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Development of Instant Chutney Powder with Incorporation of Blanched Carrot and Green Leafy Vegetable Powders

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Authors' contributions

This work was carried out in collaboration among all authors. Author JP has developed the product and performed the analysis. Author BAK has designed the study and wrote the protocol. Author SS has corrected the first draft of the manuscript. Author VKK managed the literature searches and author RS has taken care of statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Instant chutney powder, a palatable functional food adjunct, was developed by using carrot *(Daucus carota* L*)*, basella (*Basella alba* L) and spinach (*Spinacia oleracea)* leaves and other selected spice ingredients. The carrot, basella and spinach were blanched for 1 to 3 minutes and dried. The dried powders were subjected to assessment of colour parameters to standardize the time period for blanching. The Hunter (a*) values of blanched samples became more positive, indicating that those samples were greener and intensity of greenness was more in samples blanched for 3min. Hunter

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(a*) values of carrot were significantly lower ($P < 0.05$) for blanched samples than for unbalanced samples which show the intensity of carotenoids. The dried carrot, basella and spinach powders were added to standard chutney powder in different ratios and subjected to sensory evaluation. The best combination which selected was $CACP_4$ (Carrot: basella: spinach-1:1:2). It was noted that the combination of vegetable with greens were accepted better rather than only standard powder.

Keywords: Carrot; basella leaves; spinach; blanching; dehydration; instant chutney powder; sensory evaluation.

1. INTRODUCTION

Good nutritive food makes to function well physically and mentally and at the same time unhealthy diet gives rise to several disorders in the body. Chutney powders were popular, ready to serve and convenience food products and also were very tasty dish especially prepared in Southern India [1].

Carrot *(Daucus carota* L.) is the most important crop of Apiaceae family. It is a root vegetable that has worldwide distribution. Carotenoids and anthocyanins are the major antioxidant pigments found in carrots. Carrots have also a unique combination of three flavonoids: kaempferol, quercetin and luteolin. Anti-diabetic, cholesterol and cardiovascular disease lowering, anti-hypertensive, hepatoprotective, renoprotective, and wound healing benefits of carrot have also been reported [2].

Spinach (*Spinacia Oleraecea*) has good effect on human health, because of its antioxidant compound, dietary fiber, minerals vitamins and iron compounds, it prevents from various diseases anemia, and also it contains many anticancer agents. It also contains omega 3 fatty acids and anti-inflammatory agent [3].

Spinach (*Spinacia oleracea*) in an annual herb belongs to the family Chenopodiaceae. Spinach is a good source of minerals (iron, copper, phosphorous, zinc, selenium), vitamin B complex (niacin and folic acid), ascorbic acid, carotenoids (β-carotene, lutein, zeaxanthin), phenols (flavonoids, p-coumaric acid), apocynin and Omega-3-fatty acids [4].

Basella alba L. is an important green leafy vegetable found commonly in the tropical regions of the world. The plant is used as a substitute for true spinach (i.e., *Spinacea oleracea* L.) and also has great ethnomedicinal importance. Different studies have proved that the plant is rich in vitamin A and vitamin C along with flavonoids, saponins, carotenoids, many amino acids and organic acids [5].

In India, a variety of chutneys and pickles in large volumes based on vegetables, pulses and spices are consumed along with rice and breakfast items like chapatti, idly, dosa, and vada. Literature is available on development and standardization of chutney powders based on the various raw materials. Interestingly, there was no literature available on utilization of green leafy vegetables and carrot in such food adjuncts. Thus the present study was designed to incorporate green leafy vegetables and carrot in instant chutney powder to improve the micronutrients without compromising the organoleptic properties.

2. MATERIALS AND METHODS

The selected vegetables such as carrot, basella leaves and spinach were blanched by immersion in hot water for 0 minute, 1-minute, 2-minutes and 3-minutes. After blanching green leafy vegetables were immersed in 0.2% potassium meta bisulphate solution and the extra water was drained. The blanched samples were dried and powdered and stored in airtight container for further analysis. The dried vegetable powders were subjected to colour analysis by using Hunter lab colorimeter (Colour Quest XE Hunter Lab, USA) for standardization of blanching time [6].

