



## Development of *Saravallai* (*Trianthema portulacastrum*) dhal powder and acceptability of SDP incorporated Indian breakfast foods and snacks

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### ABSTRACT

Iron deficiency anemia is highly prevalent. Dietary improvement by including iron-rich green leafy vegetables is one of the best options for increasing the iron content of the diet. *Saravallai* (*Trianthema portulacastrum* Linn) was used to formulate Saravallai dhal powder (SDP) and incorporated at three, six and ten percent in traditional Indian recipes. The energy, protein, fat, calcium and iron content of SDP was 450.64±17.78 kcal, 23.74±0.53, 7.94±2.52 g percent, 589.33±8.14 and 27.16±0.76 mg. Ten percent incorporation of SDP did not alter the sensory qualities of rice, murukku, galagala, onion chutney, tomato thokku, potato fry and dhal sambar.

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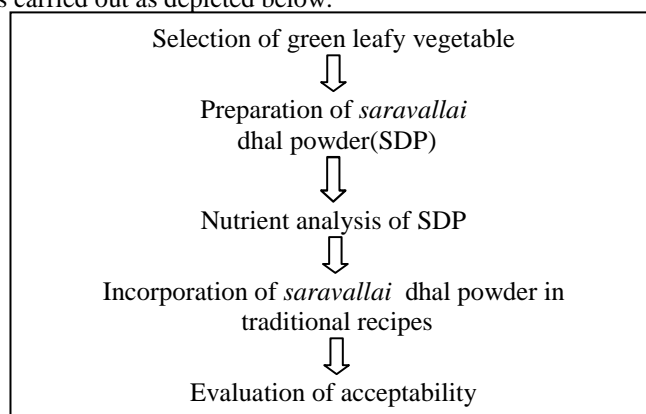
### Introduction

Adolescents account for one-fifth of the world's population and in India they account for 22.8 percent of the total population [1, 2]. Adolescent girls in India suffer from gross nutritional inadequacies. The global prevalence of micronutrient deficiency often called "hidden hunger" is estimated to be about two billion. The most viable manifestation of nutritional deficiency is the high prevalence of iron deficiency anemia [3, 4]. Anemia among rural girls of Tamil Nadu is also high as in other parts of India. The pre-pregnancy anemic status of adolescent girls is crucial and has long term intergenerational consequences. The long standing iron deficiency among adolescent girls worsens with pregnancy and this result in obstetric risks and reproductive failures such as miscarriage, still birth, premature babies, low birth weight, prenatal and maternal mortality rate. Most women who develop anemia in less developed countries are not consuming enough iron-rich foods or are eating foods that inhibit the absorption of iron [5, 6, 7, 8, 9]. Combating anemia is, perhaps, the biggest challenge in India.

The two obvious approaches to control anemia are long and short term approaches. While Long term approaches include dietary improvement for increasing the iron content of the diet by including iron-rich foods such as green leafy vegetables (GLVs), and cooking in iron pots; enhancing iron bio-availability in the existing diets by including foods rich in iron absorption promoters such as ascorbic acid and animal foods such as fish and meat; promotion of home/kitchen gardening to increase the availability of common iron rich food such as green leafy vegetables and increasing iron intake through fortification of a universally consumed food item with iron. The Short term approaches are direct supplementation either weekly or daily. Side effects associated with the allopathic drugs and the resultant chemo phobia have prompted research into traditional health care system throughout the world[10]. Hence worldwide a renewed interest is seen in tapping the traditional and easily feasible strategies to prevent anemia. Nature always stands as a golden mark to exemplify the outstanding phenomenon of symbiosis. Recently there are strong recommendations for consumption of *Saravallai* (*Trianthema portulacastrum* Linn) to improve health, prevent and treat diseases[11]. Hence this plant

could serve as a "Lead" for the development of novel agents in future, having good efficacy in treating anemia. *Trianthema portulacastrum* Linn, belonging to the family Aizoaceae is one of the common weed, which has enormous traditional uses against diseases (2003) [12]. It is also known as Shveta punarnava in Sanskrit, Horse Purslane in English, Sharunnai, and Saravallai in Tamil and Sabuni in Hindi.

To the best of our knowledge use of *Saravallai* (*Trianthema portulacastrum* Linn) is limited hence the present study entitled "Development and acceptability of *Saravallai* dhal powder incorporated Indian traditional foods" was carried out to get an insight into the nutrient content and effective use of the indigenous plant *Trianthema portulacastrum* Linn which is widely available in all seasons, grow easily even in drastic conditions, easy to collect, low in cost and known for the therapeutic properties. **Research design:** The current research was carried out as depicted below.



