INCORPORATION, EVALUATION AND STANDARDIZATION OF VARIOUS FOOD PRODUCTS USING RESISTANT STARCH RICH BANANA FLOUR AND POTATO FLOUR

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Abstract : Resistant Starch (RS) is defined as "the sum of starch and products of starch degradation which are not absorbed in the small intestine of healthy individuals". Many studies suggested that RS intake favors human health by decreasing postprandial glycemic and insulinemic responses, reducing plasma cholesterol and triglyceride concentrations, increasing satiety, decreasing fat storage and improving the growth of intestinal beneficial bacteria. So RS rich sources of food such as unripe banana and Potato were selected and purchased as it was of cheaper cost. Both were processed to flour separately and incorporated in various food products which are rich in starch and not rich in RS. They were incorporated at 25%, 50% and 75% substitution respectively to find the overall acceptability. The conclusion arrived, 25% substitution was found to be highly acceptable and considered to be the standardized one. The nutrient calculation done states that the incorporated food products show increased RS content. The 25% substitution of the flour for a recipe averages to be 7 rupees and can be used by the common people also. The shelf life of both the flour was found to be 60 days as it exceeds the safer limit of consumption more than 60 days. Altogether, RS possess positive health properties as a healthy food component.

***IndexTerms* – Resistant starch, unripe banana, potato, food products.**

1. INTRODUCTION

Today's world has been adapted to a system of consumption of foods which has several adverse effects on human health. India, a diverse country with many states is passing through an epidemiological health transition due to high rates of globalization. It had seriously affected one's eating habits and enforced many people to consume fancy and high calorie fast foods, popularly known as Junk foods[1]. It leads to an altered lifestyle with unhealthy food consumption, decreased physical activity and a shift in the disease spectrum from communicable to non-communicable diseases such as constipation, obesity, type II diabetes and heart diseases [2, 3].

Resistant Starch, the term was first coined by Englyst and others in 1982, is the starch which is not digested in the small intestine, reaches the large intestine and may be more or less fermented by the gut microflora [4]. Many studies suggested that RS intake decreases the risk of Non-communicable diseases [3, 5]. RS is further divided into five groups named RS1, RS2, RS3, RS4 and RS5. RS1 includes whole or partially milled grains and seeds, legumes and pasta. RS2 were ungelatinized resistant granules slowly hydrolyzed by α-amylase. It includes raw potatoes, green bananas, some legumes, high-amylose corn. RS3 were retrograded starch like cooked and cooled potatoes with prolonged and/or repeated moist heat treatment. RS4 were chemically modified starches. RS5 were amylose-lipid complexes which include high amylose content [6, 7, 8, 9]. Among all the sources of RS, we chose RS2 (green banana and potato) for the further study as it was available at cheaper cost.

Bananas are the fourth most important food crop after wheat, rice, and maize. India is the world's leading producer of banana accounting for nearly 25.7% of the total output. The top banana producing states in India are Tamil Nadu (5136.2 metric ton), Gujarat (4523.4 metric ton), Maharashtra (3600 metric ton) and Andhra Pradesh (3242.7 metric ton), among others. The primary product in the market is 'chips' and 'candy' made of banana. Banana flour is the most widely used raw material for value addition in the food products [10, 11]. Unripe banana is considered the resistant starch richest non-processed food [12].

Potato (*Solanum tuberosum)*, the most widely planted vegetable worldwide is one of the staples of human diet. India is one of the largest producers of potatoes. The major potato producing states are Uttar Pradesh, Bihar, West Bengal, Gujarat, Madhya Pradesh, Punjab and Haryana. The production estimation in year 2017-2018 was approximately 45000 tones (Ministry of Agriculture and Farmers welfare). The commercial products which are produced from potatoes are fried items and potato flour. It has various culinary applications in the food industry. The flour obtained from potato is now becoming a major business and it is easy to store and circulate [13]. Starches from tubers such as potatoes are highly resistant to digestion [14]. With reference to the above findings a study was planned with following objectives:

- To prepare Banana Flour (BF) and Potato Flour (PF).
- To incorporate Banana flour and Potato flour in commonly consumed food products.
- To standardize the products using sensory evaluation.
- To detect the shelf life of BF and PF.