2.1 Process Description of Commonly Used Vegetables (CUV) Incorporated Instant Chutney Powder

Pre-processing of selected vegetables: All the samples of vegetables collected were washed thoroughly in running tap water to remove dust and dirt, followed by washing with distilled water. The tender part of stems and foreign material were removed and edible portion were separated. Carrots were peeled and made into thin slices.

Blanching: All the selected green leafy vegetables (basella and spinach leaves) were blanched by emersion in hot water for 3 minutes. After blanching green leafy vegetables were immersed in 0.2 per cent potassium Meta bisulphate solution and the extra water was drained. The sliced carrot pieces were also blanched by emersion in hot water for 3 minutes.

Drying: The green leafy vegetables were dried using a cabinet dryer at 55 ± 2°C for 10-12 hours to reach desired moisture level (9-10%) and until samples became crisp and brittle to touch. The carrot shreds were dried using a cabinet dryer at 60 ± 2°C for 22-24 hours to reach desired moisture level (9-10%).After drying the samples were powdered (1.0 mm mesh) and stored in an airtight container and kept in a refrigerator for further usage.

Preparation of instant chutney powder from CUV: The unit operations involved in the preparation of vegetables and green leafy vegetable incorporated instant chutney powder is presented in Fig. 1.

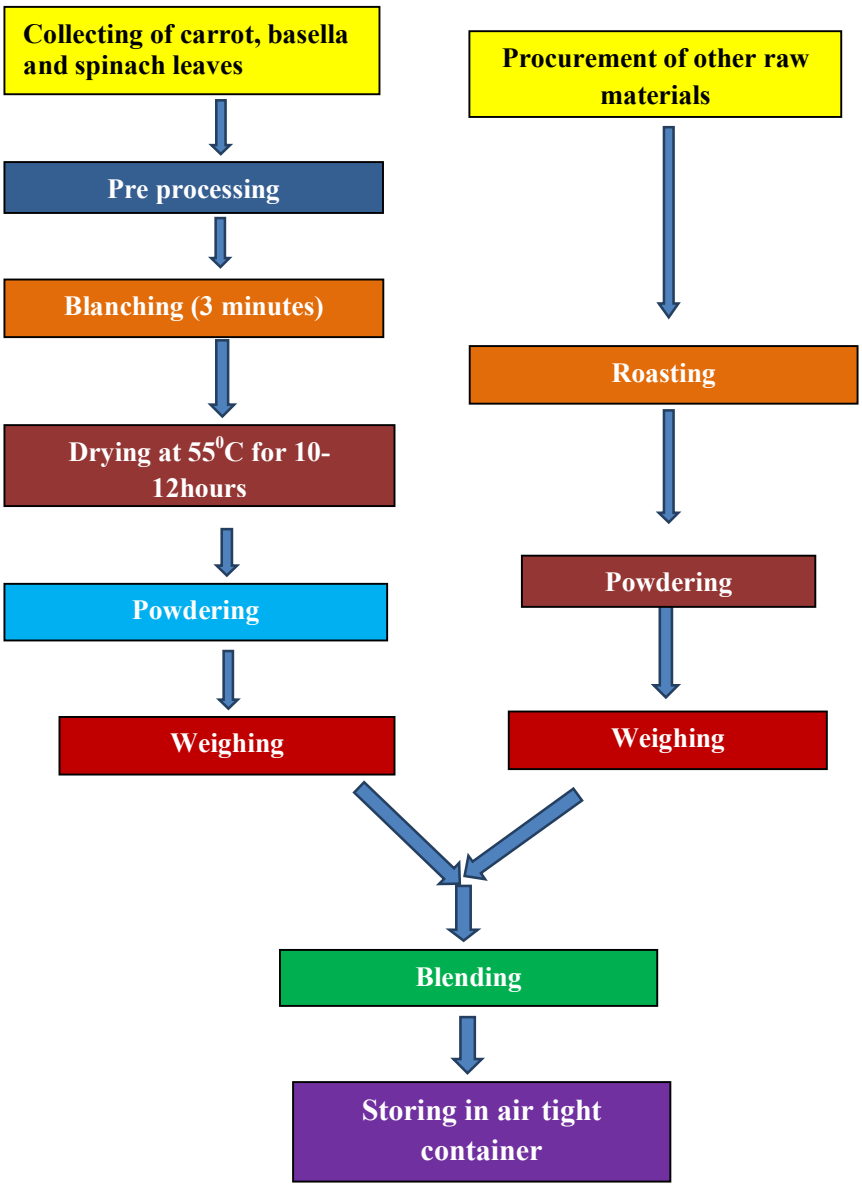

Fig. 1. Preparation of instant chutney powder

Table 1. Proportions of the ingredients used in standardization of CUV incorporated chutney powder

Ingredients	CNCP	$CACP_1$	$CACP_2$	$CACP_3$	$CACP_4$
Dried carrot powder	0.0	25.0	25.0	25.0	25.0
Dried basella leaves powder	0.0	25.0	25.0	50.0	25.0
Dried Spinach leaves powder	0.0	25.0	25.0	25.0	50.0
Black gram dhal powder	4.0	4.0	4.0	4.0	4.0
Bengal gram dhal powder	2.5	2.5	2.5	2.5	2.5
Cumin powder	2.5	2.5	2.5	2.5	2.5
Coriander seed powder	5.5	5.5	5.5	5.5	5.5
Tamarind powder	5.5	5.5	5.5	5.5	5.5
Red chilli powder	7.0	7.0	7.0	7.0	7.0
Common salt	10.0	10.0	10.0	10.0	10.0

Note: All formulae were repeated three times.
All ingredients were measured in grams
CNCP: Control instant chutney powder
$CACP_1$: Carrot, basella, spinach (1:1:1) incorporated instant chutney powder
$CACP_2$: Carrot, basella, spinach (2:1:1) incorporated instant chutney powder
