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Standardization and sensory evaluation of Manali tamarind (*Pithecellobium dulce*) based Chutney powder.

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ABSTRACT

Underutilized fruits are known as the powerhouse of nutrients and possess very high anti-oxidants and medicinal properties in spite of all these benefits their cultivation and consumption on a commercial basis are very low. For a substantial portion of the population's nutritional security, low-cost, underutilized vegetable processing and value addition are crucial to reducing significant post-harvest losses to a greater extent. Consumption of chutney powder as a food adjunct is a common practice in Indian tradition. In this present study, instant chutney powder was developed using dried Manali tamarind aril powder. Different formulations ranged from 10.0% to 70.0% incorporation of dried aril powder were developed and the best combination was selected through sensory evaluation by using a 9-point hedonic scale. It was noted that 40.0% dry aril-incorporated chutney powder was best accepted. Due to the fruit's seasonality, there was a limited supply and difficulty obtaining the raw ingredients.

Keywords: *Manali tamarind, tray drying, standardization, aril powder, Roasted Bengal gram dhal, chutney powder, and sensory evaluation.*

Introduction

Wild fruits are significant sources of dietary, nutritional, and phytochemical sources [2]. More than 300,000 higher plants are thought to exist in the earth, of which at least 250,000 have been identified botanically 30,000 are edible, and only 7000 are grown specifically on a commercial basis (23.3%) for human consumption [3]. The bulk of plants that have been reported as edible are often wild or semi-domesticated, and they are generally regarded as underutilized fruits. Because of researcher's and decision-makers', inattentiveness, they are on the point of being extinct [12].

Underutilized fruits are substitute sources of food, nutrition, and bioactive phytochemicals in light of these issues, they can be used to domesticate, cultivate additionally, neglected fruits and nuts open up new possibilities for adding value, diversifying uses, and generating employment in the fight against poverty [9].

Manali tamarind belongs to Fabaceae and its origin is America, also cultivated throughout India in different places due to its medicinal and nutritional benefits [16].

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It was known by different names in different parts of India "Vilayati Babul" in Hindi, Seema chinta or Cheema chinta in Telugu, "Kodukkapuli" in Tamil, and "Jungal jalebi," "black bead tree" and "Manali tamarind" in English [11].

Table 1. Taxonomical description of Pithecellobium dulce

Domain	Eukaryota
Kingdom	Plantae
Sub Kingdom	Viridiplantae
Infra Kingdom	Streptophyta
Phylum	Spermatophyta
Sub phylum	Angiospermae
Class	Dicotyledonae
Division	Tracheophyta
Order	Fabales
Family	Fabaceae
Genus	Pithecellobium
Species	*Pithecellobium dulce*

Pithecellobium dulce is a medium-sized tree attaining a height of 10-15 meters with irregular branches and bi-pinnate leaves with thin spines which were present at the base of the leaves ranging from 2 to 15mm [15]. Flowers are greenish white are borne on short panicles which were 10 to 20 cm in length, which composes 20 to 30 floral units [10]. Pods that are thick, spongy, dry pulp were 10 to 15cm, and the color became reddish-brown as progressed towards maturity. Each pod contains 5 to 12 shiny black seeds which makes it easy to distinguish it from others. For 1 kg 9,000 to 26,000 seeds were present, the bark is grey, and it becomes rough eventually [4].

Climatic conditions and area of cultivation: It is very commonly seen in tropical and sub- tropical areas on the roadside, and it has large unaccounted areas of forest [7]. It is widely distributed around south and central Africa and America, Portuguese and Spaniards introduced it to India it is commonly grown in many parts however it is grown as a forest species in north-eastern states, Orissa, and in Andaman Island as a food tree [13].

It grows in dry to semi-arid, sub-tropical, and tropical climatic conditions with an average rainfall ranging from 500 to 1000 mm. It can withstand shade and drought conditions, but it is highly susceptible to severe frost. It can survive at very low annual rainfall conditions which is less than 400 mm [17]. It grows well in semiarid regions were temperatures range from 7°C to 8°C in January and 40°C to 42°C in May and June. It can resist a wide range of soil types which includes nutrient-poor, clay, and rocky limestone soils, and in India grows well on saline sites and on severely eroded wastelands [6].

