Original Article

Development, Nutrient Analysis and Organoleptic Evaluation of Food Products from Industrial Turmeric Spent Starch Blended with Rice and Cassava Starch

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Abstract **Background:** The industrial turmeric spent flour is treated as wastage and its distribution has good nutritional content, beneficial for human being consumption and decreasing price in wastage treatment. The processing of spice industries have to focus on the usage of by products and during spices processing, the wastage generated could be altered into value added products. Rice starch and cassava starch are could be used in the food industries and have potential health benefits like colon health, enhanced digestive and improved insulin sensitivity. **Objectives:** Thus in the current study an attempt is made to provide an alternative to reuse the wastes of turmeric spent starch blended with rice and cassava starch at different levels in the formulation of various food products. **Materials and Methods:** The prepared various food products such as chapattis, cookies, sponge cake and cup cakes were analyzed for its nutritive value and organoleptic characteristics using standard techniques. **Results and Discussion:** As the level of incorporation of starch blend increases, there is an alteration in the nutrient composition in the developed products. Among the 4 variations analyzed, the variation 1(V1) has got 8.5 highest mean score at 10% level in chapathis and cup cake and 8.2 in cookies and sponge cakes in all the attributes respectively. It was found that the level of incorporation of starch blend increases, there is decline in the acceptability range of the developed product. **Conclusion:** The incorporation of 10% of the blended flour to wheat flour in the preparation of cookies, chapathi, sponge cakes and cupcakes showed better sensory acceptability and good nutritive value.

Keywords: Turmeric spent starch, Rice starch, Casava starch, Colon health, Improved sensitivity

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INTRODUCTION

The plant turmeric has a great chronicle of healing use, dating back almost 4000 years. The spice turmeric is also known as "Indian saffron." because of its brilliant yellow colour. Within the last 25 years, the advanced medicine has started to identified importance of turmeric, as determined by the 3000 publications with turmeric concerns (Prasad, 2011). From the tropical South Asia, the *Curcuma longa* is a turmeric product, a rhizomatous plant associated to the ginger family Zingiberaceae. The India yields nearly the world's gross turmeric byproduct and 80% of it is consumed. The turmeric from India is considered to be the elite in the world since its potential qualities and significant bioactive compound curcumin. The city Erode in the South India, the Tamil Nadu state, is the world's huge manufacturer of and the biggest important turmeric trading center.

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The spice turmeric is a major source of Curcumin (a polyphenol), which is being identified and used worldwide in many various forms for different inherent benefits of health. They differ in chemical structures, physico-chemical characteristics as well as the functional properties. The various health benefits of curcumin made it as one of the most selling and useful nutraceuticals in pharmaceutical industries. So, the component curcumin is scientifically removed from the fresh turmeric flour and is used as nutraceutical. The processing of spice industries have to focus on the usage of by products and during spices processing, the wastage generated could be altered into value added products (Vedashree M *et al.*, 2016).

The various articles are applicable on the pharmacological administration of turmeric like anti-microbial, anti-inflammatory, anticancer, hypoglycemic, antioxidant, hypocholesterolemic, and anti-mutagenic. The industrial turmeric spent flour is treated as wastage and its distribution has good nutritional content, beneficial for human being consumption and decreasing price in wastage treatment. (Leonel *et al.*, 2003).

The spice spents is a commencement of functional ingredients and bioactive compounds, i.e., protein, dietary fibre and mineral. The spice turmeric spents as a good source of functional ingredients is added to develop the nutritional quality of foods. The large implements of spice turmeric spents as a inherent source of functional ingredient could be added in bakery industry henceforth the fibre, mineral and protein content of the bakery products is resulting in upgraded for various benefits of physical health. There is a lot of potential for the usage of spents spice effectively because India is sole of the large manufacturer of spices and its by-products (Sowbhagya, 2018).

The spents from spice are high in protein, polyphenols, vitamins, minerals like zinc, iron, magnesium, calcium and dietary fibre for metabolic bodily functions. The spice spents from turmeric as a high novel source of functional ingredients in bakery products that are low in protein and fibre ensuing in higher protein and rich in dietary fibre product. In various functional food formulations, the spice spents utilization is vastly effective for health (Sowbhagya, 2018). The turmeric spent starch could be used in food industries as a functional ingredients. (Maniglia, 2015).

The rice is a considerable staple food and it is only the most ample crops yielded worldwide. The rice components like protein and starch are extracted and used as essential constitutions in food products viz infant food, baked goods, sauces and soups, products from dairy, etc. Rice starch is been used in food industries and it has unique molecular structure and starch granule size of both its amylopectin and amylose (Wani *et al.*, 2012).