$CACP_3$: Carrot, basella, spinach (1:2:1) incorporated instant chutney powder
$CACP_4$: Carrot, basella, spinach (1:1:2) incorporated instant chutney powder

Roasting: All the ingredients like black gram dhal, bengal gram dhal, cumin and coriander seeds were dry roasted separately up to development of flavour.

Powdering: All the roasted ingredients were powdered in blender and packed in air tight jars for further use.

Weighing: All the ingredients were weighed individually according to the proportions of each formula given in Table 1.

Blending: All the powdered and weighed components were mixed, blended in a food processor and packed in air tight container and at room temperature and used for further analysis.

Sensory evaluation: Standardization was done by sensory evaluation using 9-point hedonic scale at PGRC, PJTSAU where each product was coded with three-digit number and is tested by 10 semi-trained panelists. They were asked to score the product based on the sensory parameters like appearance, colour, flavour, texture, taste and overall acceptability. They were provided water to rinse the mouth for avoiding over lapping of taste of other instant chutney powders and scored from 1 – 9 with 1 being I dislike extremely *i.e.*, very bad and 9 being I like extremely *i.e.*, the product is excellent in that particular attribute [7].

3. RESULTS AND DISCUSSION

Standardization of blanching time of vegetables (CLV): It was observed from the Table 2 that with increase in blanching timing there was also gradual change in colour values i.e., L*, a*, b* and E*. The L* values of basella leaves ranged from -11.24 to -16.72. The highest L*value of basella leaves was for BAWB (-11.24) which was un-blanched sample and lowest was seen in $BAWB_3$ (-16.72) which was 3 minutes blanched sample. The results clearly indicated that the blanched basella leaves had highest a* value for sample $BAWB_3$ (27.87) and lowest for un-blanched basella leaves (22.56) respectively. The b* values of basella leaves were -1.95, -0.83, -1.51 and -2.12 (BAWB, $BAWB_1$, $BAWB_2$ and $BAWB_3$) respectively. It was observed that the highest value was in $BAWB_1$ (-0.83) and lowest was in $BAWB_3$ (-2.12). The E* value of basella leaves ranged from 25.28 to 33.47. The ascending order of basella leaves for E* values was $BAWB>BAWB_1>BAWB_2>BAWB_3$ (Table 2).