The expressions of culture, identity, heritage, and way of life are found in traditional meals. To maintain and increase market share, traditional food's quality level (i.e., safety, processing and preparation, and health) is crucial [5].

The most widely used product as a food adjunct in India is chutney powder, which is typically eaten as a side dish with rice or morning foods like idly, dosa, and vada. It functions as an auxiliary food and improves the food's palatability. Most often seen on the market were chutney powders made with legumes, curry leaves, tamarind, and mango powder [1].

As it was a seasonal fruit it cannot be available throughout the year so to store it for further usage it was dried and can be preserved for a longer period. These dried arils can be used to make a variety of ready-to-eat food adjuncts, providing nutrients in concentrated quantities. In the present study, an attempt has been made to prepare ready-to-eat instant chutney powders with the incorporation of dried aril powder.

Materials and Methods

The present study was conducted at the Department of Foods and Nutrition, Postgraduate and Research Center (PG&RC), Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana (India).

Procurement of raw materials: Manali tamarind, roasted Bengal gram dhal, cumin seeds, chilli powder, and salt were procured from local markets of Hyderabad.

Tray drying: Manali tamarind was peeled, and seeds were removed from the arils, the arils were blanched at 80°C for 5 minutes and then tray dried at 60°C for five and half hours and then made into powder.

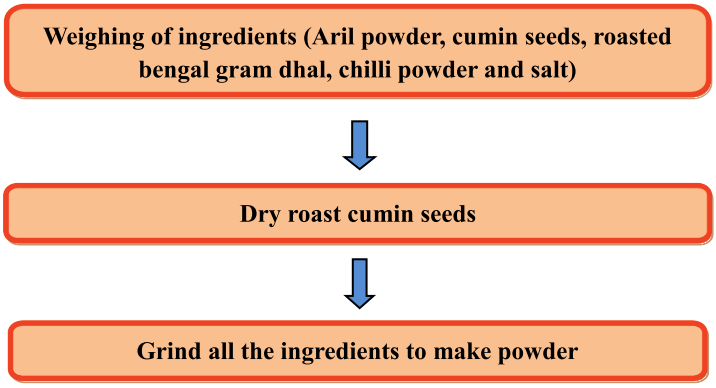

Figure1. Flow chart for preparation of chutney powder

Standardization of chutney powder: It is a process where product is tested repeatedly throughout to produce the intended result [14]. Chutney powders were made in different combinations where the ingredients like dried aril powder, roasted cumin seeds, chilli powder, roasted Bengal gram dhal, and salt all were blended. The different combinations that were developed given in Table 2.

Table 2. Formulations of chutney powder prepared by 10% to 70% incorporation of dried aril powder.

S. No.	Ingredients	Control	CP_1	CP_2	CP_3	CP_4	CP_5	CP_6	CP_7
1	Roasted Bengal gram	70.0g	60.0g	50.0g	40.0g	30.0g	20.0g	10.0g	0g
2	Salt	5.0g	5.0g	5.0g	5.0g	5.0g	5.0g	5.0g	5.0g
3	Chilli powder	20.0g	20.0g	20.0g	20.0g	20.0g	20.0g	20.0g	20.0g
4	Cumin seeds	5.0g	5.0g	5.0g	5.0g	5.0g	5.0g	5.0g	5.0g
5	Dry aril powder	0.00	10.0g	20.0g	30.0g	40.0g	50.0g	60.0g	70.0g

Control: 0.0% incorporation of dried aril powder coded as (100)
CP_1: 10.0% incorporation of dried aril powder coded as (707)
CP_2: 20.0% incorporation of dried aril powder coded as (101)
CP_3: 30.0% incorporation of dried aril powder coded as (202)
CP_4: 40.0% incorporation of dried aril powder coded as (103)
CP_5: 50.0% incorporation of dried aril powder coded as (404)
CP_6: 60.0% incorporation of dried aril powder coded as (505)
CP_7: 70.0% incorporation of dried aril powder coded as (606)

Sensory evaluation: Each product was coded with a three-digit number and examined by 15 semi-trained panelists at PGRC, PJTSAU, where standardization was carried out by sensory evaluation utilizing a nine-point hedonic scale. Based on sensory factors such as appearance, color, flavor, texture, taste, and overall acceptability, they were asked to rate the product. They were given water to rinse their mouths to prevent the taste of other chutney powders from blending in, and they were asked to rate the product on a scale of 1 to 9, with 1 representing an extreme dislike (very awful) and 9 representing an extreme liking (the product is great in that particular feature) [8].