### Incorporation of *saravallai* leaf dhal powder in selected preparations

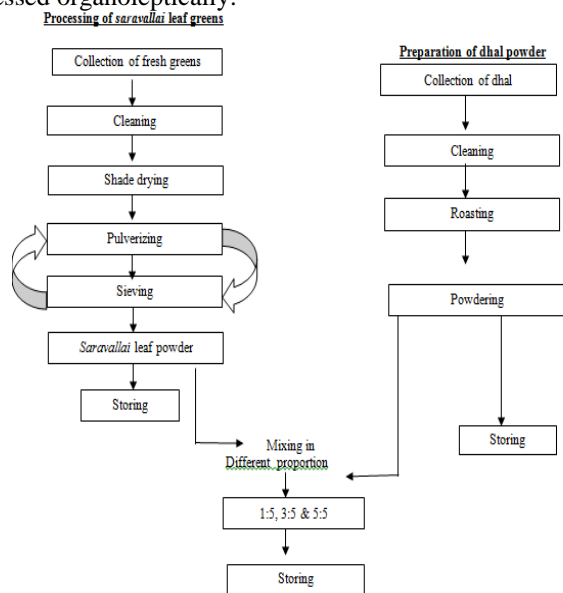
*Saravallai* dhal powder was mixed with cooked rice at three, six and ten percent to prepare "*Saravallai* rice". For preparing Diamond cuts (sweet) known as *galagala* locally and *murukku* three, six and ten grams percent of the best accepted *Saravallai* dhal powder (SDP) was mixed with the basic ingredients. In tomato *thokku*, onion *chutney*, potato fry and dhal *sambar saravallai* dhal powder (SDP) was mixed in the above mentioned percentages, after the basic recipe was

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prepared. For *Idly*, *Dosai* and *Chappathi saravallai* dhal powder was mixed with sufficient quantity oil and used directly as a side dish and the acceptability of all the recipes was assessed organoleptically.



## Results and Discussion

### Nutrient content of *saravallai* (*Trianthema portulacastrum* linn) dhal powder

The formulated *saravallai* dhal powder was analyzed for its nutrients content and quality parameters using standard AOAC procedures and the results are presented below in Table-1 and Table 2.

The energy content of *saravallai* dhal powder which was computed from the macronutrients' (carbohydrates, protein and fat) content was  $450.64 \pm 17.78$  kcal. The *saravallai* dhal powder contained a good amount of protein ( $23.74 \pm 0.53$ g) as dhal varieties such as bengal gram, red gram, black gram and groundnuts were used in its preparation. The carbohydrate content which was calculated by difference method was  $58.89 \pm 2.21$  percent, this values is little than the values computed using the nutrient contents as given in Nutritive value of Indian foods (2007)<sup>13</sup>. The fat content of *saravallai* dhal powder was  $7.94 \pm 2.52$  g percent. The groundnut used in its preparation has contributed considerable amount of fat.

The total mineral quantity, expressed as ash content was  $12.3 \pm 0.2$  percent. While the calcium content of SDP was high at  $589.33 \pm 8.14$  mg percent, the magnesium was low at  $112 \pm 5.29$  mg percent but the iron was quite low  $30.13 \pm 2.40$  mg. The vitamins namely  $\beta$ -carotene, thiamine, riboflavin and vitamin-c content were  $544.66 \pm 28.30 \mu\text{g}$ ,  $0.32 \pm 0.02 \text{mg}$ ,  $0.1 \pm 0.02 \text{mg}$  and  $29.38 \pm 1.19 \text{mg}$  respectively. Vitamins such as niacin, pyridoxine and cyanocobalamine were below detectable levels.

The *saravallai* dhal powder had a moisture content of  $4.92 \pm 0.05$ g percent. Although the green leafy vegetable, *saravallai*, that was used for the preparation of "*saravallai* dhal powder" had a high moisture content as it was completely dried, packed in HDPE covers and stored in airtight containers, the moisture content of SDP was quite low. Food Safety and Standards Authority of India(2011)<sup>14</sup>, states a value of not more than 14 and 15 percent by weight for moisture and crude fiber in dry curry powders. The present sample's moisture was well within the standard as quoted by FSSAI but the crude fiber content of SDP was a little higher at  $18.6 \pm 0.52$ g percent.

Acid Insoluble Ash that indicates the presence of extraneous matter in edible foods was  $0.05 \pm 0.02$ g and well

below the FSSAI standards of "not more than 2% by weight". The contaminant lead and anti-nutrient factors such as phytic acid and oxalates were  $0.21 \text{mg} \pm 0.01$ ,  $1.08 \pm 0.05$  and  $1.43 \pm 0.13$  in the prepared *saravallai* dhal powder.

