

Development of convenient chutney mix of Culantro (*Eryngium foetidum*) growing in North east India

Paonam Pusparani Devi¹ and Daisy Sharma²

¹MSc Food Nutrition and Dietetics

Assam down Town University, Guwahati (Assam)

²Assistant Professor Department of Food Nutrition and Dietetics Guwahati (Assam)

Abstract

Chutney is widely used for its high nutritional values. It is a thick, jam like mixtures are made from different kinds of vegetables and fruits. Preparation of good vegetable chutney mainly depends on seasonal vegetables occurring in a year. Medicinal plants can also be used to make chutney. However, the nutritional values as well as nutrient contents of chutney are less examined. Therefore, the present study was conducted to develop a convenient chutney mix of culantro (*Eryngium foetidum*) a medicinal herb available at two geographical regions in Guwahati and Manipur, north east India. The study aims to analyse nutrient compositions of culantro chutney mix and the overall acceptability with shelf life stability. Assessment of moisture content of the dry chutney of culantro was also performed. The phytochemical screening was also performed to screen some phytochemicals and tannin, flavonoids, phenol, flavonoids and alkaloids were found to be present. DPPH free scavenging activity was investigated on leave methanolic extract of *Eryngium foetidum*. Further, leave phenolic content of the plant was also conducted. The self-life and the sensory scores of the formulated chutney mix did not change much in terms of all the sensory attributes during month (30 days) of storage. Based on the chemical properties, *Eryngium foetidum* can be a good source for making chutney as well as medicine for treatment of many diseases.

Key words: Chutney, culantro, *Eryngium foetidum*, hedonic scale, phytochemical.

Introduction

Good nutritive food creates to function well physically and mentally and at the same time unhealthy diet gives increase to several ailments in the body. Importance of spices in human diet is well recognised. Chutney powders were common, ready to serve and accessibility food products and also were delicious dish especially made in Southern India (Prasoon et al. 2020). The role of Indian spices in preventive and therapeutic medicine has been described in prehistoric literature (Khedkar et al. 2019). In India, a variability of chutneys and pickles in large amounts based on pulses, vegetables and spices are consumed along with rice and breakfast items like chapatti, idly, dosa and vada (Rao et al.2013).

Chutney a spicy condiment prepared from vegetables, fruits and herbs are used widely as side dish in Indian cookery system because of rich proteins, vitamins and minerals. The word chutney comes from Hindi "Catni" which is prepared widely in India (Shah and Sengupta 2014). Consumption of chutney as side dish increases appetite and craving (Jyothirmayi et al. 2006). Chutney prepared from green leafy vegetables served as an excellent source of several nutrients. Generally, chutneys are widely consumed to overcome the nutritional deficiencies in rural regions of the country and even help in socio economic up-liftment (Prasad 2018).

Mixed chutney is also prepared from fruits and vegetables or in combinations of two, which are chopped, cooked, mixed with spices, vinegar and other ingredients and reduced to a smooth mash. Chutneys are well-preserved using oils, vinegar or citrus juice fermentation in presence of salt. Vinegar, a chief ingredient of chutney contains acetic acid (CH_3COOH) which acts as natural preservatives (Veerapandian et al. 2014). Sourness, spiciness and salt are important aspects of chutney that have major impact on the sensory scores (Rao G et al. 2008).

Further chutney needs to be heated so as to reduce the moisture content. Spices can be added to chutneys of vegetables, fruits and herbs. It may be sweet, sour, bitter or a mixture of both. Some variations of them have a hot and spicy flavour, while others have sweet and pungent taste. They can be wet or dry having crude to fine texture. Presently, chutney has become popular in Western dishes as well. Many countries have also developed their own variations to suit their taste buds to this versatile dish. Chutney made with vegetables mostly depends on seasons and what is grown locally in a specific area (Shah and Sengupta 2014). Chutney containing leaves from pudina (*Mentha spicata*) and gongura (*Hibiscus* sp.) used as side dishes in Indian cuisine (Satyanarayana et al. 2001). Standard chutney prepared from Amla (*Emblica officinalis*) has been widely used as an essential side dish because of its several health benefits (Mishra et al. 2011). Curry leaf chutney is also one of the most widely used chutney because of several health benefits (Khedkar et al. 2019).

Chutney can be prepared by putting in the hot sun over a period of several days to obtain the right flavour and consistency (Reejhsingani 1977). This method is still following in the modern Indian system of chutney making. Making of vegetable chutney depends on seasons and types of vegetables grown locally in a particular place. Some common chutney prepared with herbs especially of mint, coriander, and fruits such as coconut, sesame, peanuts, mangoes and vegetables are quite good. Increasing urbanization and women work effort and rise in purchasing power in place has led to a need to supply these accessories round the year (Khedkar et al. 2019).