Results and Discussion

Table 3. Mean sensory scores of Chutney powders with 10.0 to 70.0% aril powder incorporation

Sample	Appearance	Color	Texture	Flavor	Taste	Overall acceptability
Control	8.16^{a}±0.51	8.11^{a}±0.47	7.94^{b}±0.53	8.00^{ab}±0.48	8.11^{a}±0.47	7.88^{b}±0.58
CP_1	8.16^{a}±0.51	8.11^{a}±0.47	7.77^{bc}±0.54	7.55^{c}±0.51	7.61^{bc}±0.50	7.66^{bc}±0.48
CP_2	7.83^{bc}±0.51	7.94^{a}±0.53	7.83^{bc}±0.51	7.88^{ab}±0.47	7.72^{bc}±0.57	7.83^{b}±0.51
CP_3	7.23^{d}±0.43	6.58^{c}±0.50	7.11^{d}±0.33	7.17^{d}±0.39	7.23^{d}±0.43	7.05^{d}±0.55
CP_4	8.33^{a}±0.48	8.22^{a}±0.42	8.27^{a}±0.46	8.16^{a}±0.51	8.11^{a}±0.47	8.22^{a}±0.42
CP_5	8.05^{ab}±0.53	8.00^{a}±0.48	8.00^{ab}±0.48	7.72^{bc}±0.46	7.94^{ab}±0.53	7.88^{b}±0.57
CP_6	7.70^{c} ±0.46	7.61^{b}±0.50	7.61^{c}±0.50	7.44^{cd}±0.51	7.66^{bc}±0.48	7.61^{bc}±0.50
CP_7	7.77^{bc}±0.42	7.55^{b}±0.51	7.88^{bc}±0.47	7.44^{cd}±0.51	7.44^{c}±0.51	7.50^{c}±0.51
Mean	7.90	7.76	7.80	7.67	7.72	7.70
SE of Mean	0.48	0.58	0.04	0.47	0.04	0.49
CD	0.30	0.30	0.31	0.31	0.33	0.32
% CV	5.83	6.02	6.03	6.17	6.53	6.42

Note: Values are expressed as mean ± standard deviation of fifteen determinations.
Means within the same column followed by a common letter do not significantly differ at $p \leq 0.05$.
Control: Roasted Bengal gram dhal (7.0): Dried aril powder (0)
CP_1: Roasted Bengal gram dhal (6.0): Dried aril powder (1.0)
CP_2: Roasted Bengal gram dhal (5.0): Dried aril powder (2.0)
CP_3: Roasted Bengal gram dhal (4.0): Dried aril powder (3.0)
CP_4: Roasted Bengal gram dhal (3.0): Dried aril powder (4.0)
CP_5: Roasted Bengal gram dhal (2.0): Dried aril powder (5.0)
CP_6: Roasted Bengal gram dhal (1.0): Dried aril powder (6.0)
CP_7: Roasted Bengal gram dhal (0.0): Dried aril powder (7.0)

Appearance: The scores ranged between (7.23±0.43) to (and 8.33±0.48) The best score was for CP_4(40.0% incorporation of aril) and least was for CP_3(30.0% incorporation of aril). The scores for appearance was in the order of CP_4(8.33±0.48)>Control (8.16±0.51)> CP_1(8.16±0.51)> CP_5(8.05±0.53)>CP_2(7.83±0.51)>CP_7(7.77±0.42)>CP_6(7.70±0.46)>CP_3(7.23±0.43). There was statistically significant difference for appearance in CP_3 and CP_6 at $p \leq 0.05$, slight significant difference was observed for CP_5, CP_2 and Cp_7.