### Acceptability of *saravallai* dhal powder (SDP)

The three variations (1:5, 3:5 and 5:5) of *saravallai* dhal powder prepared were evaluated by the taste panel members and the results are presented below in Table-3

SDP<sub>1</sub> which was prepared with one part of *Saravallai* powder and five parts of dhal powder was dull green in color hence scored only  $2.4 \pm 0.51$ . Although it had a good roasted bengal gram flavor ( $2.5 \pm 0.52$ ), the sensory panel members rated low in comparison to the other two variations which had a pronounced greens flavor. Its texture, taste and overall acceptability scores were also below three on a five point scale. The second variation i.e. SDP<sub>2</sub> was better than SDP<sub>1</sub>. The scores were between  $3.4 \pm 0.51$  (flavor) to  $3.7 \pm 0.48$  (taste). Its overall mean score was  $3.64 \pm 0.23$ . SDP<sub>2</sub> variation's color and appearance was bright green and better than that of SDP<sub>1</sub> as the amount of *saravallai* dhal powder was more i.e. three parts for every five parts of dhal powder. It could also be observed that as the proportion of *saravallai* dhal powder increased the sensory scores bettered and so also the acceptability. The third and last variation SDP<sub>3</sub> which was prepared with equal amounts of *saravallai* powder and dhal powder was favored much by all the taste panel members and was scored above four for all sensory parameters.

### Acceptability of *saravallai* dhal powder incorporated recipes

The sensory evaluation scores of the various dishes namely rice, side dish powder, *murukku*, *galagala*, *onion chutney*, *tomato thokku*, *potato fry* and *dhal sambar* which were incorporated with *saravallai* dhal powder are presented in Tables-4 to 9 respectively.

From the above Table-4 it could be understood that, of the three variations, the third one (SDR<sub>3</sub>) which received 10 percent incorporation of *saravallai* dhal powder obtained the highest score in all the five sensory parameters namely color and appearance ( $4.9 \pm 0.31$ ), flavor ( $4.8 \pm 0.42$ ), texture ( $4.5 \pm 0.52$ ) and taste ( $4.8 \pm 0.42$ ). Hence, overall it was the best acceptable ( $4.66 \pm 0.25$ ) variation. SDR<sub>1</sub> obtained low score for color and appearance ( $2.4 \pm 0.51$ ), flavor ( $2.3 \pm 0.48$ ), texture ( $2.3 \pm 0.48$ ), and taste ( $2.4 \pm 0.51$ ) because the percentage of incorporation of *saravallai* dhal powder was just three percent which was insufficient and could not impart any color, flavor and taste for the rice prepared.

In spite of the rice grains being well cooked and separate, the panelist liked SDR<sub>2</sub> or SDR<sub>3</sub> compared to SDR<sub>1</sub>. The SDR<sub>3</sub> had an attractive green color. It also tasted ( $4.8 \pm 0.42$ ) better than the other two variations with a good flavor ( $4.8 \pm 0.42$ ). SDR<sub>2</sub> variation's flavor and texture scores ( $2.6 \pm 0.51$  and  $2.8 \pm 0.42$ ) were lower than three but were better than that of SDR<sub>1</sub> variation's scores of  $2.3 \pm 0.48$  and  $2.3 \pm 0.48$  for the same sensory attributes.

### *Saravallai Idly Podi* (SIP)

*Idly podi* is a coarse mixture of ground dry spices that typically contains dried chillies, black gram dhal, chick pea and sesame seeds. Tamilians (India) use this as a substitute for chutney. This is used as a dipping condiment for *idlis*, *dosa* and other south Indian dishes after mixing with oil (sesame or other) to form a moist paste. The sensory scores of the same is presented in Figure-3 given below.

**Table 1. Nutrient content of saravallai dhal powder (SDP) per 100g**

Nutrients	Mean	Standard Deviation
Energy (kcal)	450.04	17.78
Carbohydrate (g)	58.89	2.21
Protein (g)	23.74	0.53
Fat(g)	7.94	2.52
Ash(mg)	12.3	0.2
Calcium(mg)	589.33	8.14
Iron(mg)	30.13	2.40
Zinc(mg)	0.90	0.10
Vitamin-C(mg)	29.38	1.19
$\beta$ -carotene ( $\mu$ g)	544.66	28.30
Thiamine(mg)	0.32	0.02
Riboflavin(mg)	0.10	0.02
Magnesium(g)	112.00	5.29

