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Formulation of Nutri-Dense Pancake Mixes and its Storage Study

Taposhi Thakuria* and Luna Dutta Baruah

Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat-785013, Assam, India

**Corresponding author*

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A B S T R A C T

Formulation of nutri-dense pancake mix was studied for enhancing the nutritive value of the traditionally prepared rice based pancake in Assam. Twelve formulations of pancake mixes were developed substituting 50 per cent rice flour with soybean seed flour, amaranth seed flour, mushroom powder and garden cress seed powder in three different sets. The developed formulations were subjected to sensory evaluation and the most acceptable three variations were selected one from each set along with a control (rice flour alone) for further analysis of physical parameters, functional properties and storage study. Data obtained were subjected to completely randomized design (CRD). The moisture content, free fatty acid and peroxide value increased significantly from day 15 to day 30. The moisture content, free fatty acid and peroxide value were almost found to be non-significant due to different pancake mixes. At 15th day, PG_1 scored highest in colour, taste, texture and overall acceptability while PM_1 scored highest in appearance and flavour. The mean scores of microbial study of the nutri-dense pancake mixes stored in laminated aluminium foil zip lock pouches at refrigerated temperature of 4ºC changed significantly from 0th day to 30th day. It was observed that at day 30, the total bacterial count exceeded the acceptable limit of ≤100000 cfu/g as per WHO guideline 1998 signaling the end of shelf-life of the pancake mixes by day 15.

Introduction

Nutrition plays a very important role in prevention and treatment of many nutrition related diseases in human beings (Kapoor, 2016). In a survey on Indian diet, Sharma *et al.*, (2020) reported that the diet pattern of India mainly focuses on the consumption of calorie rich sources such as cereals and not enough protein or other micro-nutrient rich sources which has led to an increase in the demand for nutrient dense diet or nutrient dense products. As such, it is pertinent to develop products which are normally consumed in day-to-day lives are to be enhanced by incorporating nutrient rich ingredients.

Rice is the most commonly consumed cereal grain in Assam as compared to other cereals and a wide variety of rice based dietary snacks are prepared and consumed like *til pitha*, *tel pitha*, *ghila pitha*, *sutuli pitha* and many other such preparations either by

frying in oil, roasting over a slow fire or rolling over a hot plate/pan (Sarmah *et al.*, 2019). 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).

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). This snack can be made nutrient dense by formulating it with ingredients which are rich sources of macro-nutrient and micro-nutrients.

Combination of rice flour with an appropriate proportion of pulses, oilseeds and pseudo-cereal flours complements well for preparing balanced mixes of high biological value. Soybean is a high value nutritive crop and has been used in a variety of foods to mitigate the shortage of protein (Sharma *et al.*, 2016). Amaranth is a pseudo-cereal and the grains contain nearly twice the amount of lysine content of wheat protein and thrice the content of maize protein (Raghuvanshi and Bhati, 2019).

A versatile food item mushroom which has been appreciated for its texture, flavour as well as for its nutritional attributes (Deepalakshmi and Mirunalini, 2014). Garden cress commonly known as *Chandrasur* is used for fortification of other food items (Singh *et al.*, 2015).

All these wholesome nutritious seeds like soybean, amaranth 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 reducing the disease burden in our population (Rajamani and Rajeswari, 2016).

Considering the above facts, the research study was undertaken to develop a rice based nutri-dense pancake mix by partially substituting rice flour with flours of amaranth, soybean, mushroom and garden cress seed for sensory evaluation and shelf life in storage.

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).

In the present study, an intermediate amylose containing high yielding rice variety, '*Mulagabharu*', with 20 ± 1.08 mg (Chatterjee and Das, 2019) 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) 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). 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).

All the flours were stored at refrigerated temperature of 4ºC. 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), total minerals, energy and carbohydrates by Gopalan *et al.*, (2000) and total starch by Verma and Srivastav (2017) 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 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 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) methods along with a control using only rice flour.

Preparation of pancake batter

Pancakes were prepared following the method as reported by Akshata *et al.*, (2019) with slight modifications. All the flours and powders were sieved twice with 60 mesh size (0.25 mm) and mixed together as per formulations mentioned. Water (220 ml) was added to the mix along with common salt to taste and stirred continuously to avoid any lump formation.

Vegetable oil (1ml) was added to the batter and mixed thoroughly. On a non-stick medium heated pan, 1 ml of oil was brushed and a ladle of batter (60 ml) was poured and shallow fried for one minute on both sides by turning at every 30 seconds. Prepared pancakes were evaluated for acceptability with the help of a panel for sensory evaluation.