Figure 2Formulations of chutney powders

Correlation for sensory scores

Table 4.4. Correlation appearance for Chutney powder

	Control	CP_1	CP_2	CP_3	CP_4	CP_5	CP_6	CP_7
Control	1							
CP_1	-0.111	1						
CP_2	-0.111	0.333	1					
CP_3	0.356	0.089	-0.089	1				
CP_4	0.000	0.00	0.235	0.188	1			
CP_5	0.601**	0.177	0.035	-0.056	-0.299	1		
CP_6	-0.041	-0.041	0.289	0.033	-0.087	0.302	1	
CP_7	-0.089	-0.089	0.356	0.285	0.094	0.056	0.563*	1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
n- no. of observations (18)
H_0: There is no significant relationship among chutney powder combinations.

Table 4.4 revealed that, there was a moderate positive correlation of ($r = 0.601$, $p < 0.01$) between CP_5 and control, which was due to the impact of drying on the color of aril powder which was similar to that of control chutney powder, and also between $CP_7$and CP_6($r = 0.563$, $p < 0.05$) as highest addition of aril powder in them which was 70.0% and 60.0%. The increased amount of aril powder could lead to similarities in taste, texture, or other characteristics, resulting in a positive correlation between these control points. Hence, the null hypothesis was rejected, and the alternate hypothesis was accepted. Therefore, it could be inferred that there was a positive and significant relationship between the CP_5 and control, CP_7 and CP_6. However, no significant relationship was found between CP_4 with control and Cp_1.

Color: The scores ranged between (8.22±0.42) to (and 7.55±0.51) highest score for color was for CP_4(40.0% incorporation of aril) and the least was for CP_7. The scores of colour was in the order ofCP_4(8.22±0.42)>Control(8.11±0.47)>CP_1(8.11±0.47)>CP_5(8.00±0.48)>CP_2(7.94±0.53)>CP_6(7.61±0.50)>CP_7(7.55±0.51)>CP_3(6.58±0.50). There was a significant difference at $p \leq 0.05$ for CP_3, CP_6 and Cp_7.

Table 4.5. Correlation of colour for Chutney powder

	Control	CP_1	CP_2	CP_3	CP_4	CP_5	CP_6	CP_7
Control	1							
CP_1	-0.059	1						
CP_2	-0.206	0.488*	1					
CP_3	-0.515*	0.460	0.545*	1				
CP_4	-0.129	0.453	0.566*	0.209	1			
CP_5	0.257	0.000	0.000	0.000	0.000	1		
CP_6	-0.055	0.193	0.567*	-0.025	0.152	0.000	1	
CP_7	-0.027	0.216	-0.308	-0.125	-0.059	0.237	-0.254	1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
n- no. of observations (18)
H_0: There is no significant relationship among chutney powder combinations.

Table 4.5 revealed that, there was moderate negative relation between CP_3 and control ($r = 0.515$, $p < 0.05$) it could be due to the effect of drying and proper blending of the ingredients together. The addition of aril powder which had a light yellowish-brown tint blended properly with the Bengal gram dhal which had a light yellow colour. There was a moderate positive relation for CP_2 and CP_1 ($r = 0.488$, $p < 0.05$) it suggests that these two formulations had similar ingredient quantities. As the control point progresses from CP_1 to CP_2, there is a tendency for the ingredient quantities to increase together. There is a moderate positive relation for CP_2 with CP_3($r = 0.545$, $p < 0.05$), CP_4 ($r = 0.566$, $p < 0.05$), and CP_6($r = 0.567$, $p < 0.05$) it is suggesting that there are similarities in ingredient quantities between CP_2 and the combinations expect aril powder incorporation percentages. As CP_2 progresses towards CP_3, CP_4, and CP_6, there is a tendency for the ingredient quantities to increase together. Hence, the null hypothesis was rejected, and the alternate hypothesis was accepted. However, there is no relation was found between CP_5 with CP_1, CP_2, CP_3, CP_4, and CP_6 with Cp_5.

Texture: The score ranged between (8.27±0.46) to (and 7.11±0.33) The highest score for texture was for CP_4(40.0% incorporation of aril) and least was for CP_3(30.0% incorporation of aril). The scores was in the order of CP_4(8.27±0.46)>CP5(8.00±0.48)>Control (7.94±0.53)> CP_7(7.88±0.47)>CP_2(7.83±0.51)>CP1(7.77±0.54)>CP6(7.61±0.50)>CP_3(7.11±0.33). There was significant difference for CP_6 and CP_3andslightsignificant difference was observed for CP_1, CP_2, CP_5 and CP_7at $p \leq 0.05$.