The Starch is the main element of cassava (Ashveen Nand *et al.*, 2008). The cassava is a wonderful source of thiamine, vitamin C, niacin and riboflavin. Resistant starches are found in cassava flour. By eating resistant starches, there are a variety of possible health benefits. These potential health benefits in cassava starch include colon health and enhanced digestive and improved insulin sensitivity. Cassava starch also aids good efforts with weight loss (Waterschoot, 2014).

This present study has determined a substitute to reuse the wastes of turmeric spent starch blended with rice and cassava starch in the food products formulations like chappathi, cookies, sponge cakes and cupcakes as a intrinsic source to wheat flour. The effects of partial wheat flour substitution were examined for its nutrient profile and sensory characteristics.

MATERIALS AND METHODS

Isolation of Industrial Turmeric Spent Flour Starch

Industrial turmeric spent flour was bought from RKS Healthcare. The 1000 grams of industrial turmeric spent flour was air dried and distributed in 5 times its weight of fresh water and permitted to settle for 2 hours. This was filtered with a muslin cloth. With water, the residue was washed till the wash water was clear. At 5000 rpm for 30 minutes, the uncleaned starch milk was centrifuged and supernatant was drained. Followed by centrifuging, the starch sediment was washed more than twice with water till a spot free white starch. It was dried at 50-58 ^oC for 2 hours employing a hot air oven to allow the starch (200 grams) settle and it was kept in sealed container (Holm *et al.*, 1985).

Isolation of rice starch (Alkali Extraction Method):

The rice grains were collected from the local market of Vellore district. The rice grains were cleaned, ground in a grinder and stored at room temperature former to future use. After protein extraction, the residue obtained was extracted with 2% NaCl (each for 24 hrs at 4 ^oC) and 1 liter of each distilled water followed by extraction with 300 ml of 0.1 N NaOH twice (48 hrs at 4 ^oC). Subsequent to each of above the extraction, the slurry at 4 ^oC was centrifuged at 8000 rpm for 30 minutes and the supernatant was discarded. From the second NaOH extraction and with the residue at 85 ^oC was further extracted with 80% aqueous ethanol (100 ml) for 1 hr, at room temperature it was cooled and settled at 4 ^oC for 4 hour. The discarded supernatant, and the dehydrated residue was powdered (Kodandaram Reddy *et al.*, 2013).

Isolation of cassava starch:

Freshly harvested cassava was purchased from the local market in Vellore district. The starch from cassava was extracted by the method of Benesi *et al.* (2004). The novel cassava were peeled, washed and chopped into 1 cm cubes and then grinded for few minutes in a mixer. The pulp was suspended in 10 times its volume of water, stirred for few minutes and by using muslin cloth it is filtered. The filterate was allowed to stand for two hours for the settled starch and the top liquid was discarded. The water was added to the sediment and the mixture was stirred for few minutes. Using muslin cloth the filtration was carried out and from the filtrate the starch was allowed to settle. After decanting the starch top liquid was dried at 70 °C for 11 hour and stored for future analysis. The extracted cassava starch content (SC) was resolved by Equation.

$$SC\ (\%) = \frac{w_3}{w_4} \times 100$$

where w_4 of the root matter and w_3 is the weight of extracted starch from a known weight.

Preparation of the Value-Added Products

A blend of rice starch, cassava starch and turmeric spent flour starch are mixed in the ratio of 1:2:3, i.e., 10 g, 20 g and 30 g respectively. This blended mixture was used for the preparation of the most acceptable products such as chappathi, sponge cakes, cookies and cupcakes. Four variations with help of blended flour (10%, 20%, 30% and 50%) and one standard product (100%) were prepared.

Preparation of Various Food Products from Blended Mixture

Different food products such as chapathi, sponge cakes, cookies and cupcakes were prepared by incorporating blended at 10%, 20%, 30% and 50% levels with wheat flour. Standard products were also prepared without the incorporation of blended flour and with wheat flour. The various levels of incorporation of blended flour for the development of various food products were given in Table 1.

Table 1: Variations for the Preparation of Chapathis, Cookies, Sponge Cake and Cupcakes from Blended Flour

Variation	Wheat Flour (g)	Blended Flour (g)
Standard	100	--
V1	90	10
V2	80	20
V3	70	30
V4	50	50

Preparation of Chapathi

The wheat flour, salt, and oil were used at different levels according to the variation required. Pour all ingredients into a bowl and mix it together. Knead dough well for 3 to 4 minutes until it smoothens. Then, take small lumps from the dough. The lump was rolled into a round dough ball and flatten it a little. With some dry wheat flour now dust the dough ball and start rolling out the chapathi thinly with 6-to-7-inch diameter. Once the tawa is hot then place the chapathi on a hot tawa/griddle. First cook one side. Turn and cook the other side. This should be a little bit more cooked chapathi than the first side. Cook the chapathi until brown spots was visible. At various levels the wheat flour was incorporated with blended flour. According to the procedure the chapathis were prepared from the samples.