**Table 2. Quality characteristics of Saravallai dhal powder (SDP)**

Criteria	Saravallai dhal powder (Mean $\pm$ SD)	FSSAI values Not more than
Moisture (g)	4.92 $\pm$ 0.05	14% by weight
Acid Insoluble Ash (g)	0.05 $\pm$ 0.02	2% by weight on dry basis
Lead ( $\mu$ g)	0.21 $\pm$ 0.01	10.0 ppm on dry weight
Crude fiber (g)	18.6 $\pm$ 0.52	Not more than 15% by weight on dry basis
Oxalate(mg)	1.43 $\pm$ 0.13	
Phytic acid(mg)	1.08 $\pm$ 0.05	

**Table 3. Mean scores of saravallai dhal powder**

Sensory parameters	Control	Variations		
		SDP <sub>1</sub>	SDP <sub>2</sub>	SDP <sub>3</sub>
Mean $\pm$ SD				
Color and appearance	4.8 $\pm$ 0.42	2.4 $\pm$ 0.51	3.5 $\pm$ 0.52	4.5 $\pm$ 0.52
Flavor	4.6 $\pm$ 0.51	2.5 $\pm$ 0.52	3.4 $\pm$ 0.51	4.6 $\pm$ 0.51
Texture	4.7 $\pm$ 0.48	4.0 $\pm$ 0	4.0 $\pm$ 0	4.6 $\pm$ 0.51
Taste	4.8 $\pm$ 0.42	2.8 $\pm$ 0.42	3.7 $\pm$ 0.48	4.8 $\pm$ 0.42
Overall acceptability	4.7 $\pm$ 0.48	2.5 $\pm$ 0.52	3.6 $\pm$ 0.51	4.7 $\pm$ 0.48
Mean score	4.72 $\pm$ 0.08	2.84 $\pm$ 0.65	3.64 $\pm$ 0.23	4.64 $\pm$ 0.11

**Saravallai Dhal powder Rice (SDR)****Table 4. Mean sensory scores of saravallai dhal powder incorporated rice**

Sensory parameters	Control	Variations		
		SDR <sub>1</sub>	SDR <sub>2</sub>	SDR <sub>3</sub>
Mean $\pm$ SD				
Color and appearance	4.9 $\pm$ 0.31	2.4 $\pm$ 0.51	3.5 $\pm$ 0.52	4.9 $\pm$ 0.31
Flavor	4.8 $\pm$ 0.42	2.3 $\pm$ 0.48	2.6 $\pm$ 0.51	4.8 $\pm$ 0.42
Texture	4.6 $\pm$ 0.51	2.3 $\pm$ 0.48	2.8 $\pm$ 0.42	4.5 $\pm$ 0.52
Taste	5.0 $\pm$ 0	2.4 $\pm$ 0.51	3.3 $\pm$ 0.48	4.8 $\pm$ 0.42
Overall acceptability	5.0 $\pm$ 0	2.4 $\pm$ 0.51	3.2 $\pm$ 0.63	4.3 $\pm$ 0.48
Mean score	4.86 $\pm$ 0.16	2.36 $\pm$ 0.05	3.08 $\pm$ 0.37	4.66 $\pm$ 0.25

**Table 5. Mean sensory scores of saravallai dhal powder incorporated murukku**

Sensory parameters	Control	Variations		
		SDM <sub>1</sub>	SDM <sub>2</sub>	SDM <sub>3</sub>
Mean $\pm$ SD				
Color and appearance	4.9 $\pm$ 0.31	4.0 $\pm$ 0.66	4.5 $\pm$ 0.52	4.7 $\pm$ 0.48
Flavor	4.8 $\pm$ 0.42	3.6 $\pm$ 0.51	4.1 $\pm$ 0.87	4.7 $\pm$ 0.48
Texture	5.0 $\pm$ 0	3.7 $\pm$ 0.48	3.9 $\pm$ 0.56	4.8 $\pm$ 0.42
Taste	5.0 $\pm$ 0	3.2 $\pm$ 0.42	4.3 $\pm$ 0.48	4.9 $\pm$ 0.31
Overall acceptability	5.0 $\pm$ 0	3.2 $\pm$ 0.25	3.8 $\pm$ 0.42	4.5 $\pm$ 0.52
Mean score	4.94 $\pm$ 0.08	3.54 $\pm$ 0.34	4.12 $\pm$ 0.28	4.72 $\pm$ 0.14