The L* value of spinach leaves ranged from -12.04 to -18.39. The ascending order was $SPWB_3>SPWB_2>SPWB_1>SPWB$. The results clearly showed that a* value for spinach leaves was 22.75 (SPWB), 3.21 ($SPWB_1$), 24.85 ($SPWB_2$), $SPWB_3$ (25.63) respectively. The b* values for 1 minute blanched spinach leaves was highest for $SPWB_1$ (-3.11) and lowest for $SPWB_3$ (-4.41). The E* values for spinach leaves ranged

from 26.03 to 31.85. The E* values for all the spinach leaves were 26.03 (SPWB), 27.93 ($SPWB_1$), 30.18 ($SPWB_2$), 31.85 ($SPWB_3$) respectively (Table 2).

There was decrease in greenness after blanching and drying as a*value changed from initial value of -8.93for fresh spinach to -4.62 to -2.57 for the powder obtained from un-blanched leaves and -2.07 to -1.86 for blanched one. The L* value was found to have 48.30 to 54.19 for un-blanched powder and 51.78 to 53.11 for blanched spinach powder. Also, the increase in dehydration temperature has affected the brightness and greenness of dehydrated product adversely. It is further reflected that the better spinach powder could be obtained using the dehydration temperature of 60^0C for un-blanched and 70°C for blanched spinach [8].

The percent change of colour parameters of blanched basella leaves were graphically represented in Fig. 2. It was noted that there was decrease of about 26.24% ($BAWB_1$), 34.43% ($BAWB_2$), 48.75% ($BAWB_3$) for L* values of basella leaves compared to that of un-blanched basella leaves (BAWB). The results showed that the increase in a* values of basella leaves were 15.2% ($BAWB_1$), 23.53% ($BAWB_2$) and 28.19% ($BAWB_3$) respectively when compared to that of un-blanched basella leaves (BAWB) sample. The b*values of basella leaves were decreased about 57.43% and 22.56% ($BAWB_1$ and $BAWB_2$) and 8.71% ($BAWB_3$) compared with BAWB sample. The E* values of basella leaves were increased 17.16% ($BAWB_1$), 25.51% ($BAWB_2$) and 32.39% ($BAWB_3$) respectively when compared to that of BAWB sample.

The percent change in colour values of blanched spinach leaves were illustrated in Fig. 3. The L* values for spinach leaves were decreased of about 26.49%, 43.27% and 52.74% of $SPWB_1$, $SPWB_2$ and $SPWB_3$ respectively when compared with un-blanched sample (Fig. 3). The results showed that the a* value of spinach leaves were 2.02% ($SPWB_1$), 9.23% ($SPWB_2$) and 12.65% ($SPWB_3$) increased when compared to that of un-blanched (SPWB) sample. While, decrease in b* values of 20.66%, 10.45% and 12.5% ($SPWB_1$, $SPWB_2$, and $SPWB_3$) were observed. The E* values of spinach leaves were increased 7.29% ($SPWB_1$), 15.94% ($SPWB_2$) and 22.35% ($SPWB_3$) when compared to that of SPWB sample.

Standardization of blanching time of carrot: It was observed from the Table 3 that the L* values of carrot powders were ranged from 8.73 to 17.23. The highest L*value for blanched carrots was 17.23 ($CAWB_3$) and lowest was 8.73 (CAWB). The results clearly showed among the carrot powders a* value was highest for CAWB (46.64) and lowest was in $CAWB_1$ (35.72). The increasing order of b* values of carrot powders were 19.22, 21.41, 22.01 and 23.20 ($CAWB_1$, $CAWB_2$, $CAWB_3$ and CAWB) respectively. The E* values of carrot powders ranged from 42.92 to 52.81. There was significant difference at $p \leq 0.05$ between the samples. The ascending order of carrots for E* was $CAWB_1$>$CAWB_2$>$CAWB_3$> CAWB (Table 3).