People have used different type of chutney prepared from vegetables fruits and herbs and 80% of the world population race on traditional medicine to assist their needs in primary health care (WHO 1993). Thus many herbs used in preparation of chutney have also been used as medicines. Medicinal plants are broadly used in non-industrialized civilizations mostly because of their readily available and cheaper cost than present day medicines. In early days' medicines were prepared from fresh plant parts, in processed form of untreated extracts and mixtures (Prabha et al. 2019).

An important medicinal herb Culantro (*Eryngium foetidum*) (Apiaceae), commonly known as Peru as sacha culantro, is distributed in the Peruvian jungle, other places in America, some others places of Asia like the east of India and Australia (Raunelli et al. 2019). It is plenty available in the north-eastern states of India which is commonly known in different languages such as Mexican coriander (Mizoram and Manipur, India), awa phadigom or sha maroi (Manipur, India), culantro (English speaking Caribbean countries), Jongali memedo or man dhonia (Assam, India) (Lepsha et al. 2018). The leaves of culantro are often replaced for coriander leaves due to its similar powerful smell (Thomas et al. 2017). The plant has been used as traditional medicine for the treatment of various diseases such as fevers, burn, hypertension, asthma, acute infection, arthritis, tonsillitis, pneumonia, diarrhoea, epilepsy etc. (Prabha et al. 2019). The various bioactive components of culantro (*Eryngium foetidum*) acts as anti-inflammatory, antioxidant, hepatoprotective, antithrombotic, anticarcinogenic, free radical scavenger, antimutagenic, antimicrobial, and anticarcinogenic activity in vitro against alpha-amylase enzyme. *E.foetidum* leaf extract has exploitive effects against proinflammatory mediators. So, *Eryngium foetidum* has a high possible to be used as a food supplement to decrease risk of cancer related with inflammation (Malik et al. 2016).

Several studies have revealed that plant have anthelmintic, anti-inflammatory, analgesic, anti-convulsant, anti-carcinogenic, anti-diabetic and anti-bacterial activity against *Salmonella* spp. and *Erwinia* spp. (Saenz et al. 1997; Simon et al. 1986; Honey et al. 1980 ;). Even this plant has been used as a skin whitening agent (Paula

et al. 2011). Leaf extracts of culantro were used in rural India for treating hepatic problem (Yuhlung and Bhattacharyya 2014) and arthritis (Leishangthem and Sharma 2014).

The leaves contain about 87% moisture, 6.5% carbohydrate, 3.3% protein, 0.6% fat, 1.7% ash, 0.06% P and 0.02% Fe, vitamin A (10,460 IU/100g), vitamin B₂ (60mg/100g), vitamin B₁ (0.8 mg/100g), and 50-200 mg/100g vitamin C indicating a good dietary supplement(Singh et al. 2013, 2014). Dry weight base culantro (*Eryngium foetidum*) leaves consist of 0.1-0.95% volatile oil, 27.7% crude fibre, 1.23% calcium, , and 25 ppm boron (Ramcharan, 1999).

Not only in health benefits the plant served as a good source of essential oils which can be used in perfumery and pharmaceutical industries (Lingaraju et al. 2016). Many polyphenolic compounds such as flavonoids, tannins, saponins and several triterpenoids are present in leaves of culantro (Dutta et al. 2017). Despite having excellent medicinal values usages of culantro as food supplements in the form chutney are less known. The plant/herb is widely used in the preparation of food in many parts of North east India but formal preparation of chutney from the plant is yet to be formulated. Therefore, the present study aims to develop a chutney mix available in different regions and the percentage content of different minerals. It was expected that chutney mix prepared from the plant growing in different regions will show different test as well as mineral compositions.

Materials and Methods

Collection of samples

Plant samples of culantro (*Eryngium foetidum*) were collected from the local markets of Manipur (Wangjing, Thoubal, and Imphal) and Guwahati markets (Borbari and Ganeshguri) during the month of September and December 2019 (Table 1).

Table 1 Identification of sample codes

Sl. No	Chutney product	Product code
1	Guwahati leaves chutney	S ₁
2	Manipur leaves chutney	S ₂
3	Guwahati leaves chutney Hot water	S ₁ HW
4	Guwahati leaves chutney Cold water	S ₁ CW
5	Manipur leaves Chutney Hot Water	S ₂ HW
6	Manipur leaves Chutney Cold water	S ₂ CW
7	Plastic container	PC
8	Glass container	GC

Formulation of samples

Sample code was assigned as S₁ to sample from Guwahati and S₂ for Manipur. Onion, ginger, garlic, salt, vinegar for preparation of chutney was collected from local market. The culantro chutney mix was prepared from leaves following the steps of formulations.