Preparation of Cookies

Cookies were prepared by incorporating blended with wheat flour at 10%, 20%, 30% and 50% levels. The standard cookies were cooked without the incorporated blended flour and with wheat flour. In table 1 the various levels of incorporation of blended flour for the development of cookies were given. The basic ingredients used were wheat flour, blended flour, butter, sugar, egg, salt, and baking powder at different levels according to the variation required. For 3 to 5 minutes, in a bowl the dry ingredients were weighed and thoroughly mixed. The shortening were added and rubbed in upto good consistent. The dough was kneaded thoroughly in a mixer for 5 minutes after the addition of egg. On a sheeting board the dough was rolled to a (8.0 mm) uniform thickness and cut out to a diameter of 35.0 mm using a round scorn cutter. On greased pans the baked cut-out dough pieces were placed in a baking oven at 150 °C for 20 minutes. At room temperature the prepared cookies were cooled (30 ± 2 C) and subjected to sensory characteristics test

Preparation of Sponge Cakes

Sponge cake was prepared by incorporating blended at 10%, 20%, 30% and 50% levels with wheat flour. Standard sponge cake was cooked with wheat flour without the incorporated blended flour. The different levels of incorporated blended flour for the sponge cake development were given in Table 1. The ingredients used were wheat flour, blended flour, egg, sugar, milk powder, butter, baking soda and water at different levels according to the variation required. All ingredients except for the flour and milk were mixed by using a Professional mixer. After inclusion of the flour and milk, the mixing process was extended. The butter-coated pans were filled with cake batter and baked for 30 minutes at 190°C in an electric oven. The Cakes were taken out from the pans, after baking and cooled for 1 hour at room temperature and applied to the test of sensory characteristics.

Preparation of Cup-Cakes

Cupcake was prepared by incorporating blended flour with wheat flour at 10%, 20%, 30% and 50% levels. The standard cupcake was cooked without the incorporation of blended flour and only with wheat flour. In table 1 the various levels of incorporated blended flour for the development of cupcake were given. The ingredients used were blended flour, wheat flour, egg, sugar, milk powder, butter, vanillin and water at different levels according to the variation required. For 10 minutes the sugar and the butter were creamed in the mixer. Eggs and Vanillin was added and mixed. Milk, wheat flour and blended flour were added. The appropriate quantities of batter (50 g) were positioned into 45 mm height and 55-mm diameter aluminium, butter coated pans. The baking was cooked in an oven at 190 °C for 25 minutes. At the same level and per baking batch, the oven trays were placed in the oven with the similar sum of cakes pans. The Cakes were taken out from the pans, after baking and cooled at room temperature for 1 hour and applied to the test of sensory characteristics.

Nutrient Composition of the Various Developed Products

The developed various value added products namely chapathis, cookies, sponge cake and cup cakes were analysed for its nutrient profile. The major nutrients such as energy, protein, carbohydrates, fat, fibre, calcium and iron were calculated for all the developed products using the standard food tables (Gopalan *et al.*, 2000).

Organoleptic Evaluation of the Various Developed Products

For each product the consumer acceptability was carried out through organoleptic evaluation by panel of members with score card using 9 point hedonic scale of scores ranging from 9 to 1, where 9 = like extremely, 5 = neither like nor dislike and 1 = dislike extremely was applied. The parameters are evaluated for chapathis were taste, flavour, colour, texture, foldability, breakability and over all acceptability. Cookies were rated for taste, colour, flavour, texture, crispiness and overall acceptability (Ihekoronye and Ngoddy, 1985). For sponge cake (Moiraghi, 2013) and cup cake (Lebesi, 2011) parameters viz., texture, colour, flavour, taste, appearance, and over all acceptability were assessed by a panel of judges. A prepared ballot sheet was assessed for sensory attributes of various developed value added products.

Statistical Analysis

By using statistical methods, the final data was collected and evaluated. The results obtained were described as Descriptive statistics such as mean, standard deviation followed by Duncan's multiple comparison tests. A p-values <0.05 were examined significantly. The Duncan's multiple range tests were implemented to calculate the significant differences among samples.

RESULTS AND DISCUSSION

Nutritive Composition of the Developed Products

The nutritive value of the developed chapattis, cookies, sponge cake and cup cake were discussed in the Tables 2, 3, 4 and 5.

The nutrient content of standard chapathis were 372.9 kcals, 11.9 gm protein, 64.1 gm of carbohydrates, 6.1 gm of fat, 2.23 gm of fibre, 45.3 mg of calcium, 4.8 mg of iron. As the level of incorporation of blend increases the calorific value, protein, carbohydrates, fat and fibre content were also increased, but the calcium and iron level decreases in the prepared chapathis.