2. LITERATURE SURVEY

Several studies have suggested that consumption of unripe bananas confers beneficial effects for human health, due to its high resistant starch content, which ranges between 47% to 57% [12]. The fermentation of resistant starch results in a healthier gut demonstrated by increased amounts of short-chain fatty acids, an apparent positive change in the microbiota and increased gene expression for gene products involved in normal healthy proliferation and apoptosis of potential cancer cells. Consumption of RS was associated with reduced abdominal fat and improved insulin sensitivity. The increase of serum glucagon-like peptide 1(GLP-

1) play a role in promoting the above said health benefits. The other mechanisms observed were increased intestinal gluconeogenesis or increased adiponectin which is involved in the improved insulin sensitivity [15].

3. MATERIALS AND METHODS

Raw banana flour from green banana is especially used for its functional food purposes. Potato flour incorporations into food products are also becoming functionally adequate. Both raw banana and potato are rich in resistant starch and has more medicinal value. They were incorporated in various food products as its flour adds value to the food. And also these raw materials are easily available in our locality at cheaper cost. The probability of purchasing these products is also high. So, these two raw materials were selected for research purpose.

The Raw bananas of 'Monthan' variety and Potatoes of larger size were procured from the local market to make raw banana flour and potato flour respectively. Other ingredients such as wheat flour, refined wheat flour and rice flour were purchased from the local market and stored for the research use. Perishable items like vegetables were obtained from the market when needed to make the desired food products.

3.1 Preparation of Banana Flour (BF)

About 4670g of fresh raw bananas was procured and peeled and the skin was discarded. The peeled bananas was washed, thinly sliced and soaked in lemon water for 15 minutes to prevent the browning reaction. Then they were subjected to sun drying for 2 days of temperature ranging from 28°C at maximum to 25°C at minimum. After drying, the bananas were converted to 1008g (21.58%). (ie) ¾th portion (peeled fresh bananas) was reduced to ¼th portion (dried bananas) in its weight which is a concentrated source of nutrients and Resistant starch. The dried bananas was then milled to fine flour by a milling machine and packed in an air tight container for further study.

3.2 Preparation of Potato Flour (PF)

About 7300g of fresh potatoes was procured and washed with water. After peeling, the skin was discarded. The peeled potatoes was thinly sliced and soaked in lemon water for 15 minutes to prevent the browning reaction. Blanching was done for 5 minutes in boiling water. Then they were subjected to sun drying for three days with temperature ranging from 28°C at maximum to 24°C at minimum. (A color change from white to black was noted while drying when it was allowed to dry without blanching). After drying, the potatoes were converted to 1000g (13.69%). Then it was milled to fine flour by a milling machine and packed in an air tight container for further study.

3.3 Incorporation of Banana flour and Potato flour into various food products

The food products which are rich in starch (easily broken down by the digestive enzymes) and not rich in resistant starch such as Roti, Dosai, Puttu, Cake, Biscuit, Bread, Noodle, Idiappam, Kozhukattai and Health mix were selected for the study. These food products were made resistant starch rich by incorporating Banana Flour and Potato Flour. They were incorporated in various proportions to find the acceptability.

Table 1: Different proportions of Banana flour, Potato flour in the food products [Variation - 1 (25% substitution), Variation - 2 (50% substitution) and Variation - 3 (75% substitution)]

Foods	Standard	Variation - 1	Variation - 2	Variation - 3
Roti, Bread, Noodle	WF – 100g	WF – 75g BF – 12.5g PF – 12.5g	WF – 50g BF – 25g PF – 25g	WF – 25g BF – 37.5g PF – 37.5g
Puttu, Idiappam	RF – 100g	RF – 75g BF – 12.5g PF – 12.5g	RF – 50g BF – 25g PF – 25g	RF – 25g BF – 37.5g PF – 37.5g
Biscuit, Cake	RWF – 100g	RWF – 75g BF – 12.5g PF – 12.5g	RWF – 50g BF – 25g PF – 25g	RWF – 25g BF – 37.5g PF – 37.5g
Kozhukattai	RR – 100g	RR – 75g BF – 12.5g PF – 12.5g	RR – 50g BF – 25g PF – 25g	RR – 25g BF – 37.5g PF – 37.5g
Dosai	PR – 80g UD – 20g	PR – 60g UD – 20g BF – 10g PF – 10g	PR – 40g UD – 20g BF – 20g PF – 20g	PR – 20g UD – 20g BF – 30g PF – 30g
Health mix	STD – 20g	STD – 15g BF – 2.5g PF – 2.5g	STD – 10g BF – 5g PF – 5g	STD – 5g BF – 7.5g PF – 7.5g

[WF – Wheat Flour, BF – Banana Flour, PF – Potato Flour, RF – Rice Flour, RWF – Refined Wheat Flour, RR – Raw Rice, PR – Parboiled Rice, UD – Urad Dhal, STD – Standard Health mix].