Table 4.6. Correlation of texture for Chutney powder

	Control	CP_1	CP_2	CP_3	CP_4	CP_5	CP_6	CP_7
Control	1							
CP_1	0.154	1						
CP_2	-0.035	0.278	1					
CP_3	-0.637**	-0.184	0.117	1				
CP_4	0.065	0.025	-0.289	0.175	1			
CP_5	0.224	0.00	0.235	0.000	0.263	1		
CP_6	-0.084	0.095	0.417	-0.080	-0.268	0.241	1	
CP_7	0.668**	0.126	-0.080	-0.300	-0.120	0.000	0.055	1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
n- no. of observations (18)
H_0: There is no significant relationship among chutney powder combinations.
Table 4.6 revealed that there was a negative moderate relation of ($r = 0.637$, $p < 0.01$) for CP_3 and control it suggests that as the quantity of control (roasted bengal gram dhal) decreases, the quantity of the aril powder incorporation in CP_3 group tends to increase which has impact on the texture. Whereas CP_7 ($r = 0.668$, $p < 0.01$) moderate positive relation with control as the quantity of aril increased beyond 40.0% the acceptability of texture tends to decrease due to the impact of particle size and cohesiveness. The texture of the products decreased as the blending increased which led to choking. Hence, the null hypothesis was rejected, and the alternate hypothesis was accepted. However, there was no relation between CP_5 with CP_1 and CP_3, and CP_7 with CP_5.

Flavour: The score ranged between (8.16±0.51) to (7.17±0.39) highest score for flavour was for CP_4(40.0%incorporation of aril) and least was for CP_3(30.0% incorporation of aril). The orderwas CP_4(8.16±0.51)>Control(8.00±0.48)>CP_2(7.88±0.47)>CP_5(7.72±0.46)>CP_1(7.55±0.51)>CP_6(7.44±0.51)>CP_7(7.44±0.51)>CP_3(7.17±0.39). There was significant difference statistically at $p \leq 0.05$ for CP_1 and Cp_3.

Table 4.7. Correlation of flavor for Chutney powder

	Control	CP_1	CP_2	CP_3	CP_4	CP_5	CP_6	CP_7
Control	1							
CP_1	-0.237	1						
CP_2	0.514*	-0.216	1					
CP_3	0.00	0.1	0.108	1				
CP_4	0.471*	0.074	0.080	-0.149	1			
CP_5	0.00	-0.055	0.120	0.277	-0.537*	1		
CP_6	0.474*	-0.1	0.460	-0.1	0.149	0.305	1	
CP_7	-0.237	-0.1	-0.271	-0.1	-0.521*	0.554*	0.1	1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
n- no. of observations (18)
H_0: There is no significant relationship among chutney powder combinations.

Table 4.7 revealed that there was a moderate positive correlation of ($r = 0.514$, $p < 0.05$) for CP_2, ($r = 0.471$, $p < 0.05$) for CP_4 and ($r = 0.474$, $p < 0.05$) for CP_6 with control this indicates that as the quantity of aril increases, the quantity of the control tends to decrease which may contribute to enhancing the flavor. There was moderate negative relation for CP_5 at ($r = 0.537$, $p < 0.05$) with CP_4. There was an increase of aril powder percentages between CP_5 and CP_4. As the quantity of aril powder increased in CP_5 it had contrasting effects on the flavor, which potentially diminished the flavor associated with CP_4. There was moderate negative relation for CP_7 with CP_4 at ($r = 0.521$, $p < 0.05$) which was due to the increase of aril powder incorporation, and positive relation with CP_5 at ($r = 0.554$, $p < 0.05$) which was due to the increase of the aril quantity beyond 40.0% tends on the impact negatively on the flavor of the product. Hence, the null hypothesis was rejected, and the alternate hypothesis was accepted. However, there was no relation between CP_3, and CP_5 with control.