The nutrient content of standard cookies were 894.3 kcals, 12.63 gm protein, 116.3 gm of carbohydrates, 40.6 gm of fat, 2.73 gm of fibre, 52.36 mg of calcium, 4.36 mg of iron. As the level of incorporation of blend increases the fat and fibre content increased, but, calorific value, protein, carbohydrates, calcium and iron level was decreased.

The nutrient content of standard sponge cake were 482.26 kcals, 12.26 gm protein, 88.36 gm of carbohydrates, 7.43 gm of fat, 2.46 gm of fibre, 53.46 mg of calcium, 4.83 mg of iron. As the level of incorporation of blend increases, the calorific value, protein, carbohydrates, fat, fibre and iron content were increased, but the calcium level decreases in the developed sponge cake.

The nutrient content of standard cup cake were 492.53 kcals, 12.36 gm protein, 95.46 gm of carbohydrates, 6.33 gm of fat, 2.53 gm of fibre, 53.4 mg of calcium, 4.73 mg of iron. As the level of incorporation of blend increases the calorific value, carbohydrates, fat, fibre, calcium and iron content also increases.

Organoleptic Evaluation of the Developed Products

The organoleptic evaluation of the developed chapattis, cookies, sponge cake and cup cake were discussed in the Tables 6, 7, 8 and 9.

Table 2: Nutritive Value of Chapathis

Variations	Carbohydrate (g)	Energy (Kcals)	Protein (g)	Fibre (g)	Fat (g)	Calcium (mg)	Iron (mg)
Standard	64.1±1.05	372.9±2.6	11.9±0.41	2.23±0.30	6.1±0.1	45.3±1.11	4.8±0.45
V1	66.4±1.45	379±3.45	12.5±0.58	2.5±0.1	6.4±0.1	44.4±0.25	4.5±0.1
V2	71.7±1.05	386.4±1.00	12.2±0.70	3.7±0.52	6.53±0.25	41.4±0.51	4.73±0.56
V3	78.3±0.97	390.2±1.11	12.5±0.6	5.36±0.86	7.03±0.37	41.3±1.05	3.2±0.81
V4	80.2±0.81	405.2±0.85	12.16±0.80	6.23±1.00	7.23±0.20	40.26±1.00	3.3±1

Table 3: Nutritive Value of Cookies

Variations	Carbohydrate (g)	Energy (Kcals)	Protein (g)	Fibre (g)	Fat (g)	Calcium (mg)	Iron (mg)
Standard	116.3±1.11	894.3±0.90	12.63±0.41	2.73±0.51	40.6±0.60	52.36±0.50	4.36±0.50
V1	111.56±0.83	887.53±0.92	11.7±0.72	2.43±0.50	41.26±1.00	51.2±1.1	4.73±0.45
V2	111.23±1.00	881.26±1.00	12.33±0.90	2.96±0.66	42.3±1.05	48.23±1.05	4.26±1.05
V3	106.43±1.09	871.16±1.05	12.2±1	4.66±1.07	44.16±1.05	46.3±0.81	4.73±0.97
V4	103.56±1.16	854.46±1.35	11.43±0.96	5.13±0.80	44.36±1.30	41.66±1.30	3.23±0.90

Table 4: Nutritive Value of Sponge Cake

Variations	Carbohydrate (g)	Energy (Kcals)	Protein (g)	Fibre (g)	Fat (g)	Calcium (mg)	Iron (mg)
Standard	88.36±1.00	482.26±0.95	12.26±0.95	2.46±0.76	7.43±0.80	53.46±0.76	4.83±0.50
V1	93.4±1.01	489.36±0.90	13.36±1.00	2.66±1.30	8.23±1.10	52.56±0.94	5.26±0.85
V2	94.53±1.25	492.46±0.85	13.86±0.60	4.43±1.17	7.4±1.1	48.46±1.32	6.93±0.45
V3	96.53±1.10	497.66±0.75	15.53±0.96	5.36±1.15	7.4±0.95	46.6±0.81	7.43±1.05
V4	99.36±0.96	502.43±1.05	14.56±0.97	6.26±1.25	8.9±0.4	43.4±1.05	8.46±1.10

Table 5: Nutritive Value of Cup Cake

Variations	Carbohydrate (g)	Energy (Kcals)	Protein (g)	Fat (g)	Fibre (g)	Calcium (mg)	Iron (mg)
Standard	95.46±0.90	492.53±0.92	12.36±1.10	6.33±0.85	2.53±0.75	53.4±0.95	4.73±1.20
V1	98.63±1.20	504.53±1.23	12.73±0.86	8.7±1.11	3.63±1.02	55.73±1.20	6±0.78
V2	102.36±1.02	512.36±1.20	11.73±1.55	8.26±0.80	4.43±1.05	59.46±0.95	7.3±1.20
V3	109.5±0.95	516.36±1.15	11.33±1.15	8.5±0.95	5.56±0.86	62.56±0.86	6.5±0.95
V4	114.3±0.85	536.36±1.10	8.53±0.85	10.26±1.20	7.26±1.20	66.36±1.05	8.3±1.41