Salt and vinegar were more prominent ingredients among the formulation of chutney. The amount of onion, garlic, and ginger used was 60g, 40g, 20g respectively (Table 2). Ten (10) ml of vinegar and 2tsp of salt are common for all the formulations of chutney. 300g of culantro leaves each from the two regions were used for the preparation of the different formulation of chutney mix.

Preparation of chutney

The leaves were washed, dried, chopped and grinded in the laboratory. The paste was kept in a tray. Other ingredients such as garlic, onion and ginger were peeled, washed, chopped and grinded. Two tea spoon full (tsp) salts was added to the mix paste of culantro, garlic, onion and ginger and then blended together for 30 minutes. Finally, the mix was kept in the hot air oven to removed moisture till it is dry. The dried mixture was grinded into powder. The prepared chutney powder was kept in sterilized glass and plastic container and sealed properly and the container was stored in the room temperature.

Table 2 Formulations of chutney mix using leaves and different ingredients are given below:

Sample code	Ingredients				
	Culantro leaves	Onion	Garlic	Ginger	Vinegar
S ₁	300g	60g	40g	20g	10ml

Sensory evaluation of formulated chutney mix

Sensory evaluation is a dynamic field concentrating on the utilization for quantity of sensory sensitivity and/or their effect on food and taste acceptance (Sidel and Tone 2004).

Sensory evaluation was carried out by semi trained panel of members by using 9-point Hedonic Scale. In the present study a score was made consisting a table consuming the Hedonic ratings of 9-point scale (Peryam and Pilgrim 1957) from like extremely to dislike extremely. Each sample was supplied to the panellist and asked to give score for colour, appearance, taste, flavour, consistency and overall acceptability of food products.

Physico-chemical analysis of the leave extracts

Preparation of plant extract

Product sample powders of 3g are mixed with 50ml in methanol. By means of rotary evaporator solvent from the extracted mixture are evaporated to dryness below condense pressure at 40%. All dried extracts were then retained in tightly appropriate stopper bottles and stored at -4°C.

a) Phytochemical screening of

The phytochemical screening of the extracts was performed using standard procedures described by Trease and Evans (2009). The following tests were carried out:

1. Test for Alkaloids

Dragendroff's test: To a few ml of filtrate, 1-2ml of Dragendroff's reagent was added. A yellow precipitate indicated the test as positive and presence of alkaloid is confirmed.

2. Test for Saponins

Foam test: About 1 ml of leave extract was diluted with distilled water to 20ml and shaken in a graduated cylinder for 15(fifteen) minutes. The formation of 1cm layer of foam indicates the presence of saponins.

3. Test for Phenol

Ferric Chloride Test: A small amount of methanol (CH₃OH) extract was mixed with 1ml of water in a test tube and 1 to 2 drops of FeCl₃ was added. A blue, green, red or purple colour indicates presence of phenols.

4. Flavonoids

Lead acetate test: About 2.0g of sample extract was taken and added few drops of lead acetate solution Pb (C₂H₃O₂)₂. The yellow solution precipitate indicated presence of flavonoids.

5. Tannins

Ferric Chloride Test: 0.5ml of the plant extract was placed in a tube and then 2ml of 5% of FeCl₃ solution was added. A greenish-black precipitate indicates the presence of tannins.

b) Determination of total phenolic contents (TPC)

Total phenolic compound content was determined by using Follin-Ciocalteu reagent (Hangerman and Muller 2000). 1 mg/ml of plant extract or standard solution of gallic acid (1000, 500, 250, 125µg/ml) was added to 25ml of volumetric flask, containing 10 ml of distilled water. A blank reagent using distilled water was prepared. 0.5 ml of Follin-Ciocalteu phenol reagent was added to the mixture and shaken. After 5 minute 1.5ml of 20% sodium carbonate solution (Na₂CO₃) was added to the mixture and volume was then prepared to the mark. Upon completion of incubation for 2 hours at room temperature, the absorbance was read at 765 nm using UV Visible Spectrometer. Gallic acid was used as standard antioxidant.

The total phenolic content was estimated according to the spectrophotometric method and expressed in terms of Gallic acid equivalence (mg of GAE/g of tissue).

c) Determination of DPPH radical scavenging

Radical scavenging activity of the plant extract were determined by colorimetric assay using DPPH (2, 2 diphenyl + picrylhydrazyl) radicals source of free radical according to the method of Blois (1956) with a slight modification. About 0.1 mM solution of DPPH radical solution in methanol was prepared. In a clear 96 well cleaned plates 100µl of standard (ascorbic acid) or sample in various concentrations (1-100µg/ml) and 100µl methanol/water was transferred and then 200µl of DPPH solution was added. The reaction mixtures were left for 30 minute at room temperature in dark. The absorbance of each 96 plates was measured at 517nm in Thermo Multiskon reader. The percent of DPPH scavenging activity was calculated as

$$\% \text{ DPPH scavenging} = \frac{\text{control abs} - \text{sample abs}}{\text{control abs}} \times 100$$

Where; Abs=absorbance

Reference: Blois MS Antioxidant determinations by the use of a state free radical, Nature 1958, 2:1199-1200.

d) Determination of moisture content

Moisture content of the samples was determined following the A.O.A.C (2000) method. Five (5) gram of samples in triplicates were placed in pre-dried weighed aluminum dish spreading as thinly as possible over the base of dish and oven dried at 105°C for 1 hour, cooled in a desiccator and weighed. Continued drying until a constant weight has been reached and the moisture content was calculated from the weight loss the sample.