Similar results were reported by [9] in blanched broccoli, carrots and green beans. The lightness values (L*) for fresh broccoli, carrots and green beans were 29.5, 56.3, and 43.6 respectively. Chroma, one of the important colour attribute decreased significantly for broccoli and green beans with the exception of carrots. The blanched peas were visually lighter green than un-blanched peas immediately after blanching and after 12 weeks of frozen storage whereas they did not observe any significant difference for a* and b* value of blanched frozen green peas.

Tables 2 to 3 and Figs. 2 & 3 shows that the Hunter (a*) values of blanched samples became more positive, indicating that those samples were greener and intensity of greenness was more in samples blanched for 3min. The increase in greenness was not accompanied by a decrease in yellowness as reflected by the Hunter (b*) values. The initial brightening of the green colour of green vegetables after water blanching resulted from the removal of air from the vegetable surface and from the intercellular spaces. When green vegetables are heated in water, the chloroplasts become swollen and distorted or may even burst, and the green colour becomes more or less diffused throughout the cell. This causes the more intense green colour on the surface of the vegetable [10].

Hunter (a*) values of carrot were significantly lower ($P < 0.05$) for blanched samples than for un-blanched samples which show the intensity of carotenoids. Blanching before drying of green leafy vegetables and carrots was also reported to enhance the stability of colour pigments during storage [11].Hence, the vegetable samples blanched for 3 mins were selected for development of instant chutney powders.

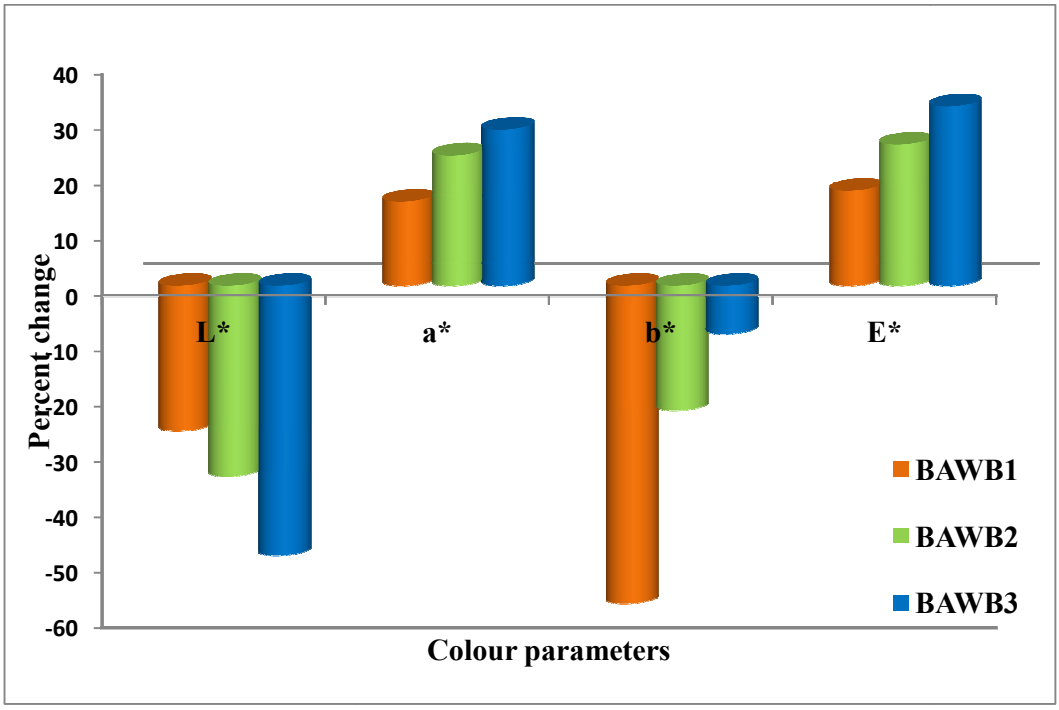

Fig. 2. Percent change of colour parameter of blanched basella leaves

Note: $BAWB_1$: Basella leaves with blanching for 1 minute
$BAWB_2$: Basella leaves with blanching for 2 minutes
$BAWB_3$: Basella leaves with blanching for 3 minutes