3.3.1 Experimental plan : Roti

The first step in the planning of Roti involves the preparation of composite flour (Wheat flour, Banana flour, Potato flour) from Table – 1. Now the flour mixture was mixed with 1g of salt, 2g of sugar, and 10ml of oil and kneaded to soft dough by using water. After the dough was kept aside for 30 minutes, it was made into balls, rolled to thin sheets and cooked till puffy.

3.3.2 Experimental plan : Bread

It involves the composite flour preparation from Table – 1. At the same time, yeast was set up by mixing 1tsp of active dry yeast with 1/2 Tbsp of sugar and warm water (till it foams up). The ¾th portion of the flour and salt (1/2 tsp) was mixed and kneaded to a soft dough using yeast water and if needed additional water. Later 1 Tbsp of oil was added, kneaded and kept in a bowl and covered tightly. It was allowed for fermentation. After 1 hour, the remaining 1/4th of the flour was mixed, kneaded and kept in a loaf pan for second fermentation. The oven was preheated by 190°C for 15 mins. After second fermentation, the dough was baked in the preheated oven for 35 to 40 min till its golden brown on top.

3.3.3 Experimental plan : Noodle

To make the noodle, the proximate flour was prepared using Table – 1 and mixed with ¼ tsp of salt and water to make dough. It was then rolled to thin sheets and passed through the extruder to get the noodle. After the noodle was shallow dried completely it was then cooked in water with salt added and few drops of oil sprinkled. Later it was made to eat by sautéing the prepared noodle with 5g of garlic, 5g of ginger, 20g of carrot, 20g of capsicum, ½ tsp of chilly powder, ½ tsp of coriander powder and salt.

3.3.4 Experimental plan : Puttu

The Puttu making first includes the composite flour preparation with reference to Table –1 and mixed with 2 Tbsp of sugar and ½ tsp of salt. Gradually water was sprinkled to make it moistened and coarse crumbs were formed by mixing. It was then cooked by steaming in puttu kolal by placing the prepared mixture and grated coconut in that by layers.

3.3.5 Experimental plan : Idiappam

The flour mixture was prepared with the help of Table – 1 and mixed with salt (1 tsp) and hot water to make soft dough. Then the prepared dough was passed through string hopper in the idli plates and steam cooked for 8 to 10 minutes. After it gets cooked, it was made eatable with coconut, sugar and milk.

3.3.6 Experimental plan : Biscuit

The proximate flour was prepared with reference to Table – 1 and mixed with 30g of butter and a pinch of salt by fork. Milk (30ml), sugar (50g) and ¼ tsp of baking soda were taken in a sauce pan and brought to boiling and poured to the flour mixture. It was then made to soft dough. The dough was rolled to thin sheets and cut using a round cutter. The oven was preheated to 160°C and cut pieces were baked for 8 to 10 mins.

3.3.7 Experimental plan : Cake

The cake preparation first involves the making of composite flour using the instructions in Table – 1. Simultaneously butter and powdered sugar (100g each) was beaten till creamy. The creamy mixture was then added with egg (1 no.), flour gradually and salt (a pinch). These ingredients were folded gently to combine. The oven was preheated to 180°C. The prepared batter was poured to the greased cake pan and baked for 20-25 minutes.

3.3.8 Experimental plan : Kozhukattai

The making of Kozhukattai first involves the batter preparation. For that, raw rice was soaked for a while and grounded coarsely. It was then mixed with banana flour and potato according to the instructions using Table – 1 for all the variations. After the pan gets heated, oil (1 Tbsp) and the spices (1 tsp mustard, 1 tsp black gram, 2 no. red chillies and a sprig of curry leaves) were added and combined with the flour mixture with little sugar (5g) for taste. It was then made into thick balls and steam cooked for 15 minutes.