Difference in weight (g)

Moisture (g/100 g of sample) = $\frac{\text{Difference in weight (g)}}{\text{Weight of the sample (g)}} \times 100$

Weight of the sample (g)

Shelf life (storage) study of the developed product

Shelf life or storage study was done to assess the overall hygiene maintained during the process of preparation of chutney products.

Sensory evaluation across one-month storage

The shelf life of chutney mix is extremely important to make the clarification process successful. The collected chutney mix from Guwahati and Manipur were stored in glass bottles for three months and its quality parameters like colour, appearance, taste etc. were studied. The mix products were stored at room temperature (26°C).

Statistical analysis

To assess whether the relationship observed between the formulation characteristics and sensory response, were likely to be real, and not merely the result of uncontrolled variation in response, the methods of statistics employed were presented in table, graph etc.

All the data of the chemical analysis were statistically analysed (AOAC 1995) methods applied for the statistical analysis of the recorded data.

Result and discussion

Determination phytochemical screening

Phytochemical analysis of leaf extract revealed the presence of metabolites in the crude extract of the *Eryngium foetidum* growing at Guwahati (Assam) and Wangjing (Manipur). Both the samples revealed the presence of alkaloids, saponins, phenols, flavonoids and tannins.

Table 3 Phytochemical investigation of culantro leaves (*Eryngium foetidum*) S₁ in methanol solvent systems.

Sl. No.	Phytochemical analysed	Test Performed	Result
			ME
1.	Alkaloids	Dragendroff's test	+
		Hager's test	+
2.	Saponins	Foam test	+
3.	Phenols	Ferric chloride test	+
4.	Tannins	Ferric chloride test	+
5.	Flavonoids	Lead acetate test	+

- + denotes average
- ME - Methanol Extract

Table 4 Phytochemical investigation of culantro leaves (*Eryngium foetidum*) S₂ in methanol solvent systems.

Sl No.	Phytochemical analysed	Test Performed	Result
			ME
1.	Alkaloids	Hager's test	-
		Dragendroff's test	-
2.	Saponins	Foam test	-
3.	Phenols	Ferric chloride test	+
4.	Tannins	Ferric chloride test	-
5.	Flavonoids	Lead acetate test	+

- + denotes average
- ME means Methanol Extract

Determination of Total phenolic content (TPC)

Plant phenolics are secondary metabolites formed by three different biosynthetic pathways viz., shikimate/chorismate or succinyl benzoate pathway, which produces the phenyl propanoids derivatives. Phenolic compound from medicinal herbs and dietary plants include phenolics acid, flavonoids, tannins, curcuminoids, curcumins etc. Numerous bio-actives of phenolic compounds are accountable for their chemo-preventive properties such as antioxidant, anti-allergenic, anticarcinogenic, anti-inflammatory effect (Naji et al., 2017; Alisha et al., 2018; Dsouza *et al.*, 2018; Hana et al., 2019; Shediwah et al., 2019). The total phenol of Guwahati culantro (*Eryngium foetidum*) leaves was found in methanol (ME) i.e., 0.0894 dry weight tissue and Manipur culantro leaves was also found in methanol (ME) i.e., 0.0834. So, both Guwahati *Eryngium foetidum* chutney mix and Manipur (*Eryngium foetidum*) leaves chutney mix have some phenolic properties.

Shashi *et. al*, 2019 conducted a study pharmacognostical evaluation of spiny coriander (*Eryngium foetidum* L.): A traditional culinary and ethnomedical herb. The study revealed that total phenolic of *Eryngium foetidum* was found to be highest in methanol: water extract (HME) i.e., 0.205.