Sensory evaluation

The organoleptic evaluation of the developed nutri-dense pancakes were done in the sensory evaluation laboratory of the Department of Food Science and Nutrition, Assam Agricultural University, Jorhat, Assam, with the help of a score card consisting of a table utilizing the Hedonic ratings of nine point scale (Peryam and Pilgrim, 1957) from like extremely to dislike extremely. The qualities taken into consideration for the evaluation were colour, appearance, taste, texture, flavour, crispness and over all acceptability.

Shelf life study

The developed nutri-dense pancake mixes were stored for a period of 30 days in laminated aluminium foil zip lock pouches at refrigerated temperature of 4ºC. The shelf life study was done in terms of moisture analysis, free fatty acid and peroxide content using A.O.A.C. (1975) method at an interval of 15 days.

Microbial analysis

The microbial safety of the products were determined at an interval of 15 days for a period of 30 days by assaying the total viable count in the developed product mixes using Potato Dextrose Agar (PDA) media.

Statistical analysis

All the data of the experiment were statistically analysed and methods applied for the statistical analysis of the recorded data were mean which is sum of all the observations (ΣX_i) divided by the number of observations (N) $\{X= \Sigma X_i / N\}$, standard deviation which is the positive square root of the arithmetic mean of the squares of deviations of the given values from arithmetic mean. If the standard deviation of a sample was smaller than the population, then it was measured by using the formula, standard deviation $(\sigma) = \Sigma (X_i - X) / N$, where, X_i = observations, X= Arithmetic mean and N=Number of observations. Data were further subjected to completely randomised design to determine significant difference between formulation means by using SPSS software.

Results and Discussion

Physical properties

The physical parameters *viz.*weight per pancake, diameter, thickness and spread ratio of pancakes using the best variation of mixes are presented in Table 4. Irrespective of the variation in mixes, all the physical parameters were found to be non-significant.

Functional properties

Functional properties such as bulk density (g/ml), water absorption capacity (%) and oil absorption capacity (%) of the best variations of pancake mixes are presented in Table 5. Bulk density was found to be highest in PMG_2 followed by PG_1. However, there was no significant difference between control and PM_1 as well as between PG_1 and PMG_2. Bulk density value increased with increasing incorporation of more variations of flours and increasing moisture content resulted in higher bulk density of PMG_2 pancake mix which corroborate the findings of Sneha and Haripriya (2018) and Rajshri and Haripriya (2018).

Water absorption capacity (%) was found to be 67.57±0.40 per cent in control, 150.27±0.40 per cent in PM_1, 138.20±0.75 per cent in PG_1 and 160.07±0.55 per cent in PMG_2. Variation among the pancake mixes was due to different protein concentration, their degree of interaction with water and conformational characteristics (Butt and Batool, 2010). Higher water absorption capacity value in PMG_2 may be attributed to many hydrophilic components in the mixes such as carbohydrate in the form of rice and amaranth flour and proteins in mushroom and soybean flour which have high affinity for water molecules (Sreerama *et al.,* 2012).

Highest oil absorption capacity value was found in PMG_2 due to presence of higher amount of garden cress seed flour which contains higher amount of fat as compared to all other flours in the mix as postulated by Chandra *et al.,* (2015). Another possible reason 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).

Shelf life study

The best variations taken from the developed nutri-dense pancake mixes across storage at refrigerated temperature of 4ºC in respect of change in moisture, free fatty acid and peroxide value have been presented in Table 6. The control treatment recorded higher moisture content over the other pancake mixes. Irrespective of the variations of pancake mixes, the moisture content increased with increase in number of days in storage.

However, no significant variations in the moisture content of all the treatments were observed till day 15 which was similar with the results of Muttagi and Ravindra (2020), thereafter, a significant difference in all the pancake mixes from day 15 to day 30 was noticed. The increase in moisture content may be due to storage environment *via.,* temperature, relative humidity as well as packaging material (Nagi *et al.,* 2012).

Similarly, significant increase in free fatty acid content was observed with increase in number of storage days from 0 day to 30 days. The increase was due to incorporation of rice flour, amaranth flour and mushroom flour which increased the moisture content that promoted fat hydrolysis during storage as reported by Singh *et al.,* (2000), while examining free fatty acid content of soy-fortified biscuits across storage.

Analysis of peroxide value of the treatments (Table 6) showed that there was an increase in values with increase in storage period. However, no significant variations were found in the treatment with 5 per cent garden cress seed flour incorporation (PG_1) and the values were found to be within the A.O.A.C. specification, i.e., less than 10 $meqO_2/kg$. The results corroborate the findings of Gordon (2001).