Taste: The score ranged between (8.11±0.47) to (and 7.23±0.43) The highest score for taste was for CP_4(40.0%incorporation of aril) and least was for CP_3(30.0%incorporation of aril). The scores was in the order of CP_4(8.11±0.47)>Control(8.11±0.47)>CP_5(7.94±0.53)> CP_2(7.72±0.57)> CP_6(7.66±0.48)>CP_1(7.61±0.50)>CP_7(7.44±0.51)>CP_3(7.23±0.43). There was statistically significant difference for CP_1, CP_4 and CP_7 at $p \leq 0.05$.

Table 4.8. Correlation of taste for Chutney powder

	Control	CP_1	CP_2	CP_3	CP_4	CP_5	CP_6	CP_7
Control	1							
CP_1	0.193	1						
CP_2	0.337	0.011	1					
CP_3	-0.129	-0.395	0.026	1				
CP_4	0.205	0.442	0.120	-0.421	1			
CP_5	0.025	0.132	-0.052	0.056	-0.205	1		
CP_6	-0.085	-0.080	0.070	-0.188	0.171	-0.524*	1	
CP_7	-0.216	-0.203	0.044	0.059	-0.460	0.308	-0.079	1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
n- no. of observations (18)
H_0: There is no significant relationship among chutney powder combinations.

Table 4.8 revealed that there was a moderate negative relation of ($r = 0.524$, $p < 0.05$) for CP_6 and CP_5. As the quantity of aril powder increased, the quantity of roasted Bengal gram dhal tended to decrease. So it may be due to the predictable changes in the quantity that tend to decrease the taste of the product. As the aril powder had a little sweet, sour, and astringent taste there was the change in taste beyond the 40.0% level of incorporation. Hence, the null hypothesis was rejected, and alternate hypothesis was accepted. However, there was relation among the other combinations.

Overall acceptability: The score ranged between (8.22±0.42) to (and 7.05±0.51) The highest score for was for CP_4(40.0%incorporation of aril) and least was for CP_3(30.0%incorporation of aril). The scores of overall acceptability was in the order of CP_4(8.22±0.42)> CP_5(7.88±0.57)> Control(7.88±0.57)>CP_2(7.83±0.51)>CP_1(7.66±0.48)>CP_6(7.61±0.50)>CP_7 (7.50±0.51)>CP_3(7.05±0.51). CP_1 and CP_3 showed significant difference statistically at $p \leq 0.05$.

Table 4.9. Correlation of overall acceptability for Chutney powder

	Control	CP_1	CP_2	CP_3	CP_4	CP_5	CP_6	CP_7
Control	1							
CP_1	0.277	1						
CP_2	0.130	0.000	1					
CP_3	-0.353	-0.149	0.247	1				
CP_4	0.104	-0.188	-0.089	0.198	1			
CP_5	0.380	0.600**	0.161	-0.205	-0.162	1		
CP_6	0.245	0.161	-0.037	0.084	0.152	0.055	1	
CP_7	-0.392	0.235	-0.111	0.106	-0.267	0.000	0.113	1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
n- no. of observations (18)
H_0: There is no significant relationship among chutney powder combinations.

Table 4.9 revealed that there was significant moderate positive relation for CP_1(r = 0.600, p< 0.01) with CP_5 which was due to the incorporation of aril powder from 10.0 to 30.0% does not have much impact as the control has the best acceptability. From 40.0 to 50.0% acceptability was high as the amount increased beyond that acceptability was low. So CP_1 had a positive relation with CP_5. Hence, the null hypothesis was rejected, and the alternate hypothesis was accepted. However, there was no relation between CP_2, with CP_1 and CP_7 with Cp_5.