Table 5 Quantitative analysis of total phenols

Sample extract	Total Phenols(mg GAE/g)
S ₁ in methanol	0.0894
S ₂ in methanol	0.0834

* S₁ –Chutney Guwahati leaves

* S₂- Chutney Manipur leaves

DPPH radical scavenging activity

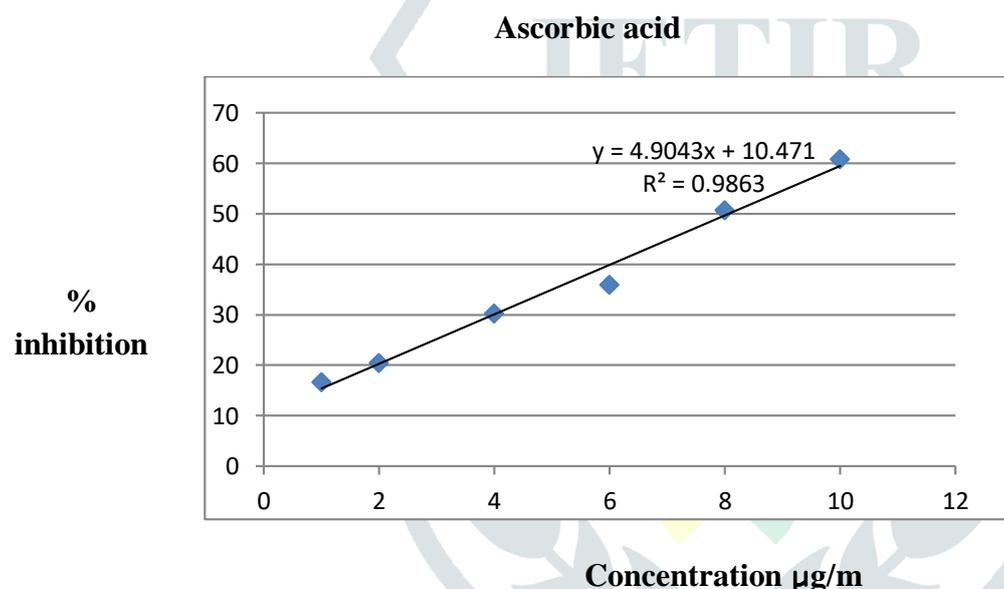


Fig.1 Quadratic regression equation for I_c50 (µg/ml) values of ascorbic acid

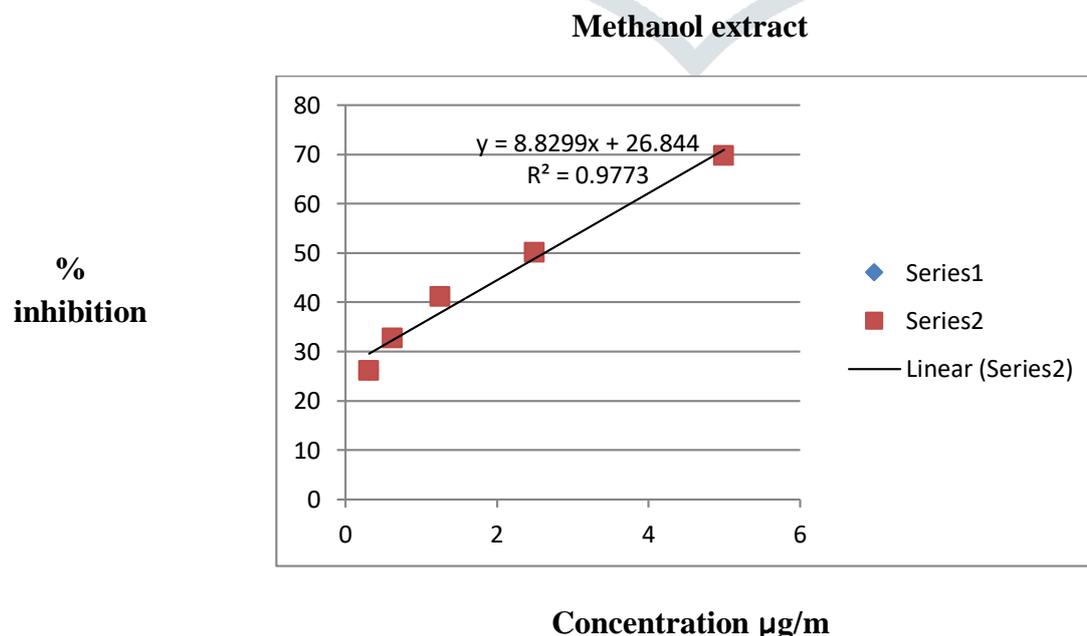


Fig. 2 Quadratic regression equation for I_c50 (µg/ml) values of Methanol extract of Guwahati leaves