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 different 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 proportions

Table.4 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]
PG_1	53.17 ± 2.84[a]	12.33 ± 0.47[a]	38.67 ± 1.53[a]	3.19 ± 0.21[a]
PMG_2	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.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 Change in moisture content (g/100g), free fatty acid (%) and peroxide value ($meqO_2$/kg) across storage of the best variations from developed nutri-dense pancake mixes

Treatment	Storage days			$CD_{(0.05)}$
	0^{th} day	**15^{th} day**	**30^{th} day**	
Moisture content (g/100g)				
Control	11.06 ± 0.20[b]	11.10 ± 0.06[b]	12.17 ± 0.01[a]	1.92
PM_1	9.67 ± 0.03[b]	9.80 ± 0.07[b]	10.11 ± 0.08[a]	0.23
PG_1	9.38 ± 0.05[b]	9.43 ± 0.07[b]	10.00 ± 0.13[a]	0.02
PMG_2	9.49 ± 0.02[b]	9.53 ± 0.05[b]	10.07 ± 0.07[a]	0.33
Free fatty acid content (%)				
Control	0.49 ± 0.20[b]	0.68 ± 0.06[b]	1.85 ± 0.01[a]	0.19
PM_1	0.87 ± 0.03[b]	0.95 ± 0.09[b]	1.21 ± 0.07[a]	0.33
PG_1	0.47 ± 0.03[b]	0.56 ± 0.07[b]	1.00 ± 0.01[a]	0.03
PMG_2	0.68 ± 0.02[b]	0.79 ± 0.05[b]	10.07 ± 0.04[a]	0.23
Peroxide value ($meqO_2$/kg)				
Control	1.60 ± 0.04[b]	1.71 ± 0.01[b]	2.02 ± 0.03[a]	0.02
PM_1	1.55 ± 0.03[b]	1.70 ± 0.10[b]	1.99 ± 0.01[a]	0.12
PG_1	1.48 ± 0.02[a]	1.57 ± 0.01[a]	1.68 ± 0.15[a]	NS
PMG_2	1.50 ± 0.01[b]	1.76 ± 0.12[b]	1.95 ± 0.15[a]	0.02

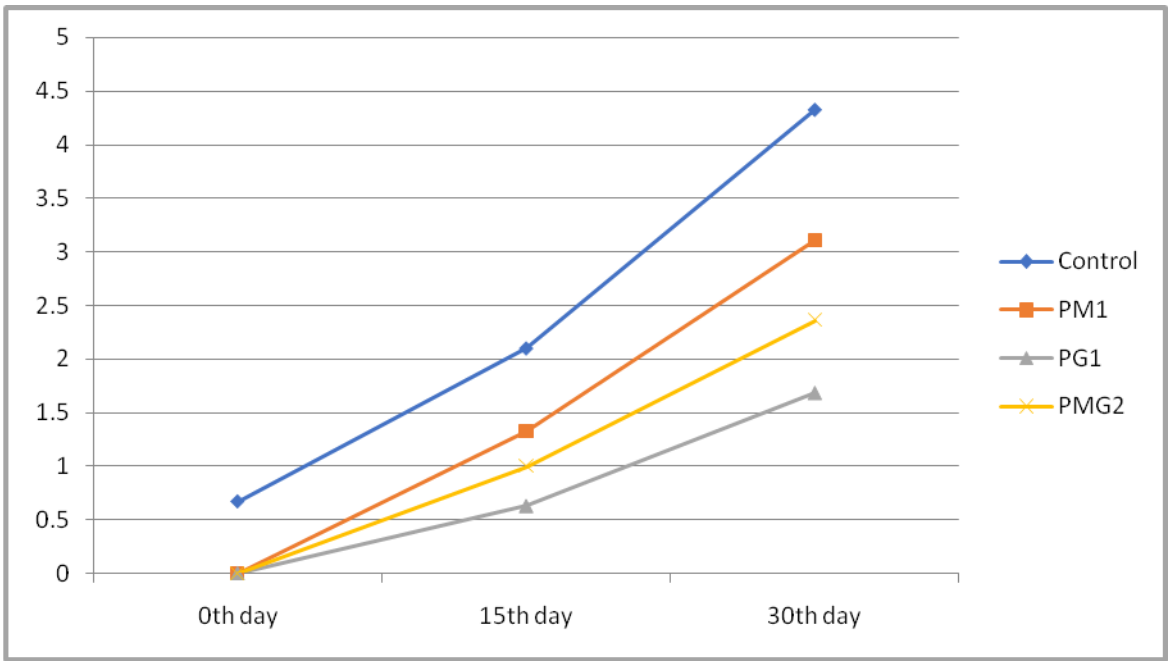
Table.7 Total bacterial load (Bacteria X 10^5 cfu/g) of the best variations from developed nutri-dense pancake mixes