**Table 6. Mean sensory scores of saravallai dhal powder added galagala**

Sensory parameters	Control	Variations		
		SDG <sub>1</sub>	SDG <sub>2</sub>	SDG <sub>3</sub>
Mean±SD				
Color and appearance	4.9±0.31	4.8±0.42	4.1±0.31	3.0±0
Flavor	4.8±0.42	2.6±0.51	3.4±0.51	4.5±0.52
Texture	4.9±0.31	2.6±0.51	3.7±0.48	4.7±0.48
Taste	5.0±0	3.2±0.42	3.7±0.48	4.8±0.42
Overall acceptability	5.0±0	2.8±0.42	3.8±0.42	3.7±0.48
Mean score	4.92±0.08	3.2±0.92	3.74±0.25	4.14±0.77

**Table 7. Mean sensory scores of saravallai dhal powder added Tomato thokku**

Sensory parameters	Control	Variations		
		STT <sub>1</sub>	STT <sub>2</sub>	STT <sub>3</sub>
Mean±SD				
Color and appearance	4.8±0.42	2.5±0.52	3.1±0.73	4.4±0.69
Flavor	4.9±0.31	2.9±0.73	3.6±0.51	4.2±0.42
Consistency	4.7±0.48	3.1±0.56	3.6±0.51	4.5±0.70
Taste	4.9±0.31	2.6±0.69	3.6±0.84	4.1±0.73
Overall acceptability	5.0±0	3.0±0.81	3.6±0.51	4.3±0.82
Mean score	4.86±0.11	2.82±0.25	3.5±0.22	4.3±0.15

**Table 8. Mean sensory scores of saravallai dhal powder incorporated Potato Fry**

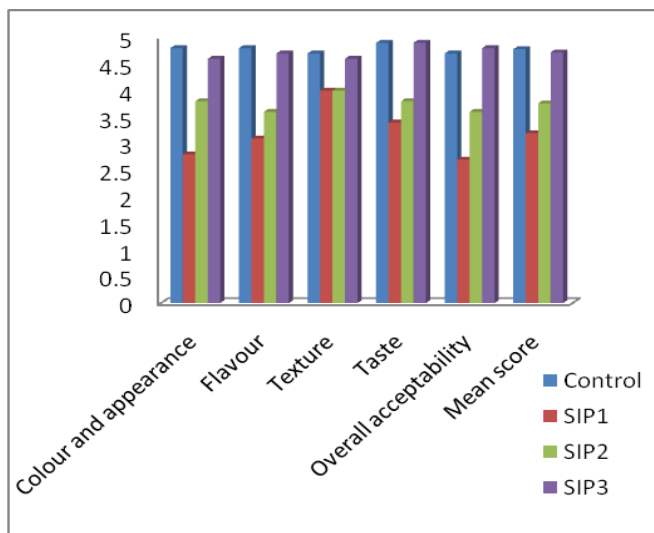
Sensory parameters	Control	Variations		
		SPF <sub>1</sub>	SPF <sub>2</sub>	SPF <sub>3</sub>
Mean±SD				
Color and appearance	4.9±0.31	4.1±0.56	3.8±0.42	3.9±0.31
Flavor	5.0±0	3.1±0.73	3.5±0.52	4.4±0.51
Texture	4.8±0.42	2.8±0.42	3.2±0.78	4.5±0.52
Taste	5.0±0	2.7±0.67	3.4±0.51	4.7±0.48
Overall acceptability	5.0±0	3.2±0.63	3.8±0.63	4.3±0.67
Mean score	4.94±0.08	3.18±0.55	3.54±0.26	4.36±0.29

**Table 9. Mean sensory scores of saravallai dhal powder incorporated dhal sambar**

Sensory parameters	Control	Variations		
		SDS <sub>1</sub>	SDS <sub>2</sub>	SDS <sub>3</sub>
Mean±SD				
Color and appearance	4.9±0.31	3.4±0.51	3.5±0.52	4.6±0.51
Flavor	4.7±0.48	3.3±0.48	3.9±0.87	4.2±0.91
Consistency	4.6±0.51	3.2±0.25	3.6±0.51	4.5±0.52
Taste	5.0±0	3.5±0.52	4.0±0.66	4.6±0.51
Overall acceptability	4.9±0.31	3.3±0.48	3.6±0.51	4.3±0.48
Mean score	4.82±0.16	3.34±0.11	3.72±0.21	4.44±0.18

**Table 10. Analysis of variance for overall acceptability of saravallai dhal powder recipes**

Criteria	SDR	SIP	SDM	SDG	SOC	STT	SPF	SDS
F-Ratio	59.07	40.46	59.95	55.41	49.71	18.6	18.55	24.76
F critical	2.866266							



**Figure 3. Mean sensory scores of saravallai Idly Podi**

When the three variations of *saravallai* dhal powder was presented as a side dish for *Dosa*, *Idly* and *Chapathi* the panel members opined that the *saravallai* incorporated dhal powder was almost like curry leaves powder with a good flavor and taste. However only the third variation (SIP<sub>3</sub>) which contained 10 percent *saravallai* dhal powder received the highest scores in all organoleptic parameters (Table-). The scores of this variation were comparable to that of the control.