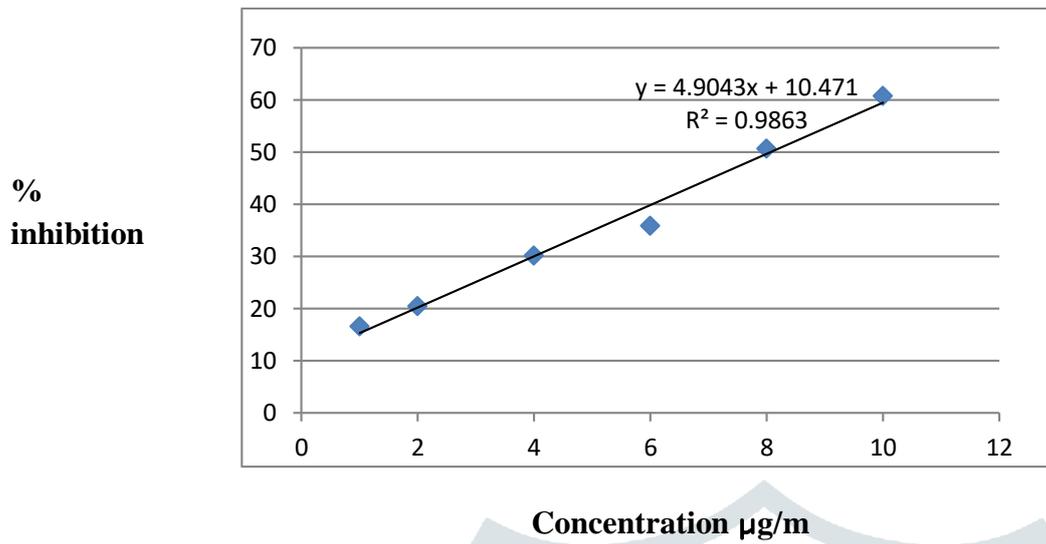


Fig.3 Quadratic regression equation for I_{c50} (µg/ml) values of ascorbic acid

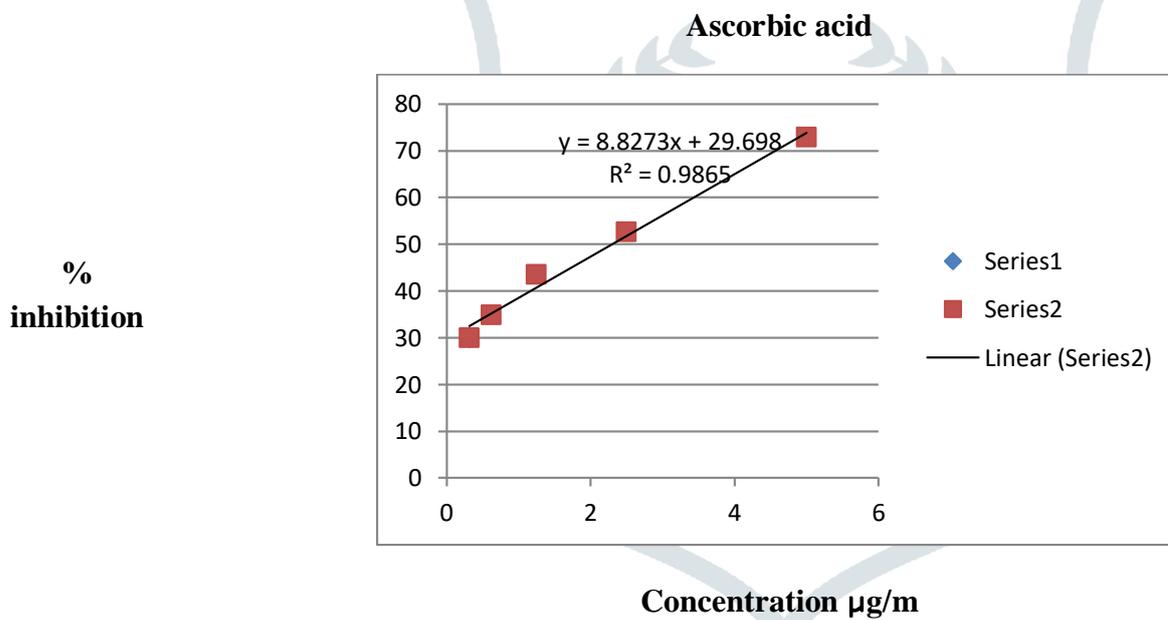


Fig.4 Quadratic regression equation for I_{c50} (µg/ml) values of Methanol extract of Manipur leaves

Table 6 DPPH and methanol radical scavenging activity of Guwahati *Eryngium foetidum* and Ascorbic acid

Antioxidant scavenging activity	Assay	Concentration	% inhibition
			Extracts of <i>E. foetidum</i>
		ME	
	DPPH	IC ₅₀ ±SD	8.0202±0.099
	Methanol	IC ₅₀ ±SD	3.4517±0.13697

Table 7 DPPH and methanol radical scavenging activity of Manipur *Eryngium foetidum* and Ascorbic acid

Antioxidant scavenging activity	Assay	Concentration	% inhibition
			Extracts of <i>E. foetidum</i>
		ME	
	DPPH	IC ₅₀ ±SD	8.0202±0.099
	Methanol	IC ₅₀ ±SD	2.9164±0.1070

The total antioxidant activity of *Eryngium foetidum* plant extract was determined by calculating the percentage inhibition against standard ascorbic acid. The concentration ranges from (0.3125, 0.625, 1.25, 2.5, 5 and 10). However, the IC₅₀ values of Methanolic extracts of Guwahati *Eryngium foetidum* (IC₅₀ = 3.4517 mg/ml) and IC₅₀ values of Manipur *Eryngium foetidum* (IC₅₀ = 2.9164) (Table 5 and 6).