3.3.9 Experimental plan : Dosai

The Dosai preparation involves the batter arrangements. For that, parboiled rice and urad dhal were soaked separately for 2 hours and grounded to a smooth paste. Then ¼ tsp of salt was added, mixed well and set aside for fermentation (about 6 hours). After it gets fermented, the flour combination was done with reference to Table – 1. To make Dosai, the pan was heated first and greased with oil. The batter was poured using a ladle on the pan. Few drops of oil were sprinkled and allowed to cook completely by flipping it.

3.3.10 Experimental plan : Health mix

The Banana flour and Potato flour were mixed with the Standard health mix and made consumable by cooking with water for gelatinization. It was then mixed with boiled milk and sugar and made consumable. [Standard health mix : Ragi–10g,

Bajra-10g, Corn-10g, Jowar-10g, Barley-10g, Wheat-10g, Red rice-10g, Green gram whole-6g, Roasted Bengal gram dhal-6g, Almond-1g, Cashew-1g, Groundnut-1g, Cardamom-a pinch, Sago-5g (Totally 90g)]

3.4 Sensory evaluation of the prepared food products

Sensory tests are done to know the consumer preference and to know the acceptability of food in case of variations incorporated. Appearance, texture, flavour and mouthfeel decide the acceptability of food. The subject's reaction to the qualities of food is the effective characteristic. Hence sensory evaluation was taken as a tool to standardize the recipes prepared by incorporating banana and potato flour. Based on the sensory results and acceptability of the food product, standardized one is decided.

For attempting sensory evaluation, the 5-point Hedonic scale method was used. The points are namely highly acceptable, very acceptable, acceptable, fairly acceptable and not acceptable ranging from 5 to 1. The samples were evaluated between 10 am -12 pm. This time is more suitable to test the samples as the panel members won't be in the state of hungry or stomach full. The panel members consisting of trained and semi-trained persons and consumers, totally 20 members were asked to test the samples based on the sensory attributes. Each day food product with standard and variations incorporated were prepared, presented and analyzed for its sensory characteristics such as colour and appearance, texture, taste, flavour and overall acceptability.

3.5 Calculation of the nutritive parameters and resistant starch of the prepared food products

The nutritive value for the standardized food product was calculated based on the values of Indian Food Composition Table – 2017. The nutritive value for Potato flour was referred from USDA National Nutrient database for Standard reference – 2018 and for Banana flour was using reference values. The Resistant Starch content for the prepared food products was also calculated using the reference values.

(Note : The reference value for banana flour was taken from https://draxe.com/nutrition/green-banana-flour/[16] and for Resistant starch, it was taken from freetheanimal.com[17]).

3.6 Affordability of the flour

The cost of the flour was calculated based on the market rates prevalent by December 2018. Based on the cost, it was interpreted with the affordability of the common consumers or people.

3.7 Shelf life analysis of banana flour and potato flour

Moisture content and microbial analysis were selected to obtain the keeping quality or shelf life of the flour. The moisture content was detected using the Test method IS 15016 : 2002. Based on this method, the moisture content of banana flour and potato flour was experimented.

To detect microbial growth of the prepared flour, Total Plate Count (TPC) was examined for about 90 days on regular intervals. The microbial count was found on the first day, 30th day, 60th day and 90th day. The Test method used to calculate the TPC was IS 5402 : 2002.

4. RESULTS AND DISCUSSION

4.1 Sensory evaluation

The above food products were made according to the mentioned procedures and analyzed to find out the standardized one using the sensory evaluation. The result obtained using sensory evaluation showed that the products containing 25% incorporation which was Variation - 1(12.5g of Banana flour and 12.5g of Potato flour) was found to be highly acceptable in all attributes namely appearance, colour, texture, flavour and taste as it recorded scores which were closer to the standard products. The nutritional qualities were also enhanced by the incorporation. So Variation – 1 is considered to be the standardized one in all the prepared food products. Although Variation – 1 is highly acceptable, variation – 2 and Variation - 3 are also acceptable. Both had only minimal value differences when compared with Variation -1. The overall acceptability falls in acceptable category in above said both the variations.