The pooled score of standard chapathi, cookies, sponge cake and cup cake in all the qualities viz., flavour, appearance, colour, taste, crispiness, texture, breakability, overall acceptability and foldability was 8.6. Amongst-the 4 variations progressed, at 10% level of the variation 1 (V1) has obtained 8.5 maximum mean score in chapathis and cup cake and 8.2 in cookies and sponge cakes in all the attributes respectively. The cookies are universally obtained and consumed in various developing countries and provide a beneficial supplementation medium for nutritional enhancement; the cookies were suggested as a increased use of blended flour due to their ready-to-eat form, wide consumption and for long shelf-life (Lorens *et al.*, 1979). It was found that the level of incorporated starch blend

Table 6: Organoleptic Evaluation of Chapathi

Variations	Taste	Colour	Flavour	Foldability	Texture	Breakability	Overall Acceptability
Standard	8.6±0.56d	8.8±0.56d	8.7±0.56d	8.6±0.56e	8.6±0.56d	8.6±0.56d	8.6±0.56d
V1	8.3±0.45d	8.6±0.45d	8.6±0.45d	8.3±0.45d	8.4±0.48d	8.6±0.48d	8.5±0.46d
V2	6.1±0.52c	6.2±0.52c	6.1±0.52c	6.2±0.52c	6.2±0.52c	6.3±0.52c	6.2±0.52c
V3	3.8±0.52b	4.5±0.48b	4.5±0.48b	4±0.48b	4.1±0.52b	3.9±0.52b	4.1±0.50b
V4	2.2±0.52a	2.2±0.52a	2.2±0.52a	1.9±0.48a	1.8±0.52a	1.8±0.48a	2±0.50a

Table 7: Organoleptic Evaluation of Cookies

Variations	Flavour	Colour	Taste	Crispiness	Texture	Overall Acceptability
Standard	$8.7±0.56^{d}$	$8.8±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$
V1	$8.2±0.50^{d}$	$8.3±0.45^{d}$	$8.2±0.50^{d}$	$8.2±0.56^{d}$	$8.2±0.56^{d}$	$8.2±0.51^{d}$
V2	$6.1±0.56^{c}$	$6.1±0.64^{c}$	$6.1±0.56^{c}$	$6.1±0.56^{c}$	$6.1±0.56^{c}$	$6.1±0.57^{c}$
V3	$4.2±0.48^{b}$	$4.2±0.48^{b}$	$3.8±0.48^{b}$	$3.4±0.48^{b}$	$3.2±0.46^{b}$	$3.8±0.48^{b}$
V4	$2.2±0.38^{a}$	$2.3±0.35^{a}$	$2.2±0.38^{a}$	$2±0.38^{a}$	$2.2±0.38^{a}$	$2.2±0.37^{a}$

Note: In Duncan's multiple range test: a-d values with different superscripts in the same column are ($p<0.05$) significantly different.

Table 8: Organoleptic Evaluation of Sponge Cake

Variations	Flavour	Colour	Taste	Appearance	Texture	Overall Acceptability
Standard	$8.7±0.56^{d}$	$8.8±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$
V1	$8.3±0.52^{d}$	$8.2±0.52^{d}$	$8.2±0.5^{d}$	$8.3±0.52^{d}$	$8.2±0.5^{d}$	$8.2±0.51^{d}$
V2	$6.2±0.52^{c}$	$6.2±0.52^{c}$	$5.9±0.56^{c}$	$5.8±0.56^{c}$	$6.1±0.52^{c}$	$6±0.53^{c}$
V3	$3.5±0.52^{b}$	$3.5±0.52^{b}$	$3.4±0.52^{b}$	$3.6±0.52^{b}$	$3.5±0.52^{b}$	$3.5±0.52^{b}$
V4	$2.2±0.48^{a}$	$2.3±0.48^{a}$	$1.9±0.52^{a}$	$1.6±0.52^{a}$	$1.6±0.52^{a}$	$1.9±0.50^{a}$

Note: In Duncan's multiple range test: a-d values with different superscripts in the same column are ($p<0.05$) significantly different.