According to the study, the highest ascorbic acid amount was recorded in methanol extract and lowest in chloroform extracts and that was correlated with the antioxidant activity. Dalukdeniya and Rathnayaka (2017) conducted a study on antibacterial and selected antioxidant activities of different *Eryngium foetidum* extracts. This study is also in compliance with the finding of the above as methanol extract showed the highest antioxidant and chloroform showed the lowest antioxidant activity. However, the IC₅₀ values of Methanolic extracts of the present study (IC₅₀ = 272.43 µg/ml) and the previous study of Singh et al. 2013) (IC₅₀ = 248.2 µg/ml) shows a similarity. So the present study found that the methanol extracts of *Eryngium foetidum* showed antioxidant activity against DPPH. Numerous bio-actives of phenolic compounds are accountable for their chemo-preventive properties such as antioxidant, anti-allergenic, anti-carcinogenic, anti-inflammatory effect (Prabha et. al. 2019)

Estimation of moisture (%)

S₁ powder contains 16% moisture whereas, S₂ was of 14%. The difference in moisture content between the two samples may be because of the place, soil characteristic features and geographical locations (Lepcha Et al. 2018).

Sensory evaluation of formulated chutney mix

Table 8 More acceptability scores of formulated chutney mix

Formulation	Products	Quality attributes						
		Colour	Appearance	Taste	Texture	Flavour	Consistency	Overall Acceptability
Guwahati leave chutney	S1HW	7.166±0.874	7.166±0.949	7.6±1.23	6.93±1.17	7.21±1.11	7.03±1.09	8.44±0.77
	S1CW	7.3±0.87	7.3±0.87	7.46±1.23	7.1±0.91	7.21±1.22	7.06±1.04	7.53±0.86
Manipur leave chutney	S2HW	7.166±0.949	6.9±1.26	6.43±1.54	6.43±1.25	6.7±1.48	6.33±1.21	7.83±1.17
	S2CW	7.26±1.08	7.26±0.90	7.2±1.39	7.23±0.93	7.4±1.191	6.96±1.27	7.3±0.89

Table 9 Mean acceptability scores of quality attributes of accepted chutney mix across storage of one month (30 days)

Formulation	Products	Quality attributes						
		Colour	Appearance	Taste	Texture	Flavor	Consistency	Overall Acceptability
Guwahati leave chutney	S1GC	7.45±1.27	7.25±1.13	7.4±1.23	7.15±1.42	7.35±1.13	7.1±1.26	8.25±0.98
	S1PC	7.05±1.19	7±1.48	6.3±1.71	6.85±1.19	6.65±1.46	6.85±1.27	7.1±1.48
Manipur leave chutney	S2GC	7.35±1.46	7.45±1.35	7.1±1.97	7.7±1.22	7.1±1.88	7.3±1.61	7.5±1.92
	S2PC	7.4±1.5	7.25±1.78	7.05±1.98	7.15±1.68	6.9±1.68	7.05±1.71	7.2±1.75

Colour: The mean colour score of the one formulation S₁CW got the highest score (7.3), S₁HW and S₂HW got the lowest score. The difference in colour pattern may be due to the heating effect.

Appearance: In case of appearance S_1CW got the highest score (7.3) while S_2HW obtain the lowest score (6.9).

Taste: S_1CW obtain highest score (7.46) and S_2HW got the lowest score (6.43) in taste.

Texture: In the case of texture S_2CW got highest score (7.23) and S_1HW got the lowest score (6.9).

Flavour: For flavour S_2CW got highest score (7.4) and S_2HW obtain the lowest score (6.7).

Consistency: In the case of consistency S_1CW obtain highest score than S_1CW has 6.33 got lowest score (see Table 7).

Overall acceptability:

S_1HW has the highest overall acceptability (8.44) and S_2CW got the lowest score. During the acceptability trials it was found that Guwahati leave chutney with hot water got the highest score in terms of overall acceptability (8.44) and the second highest score was obtained by Manipur leave chutney with hot water (7.83). The third highest score secured by Guwahati leave chutney with cold water in terms of overall acceptability (7.53) and fourth highest score obtained by Manipur leave chutney with cold water (7.3) respectively (see Table 8).