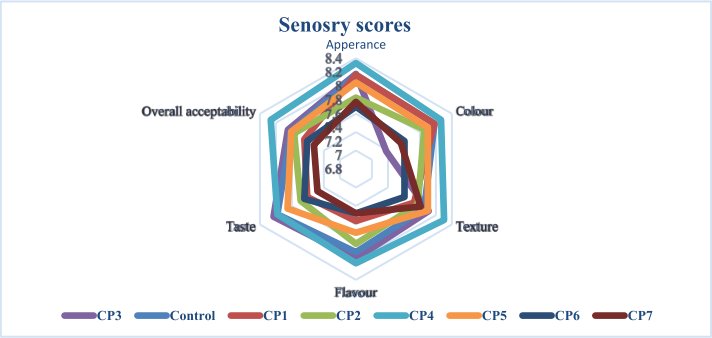

Figure 3. Mean of sensory scores for chutney powders

Acceptability index: Acceptability index of the tested samples was calculated from the obtained scores and it was observed that CP_4instant chutney powder revealed highest acceptability index (91.35%) followed by Control (89.29%), CP_5 (88.06%), CP_2 (87.13%), CP_1 (86.83%), CP_6 (84.77%), CP_7 (84.46%) and CP_3 (78.39%), indicating that $CP_4$was the best formulation among all formulations of aril powder incorporated instant chutney powders from 10.0% to 70.0% (Fig. 4).

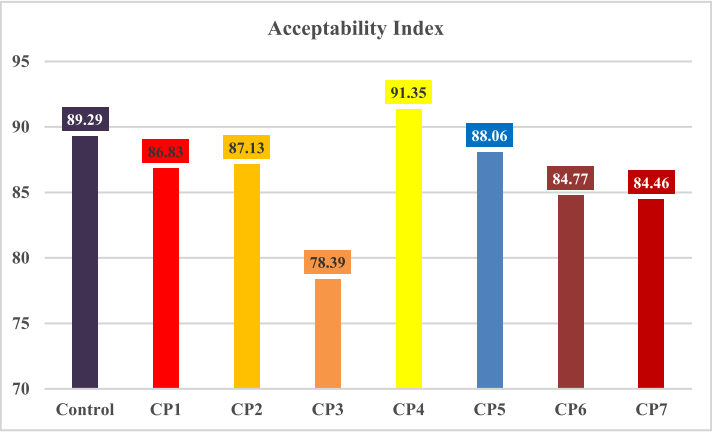

Figure 4. Percentage of Acceptability Index of Chutney Powders

The sensory parameters were good for the chutney powder with roasted Bengal gram dhal and dried aril powder in the ratio of 3:4 (30.0% roasted Bengal gram dhal: 40.0% aril powder) its appearance, color, texture, flavor, taste, and overall acceptability were good and was least for chutney powder 4:3 ratio (40.0% roasted bengal gram dhal: 30.0% dried aril powder). An increase in the content of the aril powder added a tangy taste to the chutney powder. As the amount increased beyond the 3:4 ratio all the sensory parameters were decreased.

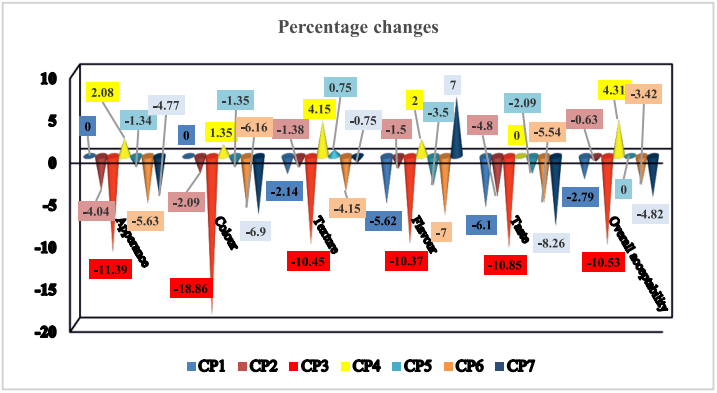

Figure 5 Percentage change in Chutney powders

The percentage change in sensory scores with 40.0% dried aril powder incorporated with chutney powder was comparatively higher than the control for appearance (2.08%), color (1.35%), texture (4.15%), flavor (2.00%) and overall acceptability (4.31%).
The CP5 with 50.0% dried aril powder and 20.0% roasted bengal gram dhal were nearly similar to control as shown in Figure5.

Health benefits: It is a nutritious substitute as it is made with roasted pulses and other significant spices that are rich in necessary vitamins, minerals, protein, and fiber. The incorporation of aril powder helps to improve the protein and fiber content.

Conclusion: The chutney powder combinations were made from 10.0% to 70.0% incorporation but as the amount of the incorporation increased beyond 40.0% the acceptability of the product was low. Even though the health benefits and nutritional contents increase the flavor and taste of the product changes as it has a little sour, astringent, and umami taste.