Table 2. Hunter lab colour parameters of commonly used leafy vegetables (CLV)

S No	Sample	L*	a*	b*	E*
1	BAWB	$-11.24^{h}\pm0.02$	$22.56^{a}\pm0.25$	$-1.95^{f}\pm0.25$	$25.28^{a}\pm0.02$
2	$BAWB_1$	$-14.19^{f}\pm0.02$	$25.99^{f}\pm0.02$	$-0.83^{h}\pm0.02$	$29.62^{d}\pm0.02$
3	$BAWB_2$	$-15.11^{e}\pm0.02$	$27.87^{g}\pm0.02$	$-1.51^{g}\pm0.02$	$31.73^{f}\pm0.02$
4	$BAWB_3$	$-16.72^{c}\pm0.02$	$28.92^{h}\pm0.01$	$-2.12^{e}\pm0.02$	$33.47^{h}\pm0.01$
5	SPWB	$-12.04^{g}\pm0.02$	$22.75^{b}\pm0.02$	$-3.92^{b}\pm0.02$	$26.03^{b}\pm0.02$
6	$SPWB_1$	$-15.23^{d}\pm0.02$	$23.21^{c}\pm0.02$	$-3.11^{d}\pm0.02$	$27.93^{c}\pm0.02$
7	$SPWB_2$	$-17.25^{b}\pm0.02$	$24.85^{d}\pm0.02$	$-3.51^{c}\pm0.02$	$30.18^{e}\pm0.02$
8	$SPWB_3$	$-18.39^{a}\pm0.00$	$25.63^{e}\pm0.00$	$-4.41^{a}\pm0.00$	$31.85^{g}\pm0.00$
9	Mean	-11.26	25.22	-1.97	29.51
10	SE	0.05	0.05	0.05	0.05
11	CD	0.16	0.16	0.16	0.16
12	CV (%)	0.99	0.99	0.99	0.99

Note: Values are expressed as mean ± standard deviation of three determinants
Means within the same column followed by a common letter do not differ significantly at ($p \leq 0.05$)
BAWB: Basella leaves without blanching
$BAWB_1$: Basella leaves with blanching for 1 minute
$BAWB_2$: Basella leaves with blanching for 2 minutes
$BAWB_3$: Basella leaves with blanching for 3 minutes
SPWB: Spinach without blanching
$SPWB_1$: Spinach with blanching for 1 minute
$SPWB_2$: Spinach with blanching for 2 minutes
$SPWB_3$: Spinach with blanching for 3 minutes