Table 2: Sensory evaluation of the incorporated products

Food product	Color & appearance	Texture	Taste	Flavor	Overall acceptability
Roti					
Std	4.1±0.9	3.5±0.8	3.4±0.	3.8±1	3.5±0.7
V – 1	*4±1*	*4.1±0.5*	*4±0.9*	*4.1±0.8*	*4.2±0.7*
V - 2	3.4±1	3.4±0.9	3.5±0.	3.5±0.9	3.5±0.9
V - 3	3.2±1	3.9±0.8	3.6±1	3.5±1.1	3.6±1
Bread					
Std	4.9±0.3	4.4±0.5	4.4±0.	4.4±0.5	4.6±0.5
V – 1	*4.6±0.5*	*4.2±0.4*	*4±0.7*	*3.8±0.6*	*4.1±0.5*
V - 2	4.1±0.5	3.4±0.8	3.1±1.	3.5±0.8	3.4±0.8
V - 3	3.2±0.6	2.8±0.7	2.6±0.	3±0.8	3±0.6
Noodle					
Std	4.9±0.3	4.5±0.5	4.5±0.	4.5±0.7	4.8±0.4

V – 1	*4.6±0.5*	*4.4±0.6*	*4.6±0.*	*4.5±0.7*	*4.7±0.4*
V - 2	3.6±0.8	3.6±0.6	3.8±0.	3.9±0.8	3.9±0.7
V - 3	3.4±1	2.9±1.1	3.1±0.	3.1±1	3.3±0.9
Puttu					
Std	4.7±0.4	4.5±0.5	4.4±0.	4.4±0.6	4.5±0.7
V – 1	*4.5±0.5*	*4.2±0.9*	*4.5±0.*	*4.5±0.5*	*4.5±0.5*
V - 2	4.6±0.5	4.1±0.8	4.2±0.	4.3±0.8	4.3±0.8
V - 3	4±0.8	4.1±0.7	4.3±0.	4.3±0.6	4.2±0.9
Idiappam					
Std	4.2±0.9	4.1±0.8	3.±0.7	4.1±0.8	4.1±0.7
V – 1	*4.3±0.6*	*3.9±0.5*	*4±0.8*	*3.8±0.7*	*4.1±0.7*
V - 2	4.1±0.5	4.1±0.5	3.9±0.	3.7±0.6	4±0.6
V - 3	3.9±0.8	4.1±0.7	3.8±0.	3.8±0.7	4±0.8
Biscuit					
Std	4.6±0.6	4.7±0.4	4.4±0.	4.5±0.5	4.6±0.5
V – 1	*4.4±0.6*	*4.4±0.5*	*4.2±0.*	*4.4±0.6*	*4.3±0.6*
V - 2	4.2±0.7	4.2±0.6	4.1±0.	4.2±0.7	4.1±0.5
V - 3	4.1±0.8	4.1±0.7	3.7±0.	4.1±0.7	3.8±0.6
Cake					
Std	4.8±0.4	4.7±0.4	4.6±0.	4.7±0.4	4.8±0.4
V – 1	*4.7±0.4*	*4.6±0.5*	*4.6±0.*	*4.7±0.4*	*4.7±0.4*
V - 2	4.4±0.6	4.2±0.9	4.6±0.	4.8±0.4	4.6±0.5
V - 3	4.4±0.6	3.9±1.1	4.5±0.	4.5±0.8	4.5±0.7
Kozhukkattai					
Std	4.1±0.8	3.4±0.9	3.8±0.	4.1±0.7	4.1±0.7
V – 1	*3.5±0.8*	*3.3±0.6*	*3.3±0.*	*3.4±0.6*	*3.4±0.8*
V - 2	3.3±0.8	3.2±0.7	2.9±0.	3±0.9	3.3±0.6
V - 3	3±1.1	4±0.8	3.7±0.	3.6±0.8	3.8±0.9
Dosai					
Std	4.1±0.8	4.2±0.9	4.1±0.	4±0.8	4.1±0.8
V – 1	*3.8±0.7*	*4±0.4*	*3.8±0.*	*3.9±0.7*	*4.1±0.8*
V - 2	3.7±0.8	4±0.6	3.8±0.	4±0.8	4±0.9
V - 3	3.4±0.6	3.8±0.7	3.0±0.	3.7±0.8	3.7±0.6
Health mix					
Std	4.6±0.5	4.6±0.6	4.3±0.	4.6±0.6	4.5±0.5
V – 1	*4.7±0.6*	*4.5±0.7*	*4.5±0.*	*4.5±0.7*	*4.6±0.6*
V - 2	4.7±0.4	4.6±0.5	4.6±0.	4.5±0.5	4.6±0.5
V - 3	4.7±0.6	4.4±0.6	4.3±0.	4.4±0.8	4.4±0.8

[V-1 : Variation – 1 (25% substitution), V-2 : Variation – 2 (50% substitution), V-3 : Variation – 3 (75% substitution)]
Note: Values are denoted as Mean±S.D (n=20).