Challenges of the study: There is abundant availability during season and procurement of raw material in off season was difficult. The dried powder did not blend well with all the combinations as the highest incorporation had intense color, flavor and umami taste.

Future scope of study: To know potential benefits of the Manali tamarind-based value-added products like chutney powder. Further studies on the preservation methods and packaging material that retains the best flavor, color, and nutritional content of powdered fruits and their products needed.

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References

1. Balaswamy, K., Jyothirmayi, T. and Rao, D.G. 2004. Studies on preparation of curry leaf (*Murraya koenigii L.*) chutney powder. *Journal of FoodService*. 14 (3): 175-187.

2. Bvenura, C and Sivakumar, D. 2017. The role of wild fruits and vegetables in delivering a balanced and healthy diet. *Food Research International*. 99 (1):15-30.

3. FAO/UN. 1997. The state of the world's plant genetic resources for food and agriculture. Food and Agriculture Organization of the United Nations, Rome. 1-501.

4. Goyal, P., Kachhwaha, S and Kothari, S.L. 2012. Micropropagation of Pithecellobium dulce (Roxb.) Benth- A multipurpose leguminous tree and assessment of genetic fidelity of micropropagated plants using molecular markers. *Physiology and Molecular Biology of Plants*. 18 (2): 169-176.

5. Guerrero, L., Guardia, M.D., Xicola, J., Verbeke, W., Vanhonacker, F., Zakowska-Biemans, S and Scalvedi, M.L. 2009. Consumer-driven definition of traditional food products and innovation in traditional foods: A qualitative cross-cultural study. *Appetite*. 52(2): 345-354.

6. Lal, N and Nath, V. 2017. Minor fruits: Nutraceutical importance and cultivation. 901-912.

7. Mahopatra, A.K. 2008. Wild edible fruits, nuts and berries. Conservation Programme, RPRC, Bhubaneshwar.

8. Meligaard, M., Civille, G.V and Carr, B.T. 1999. Sensory Evaluation Techniques (3rd Edition), CR Press, Boca Raton.

9. Murthy, H.N and Bapat, V.A. 2020. Importance of Underutilized Fruits and Nuts. Bioactive compounds in underutilized fruits and nuts. 3-19.

10. Murugesan, S., Lakshmanan, D.K., Arumugam, V and Alexander, R.A. 2019. Nutritional and therapeutic benefits of medicinal plant Pithecellobium dulce (*Fabaceae*): A review. *Journal of Applied Pharmaceutical Science*. 9 (7): 130-139.

11. Orwa, C., Mutua, A., Kindt, R., Jamnadass, R and Simons, A. 2009. Agroforestry database: A tree species reference and selection guide version 4.0. World Agroforestry Centre ICRAF, Nairobi, KE.

12. Padulosi, S., Thompson, J and Rudebjer, P. 2013. Fighting poverty, hunger and malnutrition with neglected and underutilized species (NUS): Needs, challenges and the way forward. Biodiversity International, Rome. 1-56.

13. Pareek, O.P and Vishal, N. 2006. Arid and minor fruits. In: Text of Horticulture. Malhotra publishing house, New Delhi.

14. Quadri, A and Rao, A. 2018. Development, organoleptic evaluation and acceptability of products developed from agro based wastes-seeds and rind of watermelon. *Food Science and Nutrition Research*. 1(1):1-9.

15. Rao, B.G., Samyuktha, P, Ramadevi, D and Battu, H. 2018. Phyto pharmacological studies on *Pithecellobium dulce*. *Journal Global Trends of Pharma Sciences*. 9 (1): 4797-4807.

16. Rao, G.N., Nagender, A., Satyanarayana, A and Rao, D.G. 2011. Preparation, chemical composition and storage studies of quamachil (*Pithecellobium dulce* L.) aril powder. *Journal of Food Science and Technology*. 48(1):90-95.

17. Relwani, L.L., Lahane, B.N and Gandhe, A.M. 1988. Performance of nitrogen-fixing MPTS on mountainous wastelandsin low rainfall areas. International Institute for Agricultural Development Research Centre of Canada. 105-113.