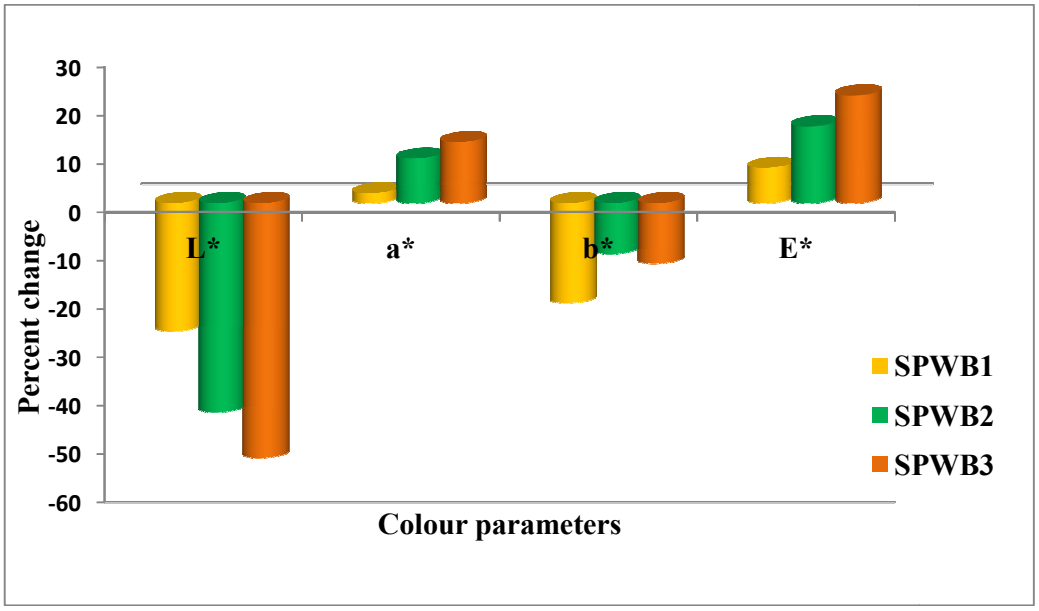

Fig. 3. Percent change of colour parameter of blanched spinach leaves

Note: $SPWB_1$: Spinach with blanching for 1 minute
$SPWB_2$: Spinach with blanching for 2 minutes
$SPWB_3$: Spinach with blanching for 3 minutes

Table 3. Standardization of blanching time of commonly used vegetables

S No	Sample	L*	a*	b*	E*
1	CAWB	8.73^{a}±0.02	46.64^{e}±0.02	23.20^{e}±0.01	52.81^{e}±0.01
2	$CAWB_1$	14.05^{b}±0.02	35.72^{b}±0.01	19.22^{b}±0.01	42.92^{b}±0.01
3	$CAWB_2$	16.87^{d}±0.01	37.59^{c}±0.02	21.41^{c}±0.02	46.63^{c}±0.02
4	$CAWB_3$	17.23^{e}±0.02	38.23^{d}±0.02	22.01^{d}±0.03	47.35^{d}±0.02
6	Mean	14.4	37.67	20.07	44.78
7	SE	0.00	0.00	0.00	0.00
8	CD	0.01	0.01	0.01	0.01
9	CV (%)	0.02	0.02	0.02	0.02

Note: Values are expressed as mean ± standard deviation of three determinants
Means within the same column followed by a common letter do not differ significantly at ($p \leq 0.05$)
CAWB: Carrot without blanching
CAWB1: Carrot with blanching for 1minute
CAWB2: Carrot with blanching for 2minute
CAWB3: Carrot with blanching for 3minute

The mean sensory scores for vegetables incorporated chutney powders were presented in Fig. 4. Among the five samples highest score for appearance was given to $CACP_4$ (8.00±0.00) where as all other products were less than it. The highest mean sensory score for colour was given to $CACP_4$ (7.80±0.78) followed by $CACP_2$ (7.60±0.69), $CACP_3$ and $CACP_1$ (7.50±0.52), where as the control sample CNCP score was low (7.20±0.42) for the colour parameter.

The Fig. 6 depicts the ascending order of mean sensory scores for texture was CNCP>$CACP_2$>$CACP_1$>$CACP_3$>$CACP_4$. The mean highest sensory for flavour was given to $CACP_4$ (8.00±0.00) followed by $CACP_2$ (7.80±0.78), CNCP (7.70±0.67) and lowest score was given to $CACP_1$ and $CACP_3$ (7.30±0.48).

The taste was highest in $CACP_4$ experimental sample *i.e.,* 7.90±0.56 when compared to other experimental sample and also the control (CNCP) sample. The overall acceptability of mean sensory scores was also highest for $CACP_4$ experimental sample when compared with other experimental samples ($CACP_1$, $CACP_2$

and $CACP_3$) and that of control (CNCP). The Fig. 4 clearly shows that among the five combinations $CACP_4$ has scored highest for all the sensory the parameters when compared to the control and also with the experimental samples. The difference was significant at ($p \leq 0.05$).