SIP<sub>3</sub> was grainy in texture ( $4.6 \pm 0.51$ ) was well acceptable. Whereas, SIP<sub>1</sub> and SIP<sub>2</sub> were coarse hence obtained a little lower score of  $4.0 \pm 0$ . Similarly the color and appearance of SIP<sub>1</sub> ( $2.8 \pm 0.42$ ) and SIP<sub>2</sub> ( $3.8 \pm 0.42$ ) was pale to light green and was not liked by the taste panelists. It could also be observed from the above figure-1 that as the percentage of *saravallai* dhal powder incorporation increased, the flavor, taste and overall acceptability scores gradually improved.

#### Saravallai Dhal Murukku (SDM)

Murukku is a crunchy Indian savoury snack. It derives its name from the Tamil word for "twisted". It originated in Tamil Nadu state. It is typically made from rice flour and black gram dhal flour. This dish has many variations based on the type and proportions of flour used.

During the evaluation of *murukku* the deep fried savory item that was incorporated with *saravallai* dhal powder at three, six and ten percent, all the three variations of *murukku* scored above four for color and appearance, because they had a light to dark greenish tint which was appealing. SDM<sub>1</sub> consistently obtained a score of less than four in all the sensory parameters except that of color. With respect to flavor SDM<sub>2</sub> and SDM<sub>3</sub> were better than SDM<sub>1</sub> with  $4.1 \pm 0.87$  and  $4.7 \pm 0.48$  scores. However between SDM<sub>2</sub> and SDM<sub>3</sub> the later was the best. This is because of the higher amount of *saravallai* dhal powder that had helped to enhance the flavor. The same trend could be observed with respect to taste scores also. The panel members were of the opinion that 10 percent *saravallai* dhal powder incorporated *murukku* had a pleasant "green leafy flavor" and was tastier than the other two variations i.e. SDM<sub>1</sub> and SDM<sub>2</sub>.

#### Saravallai Galagala (SDG)

It is a simple, tasty, crispy, flattened, diamond shaped tea time sweet- snack prepared with wheat flour or all-purpose flour and sugar.

It was clear from the above Table -6 that the color and appearance score of (sweet diamond cuts) *galagala* decreased with increasing addition of *saravallai* dhal powder namely three, six and 10 percent. On the contrary it could be seen from the

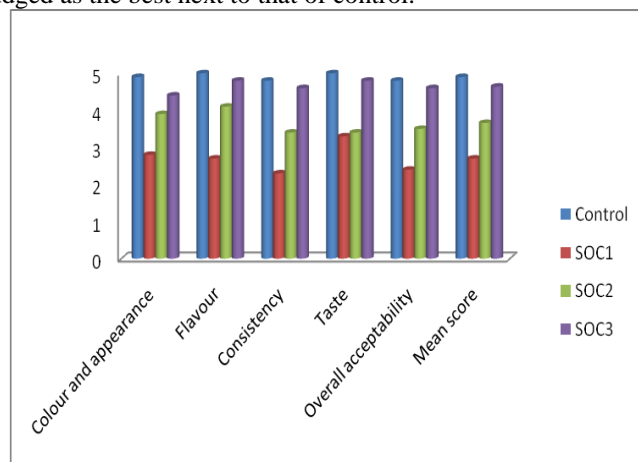
flavor, texture and taste scores that as the percentage of incorporation of *saravallai* dhal powder increased, the scores became better indicating that each variation is superior to the preceding one.

Although-SDG<sub>1</sub> obtained quite a low score for flavor ( $2.6 \pm 0.51$ ), texture ( $2.6 \pm 0.51$ ), and overall acceptability ( $2.8 \pm 0.42$ ) it got a better score of  $3.2 \pm 0.42$  for taste. It is quite obvious from the above table that in spite of having good flavor ( $4.5 \pm 0.52$ ), texture ( $4.7 \pm 0.48$ ) and taste ( $4.8 \pm 0.42$ ), the SDG<sub>3</sub> did not fare well in overall acceptability because its low color score ( $3.0 \pm 0$ ). While SDG<sub>1</sub> was little soggy in texture ( $2.6 \pm 0.51$ ), SDG<sub>2</sub> ( $3.7 \pm 0.48$ ) and SDG<sub>3</sub> ( $4.7 \pm 0.48$ ) were crispier hence a better score and infact the texture of SDG<sub>3</sub> ( $4.7 \pm 0.48$ ) was almost like that of control *galagala*'s texture.