Treatment	Storage days			$CD_{(0.05)}$
	0^{th} day	**15^{th} day**	**30^{th} day**	
Control	0.67 ± 0.58[b]	2.10 ± 1.00[b]	4.32 ± 1.15[a]	1.88
PM_1	-	2.10 ± 1.00[b]	3.11 ± 0.58[a]	1.33
PG_1	-	0.63 ± 0.57[b]	1.69 ± 0.53[a]	0.94
PMG_2	-	1.00 ± 0.00[a]	2.36 ± 0.49[a]	0.67

Table.8 Sensory evaluation of the best variations from developed nutri-dense pancake mixes

Quality attributes						
Storage period (Days)	**Colour**	**Appearance**	**Taste**	**Texture**	**Flavour**	**Overall acceptability**
Control						
0	4.8 ± 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}
15	6.7 ± 0.13^{a}	6.2 ± 0.11^{a}	6.0 ± 0.32^{a}	5.9 ± 0.27^{b}	5.81 ± 0.33^{b}	5.6 ± 0.01^{a}
$CD_{(0.05)}$	NS	NS	NS	1.13	0.11	NS
PM_1						
0	7.4 ± 0.52^{a}	7.5 ± 0.53^{a}	7.3 ± 0.68^{a}	7.6 ± 0.52^{a}	7.2 ± 0.42^{a}	7.6 ± 0.52^{a}
15	6.9 ± 0.12^{a}	7.0 ± 0.22^{a}	6.4 ± 0.68^{a}	6.9 ± 0.12^{a}	6.8 ± 0.12^{a}	6.0 ± 0.30^{a}
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS
PG_1						
0	7.4 ± 0.52^{a}	7.6 ± 0.52^{a}	7.1 ± 0.88^{a}	7.5 ± 0.53^{a}	7.0 ± 0.47^{a}	7.5 ± 0.53^{a}
15	7.0 ± 0.13^{a}	6.8 ± 0.21^{a}	6.7 ± 0.32^{a}	7.1 ± 0.17^{a}	6.6 ± 0.33^{a}	6.9 ± 0.02^{a}
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS
PMG_2						
0	7.4 ± 0.52^{a}	7.3 ± 0.82^{a}	6.9 ± 0.57^{a}	7.3 ± 0.82^{a}	6.7 ± 0.82^{a}	7.1 ± 0.74^{a}
15	6.0 ± 0.12^{a}	6.7 ± 0.22^{a}	6.1 ± 0.68^{a}	6.7 ± 0.13^{a}	5.6 ± 0.11^{b}	6.5 ± 0.13^{a}
$CD_{(0.05)}$	NS	NS	NS	NS	0.07	NS

Fig.1 Total Bacterial Load (Bacteria X 10^5cfu/g) of the Best Variations from the Developed Nutri-Dense Pancake Mixes Across Storage



Microbial study

Data presented in Table 7 revealed that the mean scores of microbial study of the nutri-dense pancake mixes stored in laminated aluminium foil zip lock pouches at refrigerated temperature of 4ºC changed significantly from 0 day to 30 days.

There was no bacterial load on the first day of storage in all the treatments except in control, i.e., $(0.67\pm0.58)\times10^5$ cfu/g which increased to $(2.10\pm1.00)\times10^5$ cfu/g in 15 days and further increased to $(4.33\pm1.15)\times10^5$ cfu/g in 30 days.

Among all the treatments, bacterial load was observed highest on 15th day in PM_1 followed by PMG_2 and PG_1 which were further increased. It was observed that the total bacterial counts exceeded the acceptable limit of ≤100000 cfu/g as per WHO guideline 1998 at day 30 signalling the end of shelf-life of the product by day15 (Fig.1). The possible reason for low shelf life of the mixes may be due to higher moisture content of the mixes as reported by Sandulachi (2012) as well as Rezaei and Vander Gheynst (2010).

Sensory evaluation

All the sensory attributes (Table 8) revealed that the mean scores of the pancake mixes did not change significantly except for flavour and texture in control and PMG_2. At 15th day, PG_1 scored highest in colour, taste, texture and overall acceptability, while PM_1 scored highest in appearance and flavour. The threshold level of acceptability and microbial limit exceeded on 30th day for which sensory evaluation was not done on 30th day of storage period.

The developed nutri-dense pancake mix with nutrient dense ingredients like soybean seed flour, amaranth seed flour, mushroom powder and garden cress seed powder in different proportions in the traditional rice flour based pancake mix has a good nutritional profile. Consumption of items containing these ingredients can help in achieving a good nutritional status among the population. The study showed that the nutri-dense pancake mixes had a shelf life of 15 days which might get increased by reducing the moisture content leading to decrease in bacterial or other microbial load.

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