Fig. 4. Standard instant chutney powder (CNCP)

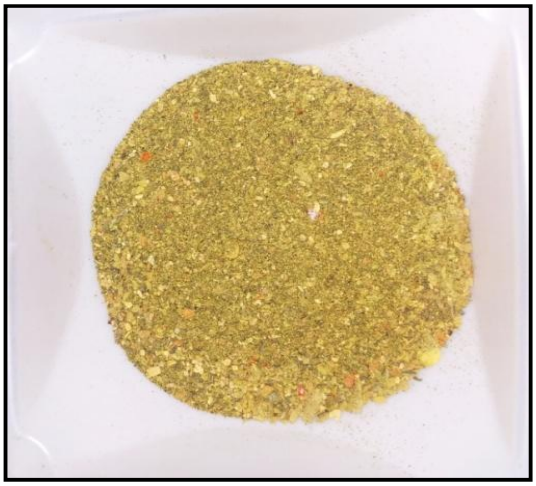

Fig. 5. $CACP_4$-Carrot, basella, spinach (1:1:2) incorporated instant chutney powder

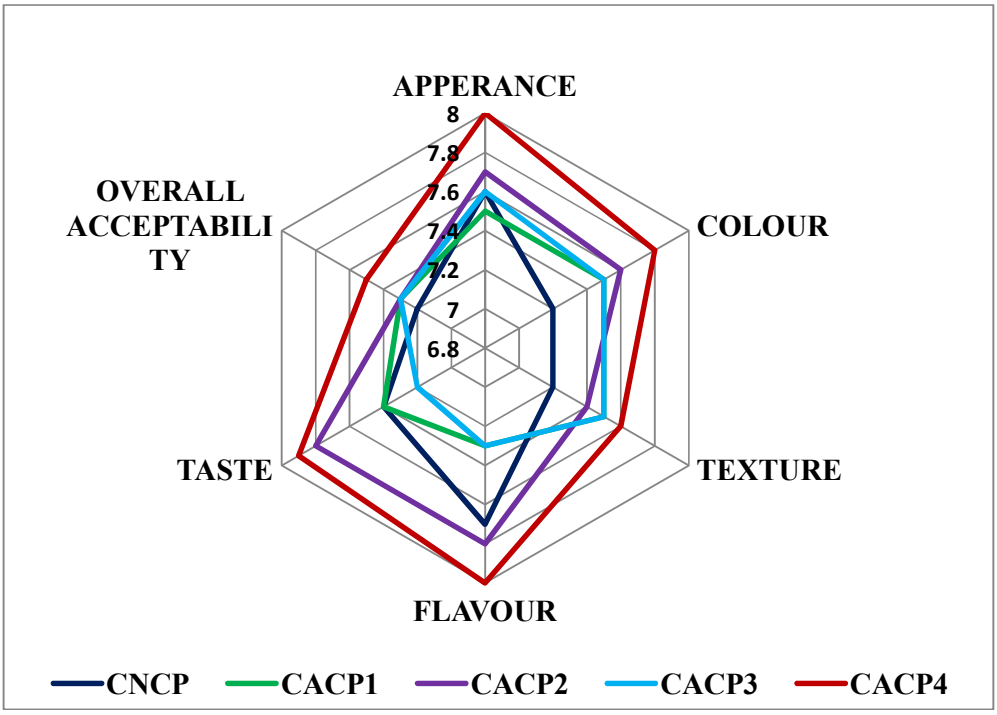

Fig. 6. Mean sensory scores of CUV incorporated chutney powders

Note: Values are expressed as mean ± standard deviation of ten determinations

CNCP: Control instant chutney powder

$CACP_1$: Carrot, basella, spinach (1:1:1) incorporated instant chutney powder

$CACP_2$: Carrot, basella, spinach (2:1:1) incorporated instant chutney powder

$CACP_3$: Carrot, basella, spinach (1:2:1) incorporated instant chutney powder

$CACP_4$: Carrot, basella, spinach (1:1:2) incorporated instant chutney powder

4. CONCLUSION

Thus it can be concluded that the instant chutney powders with the commonly used vegetables like carrot, basella and spinach were having a numerous health benefits. The study showed that the commonly used vegetables combinations were given priority and also sensorially highly accepted well by the panel members. A combination of vegetable and green leafy vegetables was best selected by panel members and it also possesses a wide range of nutrients.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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