#### Saravallai Onion Chutney (SOC)

Chutney is a unique, tangy, sweet, spicy, flavorful condiment made from a highly variable mixture of vegetable or fruit mash and associated with South Asian cuisine. It is a good dipping accompaniment for *idli*, *dosa* and even *appam* the popular South Indian breakfast foods.

Onion *chutney* prepared by adding three, six and 10 percent *saravallai* dhal powder was evaluated (Fig-5) by taste panelist and they opined that the color of SOC<sub>3</sub> was more greenish and it resembled coriander or mint *chutney*. Hence the score was the top most  $4.4 \pm 0.51$ , whereas SOC<sub>1</sub> had an unappealing dull green color and is evident by the low score of  $2.8 \pm 0.63$ . However SOC<sub>2</sub> was better than SOC<sub>1</sub> in terms of color and appearance, flavor, texture and taste. While the consistency of SOC<sub>1</sub> was semi thin ( $2.3 \pm 0.48$ ), it was relatively thick in SOC<sub>2</sub> ( $3.4 \pm 0.51$ ) and SOC<sub>3</sub> ( $4.6 \pm 0.51$ ), because of the higher quantity of *saravallai* dhal powder blended. As far as taste was concerned both SOC<sub>1</sub> and SOC<sub>2</sub> were almost the same and scored  $3.3 \pm 0.48$  and  $3.4 \pm 0.69$  only. Overall the third variation (SOC<sub>3</sub>) only: was judged as the best next to that of control.



**Figure 5. Mean sensory scores of saravallai dhal powder incorporated onion chutney**

#### Saravallai Tomato Thokku (STT)

*Thokku* is a Tamil term meaning a spicy, glossy vegetable or fruit mash concentrated to a semi gravy state. It is a sort of pickle that can be made in a short time and used as a dipping accompaniment for South Indian breakfast items or mixed with rice and consumed. It has a good keeping quality when prepared hygienically with sufficient oil and spices

It is evident from the above Table-7 that the standard tomato *thokku* was the best in all sensory attributes namely color and appearance ( $4.8 \pm 0.42$ ), flavor ( $4.9 \pm 0.31$ ), consistency ( $4.7 \pm 0.48$ ), taste ( $4.9 \pm 0.31$ ) and overall acceptability ( $5.0 \pm 0$ ). The third variations (STT<sub>3</sub>) that was prepared with 10 percent

*saravallai* dhal powder was comparable to that of control in all the sensory characteristic with  $4.4 \pm 0.69$  (color and appearance),  $4.2 \pm 0.42$  (flavor),  $4.5 \pm 0.70$  (consistency),  $4.1 \pm 0.73$  (taste) and  $4.3 \pm 0.82$  (overall acceptability) scores. The other two variations namely STT<sub>1</sub> and STT<sub>2</sub> did not fare well in the sensory evaluation and both obtained low overall mean score of  $2.82 \pm 0.25$  and  $3.5 \pm 0.22$  because their color was dull reddish green and unappealing, consistency was semi thin, did not have the appetizing flavor of roasted gram and tasted fair compared to that of control and STT<sub>3</sub>. It could also be found that although the STT<sub>2</sub> did get scores above 3.5 in flavor, consistency, taste and over all acceptability due to its unappealing color ( $3.1 \pm 0.73$ ) the total mean score got reduced.

#### Saravallai Potato Fry (SPF)

The other preparation that was subjected to sensory evaluation (Fig-8) was potato fry. Potato fry is an easy quick and delicious stir fry recipe. It is a good accompaniment to many meals. Along with the regular ingredients used for seasoning the *saravallai* dhal powder was added at three, six and 10 percent to enrich its nutritional value.

It could be observed from the above Table-8 that color scores gradually decreased from  $4.1 \pm 0.56$  (SPF<sub>1</sub>) to  $3.9 \pm 0.31$  (SPF<sub>3</sub>) as the percentage of *saravallai* dhal powder addition increased (Three to ten percent). The members of the taste panelist were of the opinion that the color of turmeric and green color of *saravallai* dhal powder did not merge well when the percent of *saravallai* dhal powder increased.