Table 9: Organoleptic Evaluation of Cup Cake

Variations	Flavour	Colour	Taste	Appearance	Texture	Overall Acceptability
Standard	$8.7±0.56^{d}$	$8.8±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$
V1	$8.5±0.56^{d}$	$8.6±0.56^{d}$	$8.6±0.56^{d}$	$8.4±0.56^{d}$	$8.6±0.56^{d}$	$8.5±0.56^{d}$
V2	$6.2±0.56^{c}$	$6.2±0.56^{c}$	$6.1±0.52^{c}$	$6.0±0.48^{c}$	$6.0±0.48^{c}$	$6.1±0.52^{c}$
V3	$3.4±0.48^{b}$	$3.4±0.48^{b}$	$3.6±0.48^{b}$	$3.4±0.52^{b}$	$3.6±0.52^{b}$	$3.5±0.50^{b}$
V4	$1.9±0.56^{a}$	$1.9±0.56^{a}$	$1.7±0.52^{a}$	$1.7±0.52^{a}$	$1.7±0.52^{a}$	$1.8±0.53^{a}$

Note: In Duncan's multiple range test: a-d values with different superscripts in the same column are ($p<0.05$) significantly different.

increases and there was decreased acceptability range of the developed product. The chapathis developed from 10% cereal bran had the good performance compared with whole-wheat flour with respect to the sensory attributes and proximate components (Butt *et al.*, 2004). The sensory analysis aid in describing the characteristics of cookies which are significant with respect to customer acceptance and acceptability. Duncan's test results reported the ($p<0.05$)