4.2 Resistant starch content of food products

The Resistant starch calculation done based on the reference values for the prepared food products states that, as the proportion of incorporation of Banana flour and Potato flour increased, it automatically increased the Resistant starch content of the food products ranging from 4g of minimum to a maximum of 12.5g. The highest proportion of resistant starch was found in Puttu, Idiappam and Kozhukkattai while the lowest content was observed in Roti, Bread and Noodle. The food products made of rice flour, substituted with banana flour and potato flour has recorded high content of resistant starch as rice flour has only minimal amount of resistant starch. Wheat flour based food products such as roti, bread and noodle has minimal increase because wheat flour has certain amount of resistant starch present it. The Resistant starch content of Cake and Biscuit has also been greatly increased than standard when incorporation was done because refined wheat flour had meager amount of resistant starch. The Resistant starch for Health mix was not calculated since there is only least amount of incorporation of both the flours.

Table 3: Resistant starch content of food products

Food product	Standard	Variation - 1	Variation - 2	Variation - 3
Roti	13	14.33	15.67	17.00
Bread	13	14.33	15.67	17.00
Noodle	13	14.33	15.67	17.00
Puttu	1.6	5.78	9.97	14.16
Idiappam	1.6	5.78	9.97	14.16

Biscuit	5.4	8.63	11.87	15.1
Cake	5.4	8.63	11.87	15.1
Kozhukkattai	1.6	5.78	9.97	14.16
Dosai	1.92	5.11	8.304	11.49

4.3 Nutritive value of the standardized food products

For the determination of nutritive value, nutrients such as energy, carbohydrates, protein and fat were calculated for the standardized food products. The incorporation of both the flours increased energy in the food products such as Roti, Kozhukattai, Noodle and Bread. The carbohydrate content of the food was also increased because the carbohydrate content of Banana flour and Potato flour was high when compared with wheat flour, refined wheat flour and rice. The protein content of the food product was decreased in all incorporated recipes when compared to the standard. This is because the protein content of both banana flour and potato flour were low when compared to that of wheat flour and rice. The fat content was decreased in some of the food products such as Roti, Dosai, Puttu, Biscuit, Idiappam, Kozhukattai and Bread. Some food products like Cake and Noodle stand on par with the standard in case of fat.

Table 4: Nutritive value of the standardized products

Food product		Energy (Kcal)	Carbohydrate (g)	Protein (g)	Fat (g)
Roti	Std	418.27	66.17	10.57	11.53
	Variation - 1	426.05	71.54	9.27	11.4
Bread	Std	405.27	74.17	10.57	6.53
	Variation - 1	413.07	79.51	9.5	6.4
Noodle	Std	528.71	69.11	11.74	21.79
	Variation - 1	536.49	74.48	10	21.7
Puttu	Std	636.58	100.31	9.73	21.4
	Variation - 1	636.45	102.43	9.1	21.24
Idiappam	Std	481	88.91	8.91	9.4
	Variation - 1	481	91.03	8.3	9.28
Biscuit	Std	790.4	125.75	11.49	26.2
	Variation - 1	790.45	128.59	10.24	26.1
Cake	Std	1541.52	174.27	16.12	85.96
	Variation - 1	1541.5	177.11	14.87	86
Kozhukkattai	Std	671.03	86.39	9.86	31.34
	Variation - 1	699.79	88.24	9.22	31.21
Dosai	Std	436.25	71.93	10.86	10.78
	Variation - 1	436.27	73.64	10.38	10.7

4.4 Cost calculation of the incorporated products

The affordability of the flour by the consumers is decided by the cost of the flour. The cost was calculated for the proportion of the flour incorporated. The total cost for purchasing, pre-preparation, drying and milling of Banana flour for 1000g (1Kg) was found to be 300 rupees and for 12.5g was 3.75 rupees. Likewise, for Potato flour of 1000g was found to be 260 rupees and for 12.5g was 3.25 rupees. So 25% of the above said flour substitution for a recipe averages to be 7 rupees. As the cost was low, it can be afforded and incorporated by the common people also.