While the control potato fry received a score of  $4.9 \pm 0.31$  for color and appearance, SPF<sub>3</sub> obtained  $3.9 \pm 0.31$ . The potato fry (SPF<sub>3</sub>) was less attractive because of the dark green color. As far as color and appearance was concerned SPF<sub>1</sub> scored better ( $4.1 \pm 0.56$ ) than SPF<sub>2</sub> ( $3.8 \pm 0.42$ ) and SPF<sub>3</sub> ( $3.9 \pm 0.31$ ) because of the mild green color. With respect to flavor, texture and taste; SPF<sub>3</sub> was the best next to the control. Overall the acceptability was better for SPF<sub>3</sub> compared to the other two. Both the control and SPF<sub>3</sub> potato fry were well cooked and crispier outside. Hence texture scores were better than SPF<sub>1</sub> and SPF<sub>2</sub> which were less crunchy.

#### Saravallai Dhal Sambar (SDS)

Sambar is a lentil based vegetable stew made with tamarind extract. It is used as a side dish for South Indian breakfast items like *idly*, *dosa* and also used to mix with plain white rice. It is consumed almost daily in Tamil households.

*Sambar* a regularly consumed item as an accompaniment in Tamil households was also incorporated with *saravallai* dhal powder at three different variations (Three, six and ten percent) and subjected to organoleptic evaluation. While the control *sambar* and SDS<sub>3</sub> had a pleasing color and appearance and looked appetizing with a score of  $4.9 \pm 0.31$  and  $4.6 \pm 0.51$ ; SDS<sub>1</sub> and SDS<sub>2</sub> appeared dull green in color and their scores were below four on a five point hedonic scale. Whereas the SDS<sub>3</sub> obtained a score of above four for all sensory attributes. The third variation of *sambar* (SDS<sub>3</sub>) had a pronounced greens flavor and was highly appealing. The control *sambar* was thick in consistency ( $4.6 \pm 0.51$ ). Addition of three, six and ten percent *saravallai* dhal powder had made the *sambar* too thick or gluey. As far as taste was concerned the organoleptic evaluation panel members were of the opinion that the control *sambar* ( $5.0 \pm 0$ ) was the best. Next in line was SDS<sub>3</sub> ( $4.6 \pm 0.51$ ).

#### Mean Overall acceptability score

The overall acceptability scores of all the preparations were computed as percentages and is depicted in Figure-6

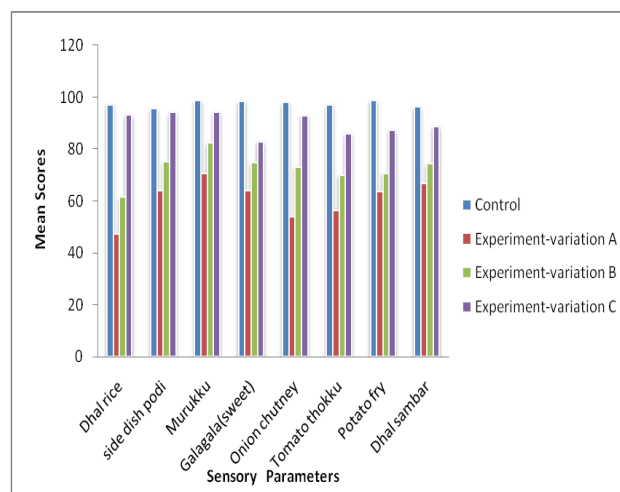


Figure 6. Mean overall acceptability score percentage of *saravallai* dhal powder incorporated recipes

#### Statistical Analysis

Analysis of variance technique was used for the analyzing the variations among the experimental groups of all the eight preparations individually and it is presented in the Table 10 given below

A large F ratio means that the variation among group means is more and based on the degrees of freedom (sample size) at the desired level of significance the null hypothesis may be accepted or rejected. In this study, as per the control group and the experimental groups (A, B and C) the F values are calculated and for all the preparations the calculated values are greater than the F – Critical Value at 5% level of significance. Hence the null hypothesis is rejected. There is a significant difference between the control group and experimental groups. The means of the variations are not equal. And it is statistically significant among the control and the three variations prepared as determined by one-way ANOVA in *saravalli* incorporated rice (SDR-F =59.07), *Idly podi* (SIP-F=40.46) *murukku* (SDM-F59.95), *Galala* (SDG-F=55.41), *Onion Chutney* (SOC-F49.71), *Tomato Thokku* (STT-F=18.6) *Potato fry* (SPF-F=18.55) and *Dhal sambar* (SDS-F=24.76).

#### Summary and conclusion

Some of the highlights of the study are listed below:

- An equal amount of *saravallai* powder and dhal powder can be mixed and a highly acceptable *saravallai* dhal powder can be prepared.
- SDP<sub>3</sub> addition (10 percent) did not alter the sensory qualities of *rice*, *murukku*, *galagala*, *onion chutney*, *tomato thokku*, *potato fry* and *dhal sambar*.

#### Acknowledgement

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