0.03^{c}	66.61 ± 0.04^{b}	95.82 ± 0.17^{b}	9.03 ± 0.07^{b}
PMG_2	9.49 ± 0.02^{bc}	255.39 ± 7.65^{e}	15.48 ± 0.03^{c}	6.69 ± 0.01^{a}	3.48 ± 0.02^{a}	62.47 ± 0.08^{c}	111.50 ± 1.32^{a}	16.4 ± 0.33^{a}
$CD_{(0.05)}$	0.19	2.46	0.054	0.11	0.05	0.39	1.49	0.38

Table 5: Functional properties of the best variations of nutri-dense pancake mixes

Treatment	Bulk density (g/ml)	Water absorption capacity (%)	Oil absorption capacity (%)
Control	1.54 ± 0.002^{b}	67.57 ± 0.40^{d}	87.23 ± 0.25^{d}
PM_1	1.54 ± 0.001^{b}	150.27 ± 0.40^{c}	109.17 ± 0.25^{b}
PG_1	1.66 ± 0.002^{a}	138.20 ± 0.75^{b}	99.57 ± 0.59^{c}
PMG_2	1.70 ± 0.002^{a}	160.07 ± 0.55^{a}	112.27 ± 0.25^{a}
$CD_{(0.05)}$	0.003	1.03	0.69

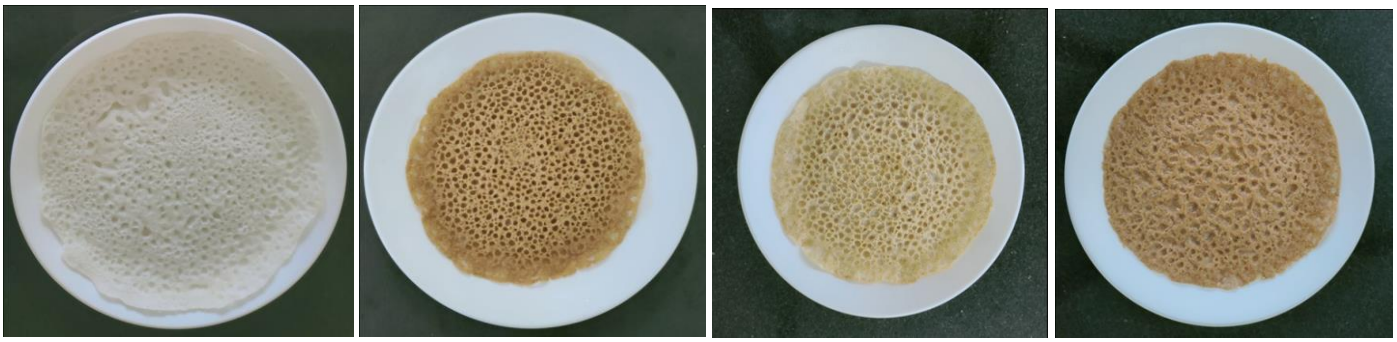
Table 6: Physical parameters of the best variations of nutri-dense pancakes

Treatment	Weight per pancake (g)	Diameter (cm)	Thickness (mm)	Spread ratio
Control	53.00 ± 2.29[a]	12.27 ± 0.68[a]	34.00 ± 1.00[a]	3.61 ± 0.28[a]
PM_1	53.67 ± 0.76[a]	12.17 ± 0.58[a]	36.67 ± 1.15[a]	3.32 ± 0.23[a]
PG1	53.17 ± 2.84[a]	12.33 ± 0.47[a]	38.67 ± 1.53[a]	3.19 ± 0.21[a]
PMG2	53.83 ± 1.61[a]	12.23 ± 0.64[a]	40.00 ± 1.00[a]	3.05± 0.23[a]
$CD_{(0.05)}$	NS	NS	NS	NS

Table 7: Colour measurements in terms of Hunter Lab values of the best variations from developed nutri-dense pancakes

Treatment	L*	a*	b*	Hue (tanθ=b*/a*)	Chroma
Control	80.92 ± 0.28[a]	0.70 ± 0.04[d]	9.45 ± 0.23[c]	85.76 ± 7.61[a]	90.00 ± 1.61[c]
PM_1	44.29 ± 0.54[c]	5.55 ± 0.09[a]	2.51 ± 0.17[d]	24.33 ± 0.45[c]	11.85 ± 0.19[d]
PG_1	65.90 ± 0.31[b]	1.55 ± 0.15[c]	17.1 ± 0.48[a]	84.82 ± 4.23[a]	293.96 ± 3.46[a]
PMG_2	39.12 ± 0.64[d]	3.39 ± 0.27[b]	10.40 ± 0.54[b]	71.95 ± 0.28[b]	111.55 ± 0.39[b]
$CD_{(0.05)}$	2.32	0.32	1.33	0.33	1.74

In Hunter Colour Lab L* indicates lightness or darkness (0= black, 100= white),
a* indicates the hue on the green-to-red axis (negative value= greenness, positive value= redness),
b* indicates the hue on the blue-to-yellow axis (negative value= blueness, positive value= yellowness),
Chroma is the intensity of the hue [$c^*= (a^{*2}+b^{*2})1/2$],
Hue angle (H°) is the angle in the colour wheel of 360° ($H°=\tan^1 b^*/a^*$)



Control **PM_1** **PG_1** **PMG_2**

Fig 1: Colour analysis of the best variations from developed nutri-dense pancakes

Conclusion

It can be concluded from the present investigation that the developed nutri-dense pancake mix with nutrient rich ingredients such as soybean seed flour, amaranth seed flour, mushroom powder and garden cress seed powder with rice flour could improve the nutritional value of the product. Consumption of traditional pancake (*pitha*) containing these ingredients can help in achieving a good nutritional status of human beings and can be popularized as a nutritious food in the form of snack.

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