4.5 Moisture content

It is evident that the moisture content of the Banana Flour (BF) was 8.8% and the Potato Flour (PF) was 8.2% which were calculated by the above mentioned procedure. The present study was on par with some studies. A study done by Pragati[18] in 2014 found that the unripe banana flour had a moisture content of 8.8%. Also a study done by Kulkarni D[19] in 1996 had analyzed the physicochemical properties and functional properties of potato flour and incorporated in some recipes. They found that the moisture content of the potato flour ranges from 8.2 to 8.9%.

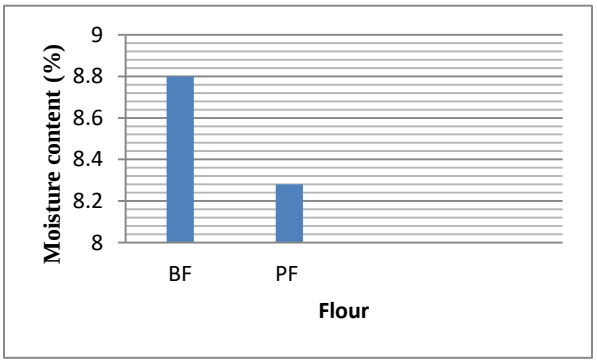

Figure 1: Moisture content of BF and PF

4.6 Microbial analysis

The microbial analysis for both the flours states that, the microbial count of banana flour ranged from 15000cfu/ml (1st day) to 38000cfu/ml (60th day) and potato flour ranged from 18000cfu/ml (1st day) to 40000cfu/ml (60th day). At 90th day it was uncountable. This shows that the microbial count has increased in the storage period. This states that the keeping quality of the flour was found to be 60 days when packed in an air tight container. After 60 days, it was found that the flour had exceeded the safer limit of consumption. So the shelf life of both the flour was found to be 60 days when kep at room temperature. The keeping quality of both the flour can be increased from 3-6 months when they are stored at optimum refrigertaed conditions.

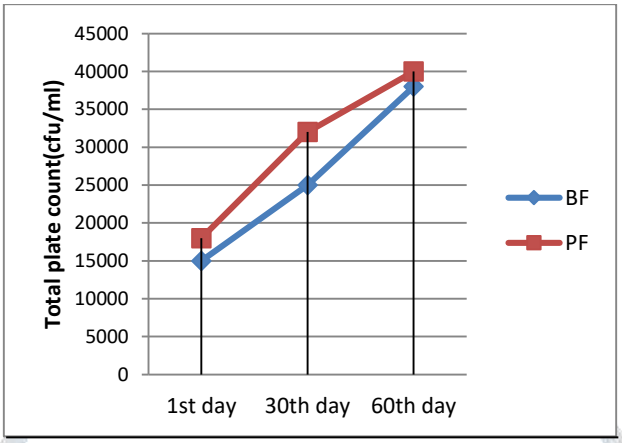

Figure 2: Microbial analysis of BF and PF

5. CONCLUSION

Non-communicable diseases killed millions of people in the last few years and a large portion of these deaths occurred before the age of 60 during the most productive period of life. The magnitude of these diseases is increasing day by day. In India, many people have unique features of increased body fat, abdominal adiposity and deposition of fat in ectopic sites. These can lead further lead to complications (non-communicable diseases). Emerging research suggests that Resistant Starch as an ingredient in the food is essential to prevent the metabolic diseases such as diabetes, obesity and cardiovascular diseases. As banana flour and potato flour were found to have increased resistant starch content, when incorporated increases the Resistant starch content of the food products. By adding 25 to 50% of banana flour and potato flour to our daily menu it increases the resistant starch content in our food. The higher proportion of incorporation also shows no drastic alterations in taste and overall acceptability. By taking an increased amount of resistant starch in our diet, we can be able to lead a healthy life by preventing almost all kind of Non-communicable diseases. Overall, Resistant starch possesses favorable health effects as an essential food component.

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