Figure 1: Blended Industrial Turmeric Spent Flour Incorporated Chapathi

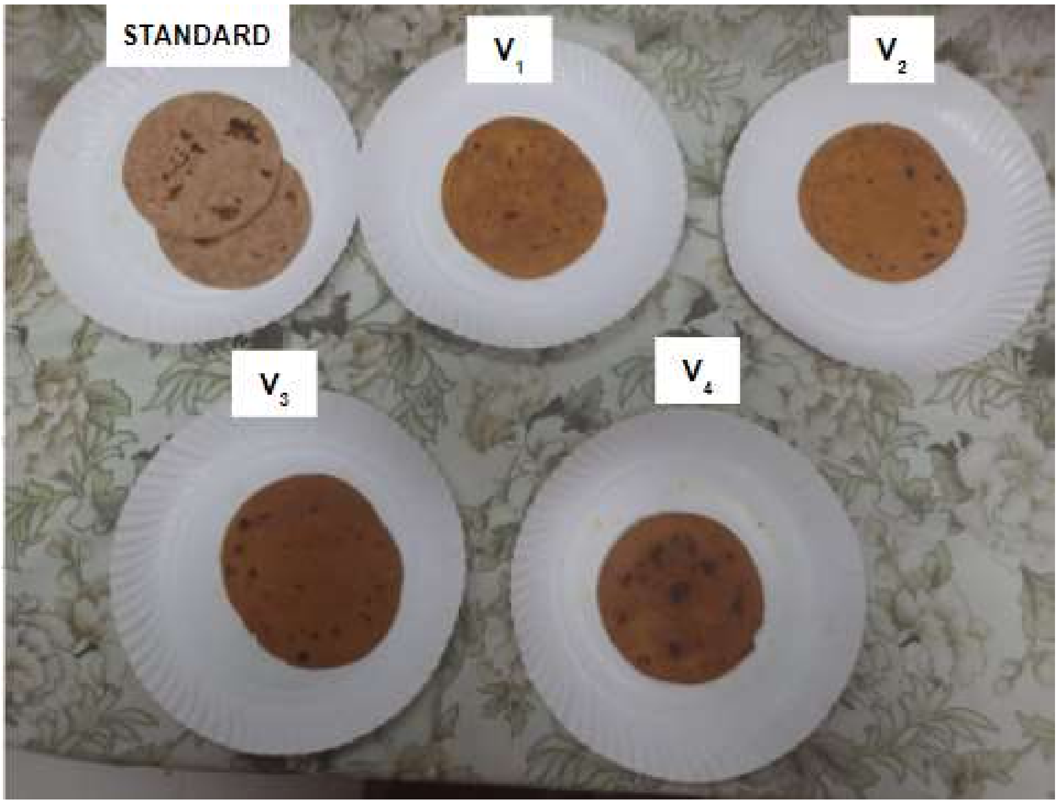


Figure 2: Blended Industrial Turmeric Spent Flour Incorporated Cookies

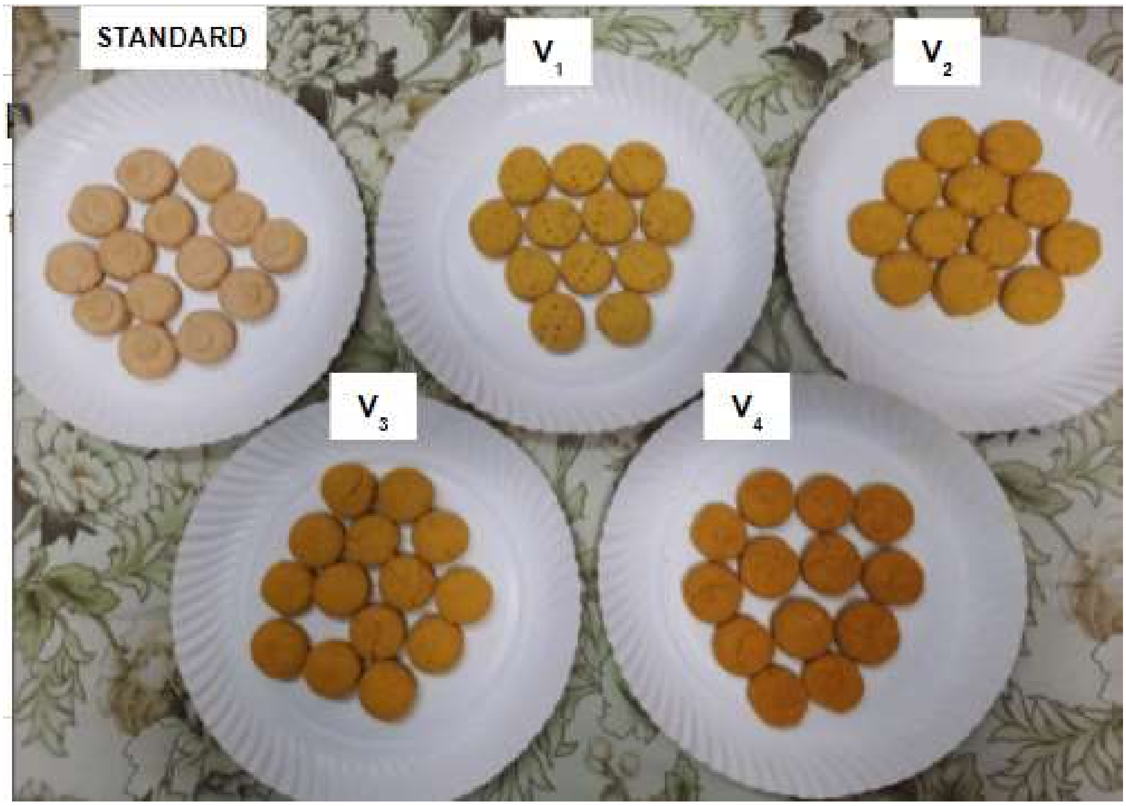


Figure 3: Blended Industrial Turmeric Spent Flour Incorporated Sponge Cake

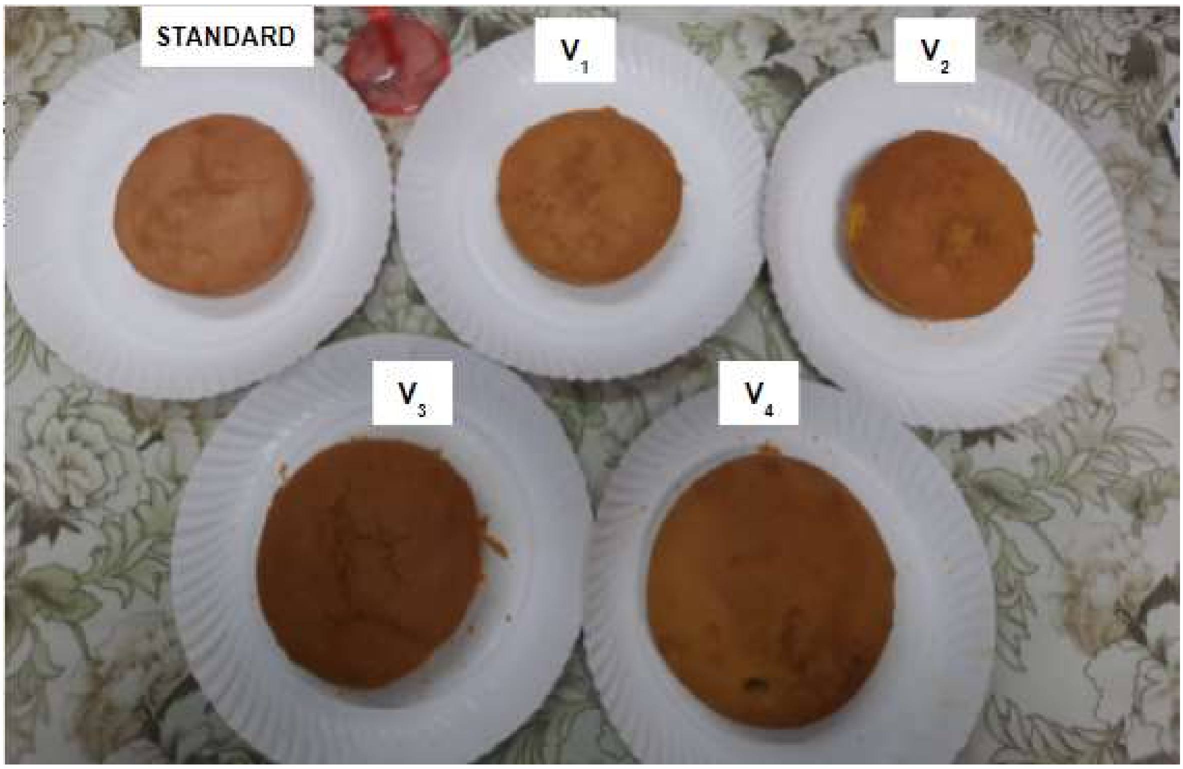
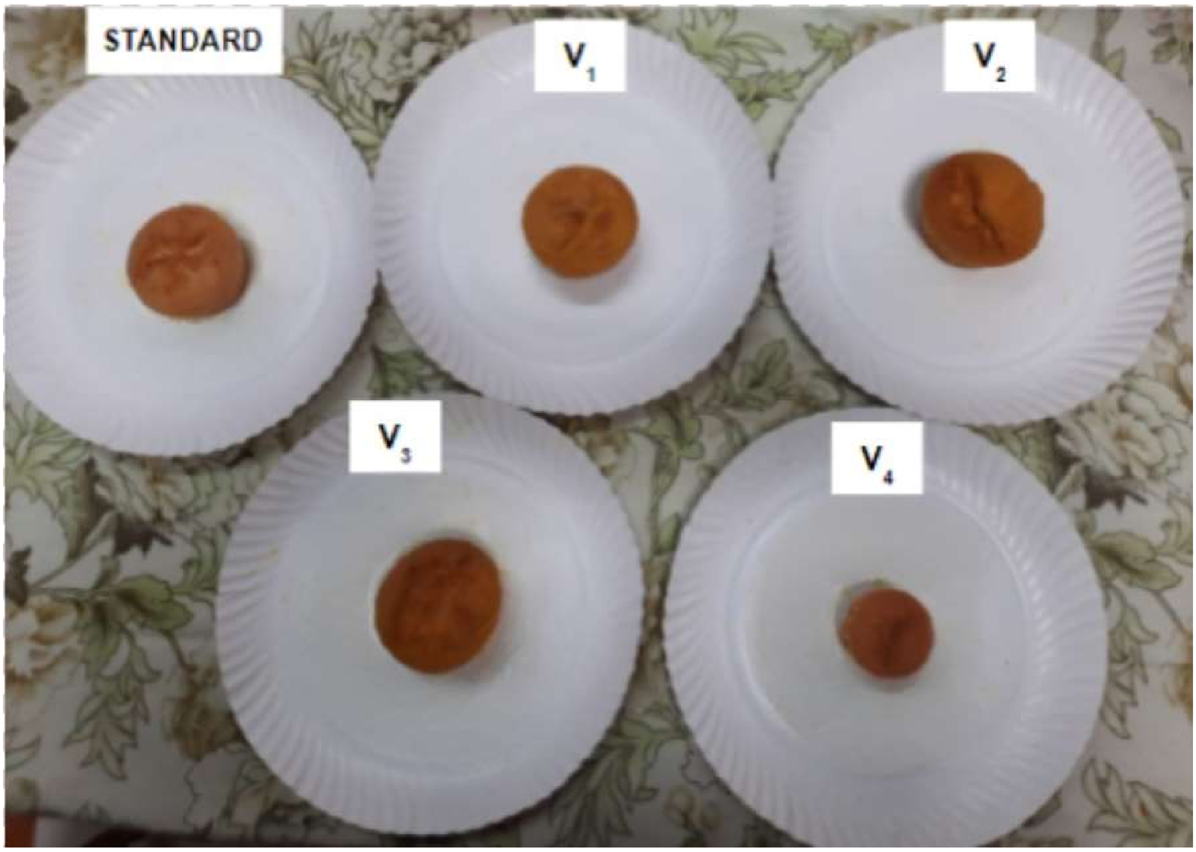


Figure 4: Blended Industrial Turmeric Spent Flour Incorporated Cup Cakes



significant difference for all the variations in respond to all the organoleptic criterion assessed for acceptability.

CONCLUSION

The incorporation of 10% of the blended flour to wheat flour in preparing the cookies, chapathi, sponge cakes and cupcakes exhibited good sensory acceptability. Thus illustrates that best sensory qualities of value added products could be manufactured from the 10% level of the variations incorporated blended flour (Rice starch, cassava starch and industrial turmeric spent flour starch).

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