Shelf life storage of the developed chutney mix

Storage study was done for one month by keeping chutney mix in cool and dry place away from direct sunlight to prevent any changes of the product. Formulated dry chutney mixed were filled in sterilized both glass and plastic container.

Sensory evaluation during storage scores

A slight variation was observed among the scores during the storage period across one month in terms of colour, appearance, taste, texture, flavour, consistency and overall acceptability. The two mix products S_1 (Guwahati leaves chutney) and S_2 (Manipur leave chutney) were kept in both glass container and plastic container. S_1GC got highest scores in term of overall acceptability for 30 days (8.25) and second highest scores were S_2GC and S_2PC (7.5 and 7.2 respectively (Table 9). And the lowest score obtained by S_1PC (7.1). Change in the quality of the product may be due to the storage duration. According to Khedkar et al. (2018) study shows overall acceptability of standardization, characterization and storage stability of curry leaf chutney scores range from 8.7(excellent) to 8.2 (very good).

Statistical analysis of the sensory scores for curry leaf chutney in PET sored under ambient temperature conditions for 90 days was carried out using Turkey's post hoc test. The product packed in PET did not show any significant difference in the sensory scores during the storage period conducted a study revealed that the colour, flavour and turbidity of chutney were acceptable as there were no changes up to four months of storage. Therefore, the developed chutney mix can be consumed for one month (30 days).

Conclusion

It is concluded that culantro can be a good source for convenient chutney mix for overall consumption as side dish. Based on their physical and chemical properties the plant can be a better source of medicine for treatment of many diseases and health benefits for all communities. This convenient food can be prepared to enhance the ease of consumption. Such food is typically ready to eat without further preparation. It is also found that the formulation of the products can be prepared at domestic level and can be stored for ten months. Hence, culantro (*Eryngium foetidum*) will serve a good and convenient food for making chutney as it is available plenty.

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References

- AOAC (1995) Official methods of analysis, 16th edn. Association of Official Analytical Chemists, Washington
- Blois, M. S. 1958. Antioxidant determinations by the use of a state free radical. *Nature*, 2:1199-1200.
- Dalukdeniya, D. A. C. K., & Rathnayaka, R. M. U. S. K. 2017. Comparative Study on Antibacterial and Selected Antioxidant Activities of Different *Eryngium foetidum* Extracts. *Journal of Applied Life Sciences International*, 1-7.
- Honeychurch, P. N. 1980. Carribean wild plants and their uses. Letchworth Press: Barbados, W.I.
- Jyothirmayi, T, Narsing R. G, Govardhana R. D. 2006. Studies on instant raw tamarind chutney powder. *Journal of Foodservice*, 17:119-123.
- Khedkar, R., Shastri, P., & Bawa, A. S. 2019. Standardization, characterization and storage stability of curry leaf chutney. *Carpathian Journal of Food Science & Technology*, 11(3):152-162.
- Leishangthem S, Sharma LD. Study of some important medicinal plants found in Imphal East district, Manipur, India. *Int. J. Sci. Res. Publ.* 2014; 4(9):1-5.
- Lepcha, T. T., Upadhyay, S., Manivannan, S., Diki, K., Bhutia, L. S., & Muddarsu, V. R. Proximate and nutritional analysis of Culantro (*Eryngium foetidum*). *JPP, SPI*: 3129-3134.
- Lingaraju, D. P., Sudarshana, M. S., Mahendra, C., & Rao, K. P. 2016. Phytochemical screening and antimicrobial activity of leaf extracts of *Eryngium foetidum* L. (Apiaceae). *Indo American Journal of Pharmaceutical Research*, 6 (2):4339-4344.
- Malik, T., Pandey, D.K., Roy, P., & Okram, A. (2016). Evaluation of phytochemicals, Antioxidant, Antibacterial and Antidiabetic Potential of *Alpinia galanga* and *Eryngium foetidum* Plants of Manipur (India). *Pharmacognosy Journal*, 8(5)
- Mishra, P. M., Verma, V., Mishra, S. Mishra and G. K. Rai 2011. Studies on development of ready to eat Amla (*Emblica officinalis*) chutney and its preservation by using class one preservatives, *American journal of Food Technology* 6 (3):244-252.
- Paula, J. H. A., Seaforta, C. E., Tikasingh, T. 2011. *Eryngium foetidum* L. A review, *Fitoterapia*, 82 (3): 302-308.
- Prabha, S., Athoibi, S., & Dsouza, M. R. Pharmacognostical evaluation of Spiny coriander (*Eryngium foetidum* L.): A traditional culinary and ethnomedicinal herb, 4(4):64-70.
- Prasad, B. V. G., Munsu, P., Chakravorty, S. 2018. Underutilized leafy vegetables: diversity, nutritional security and medicinal benefit in context of eastern India. *Advances in biodiversity conservation for sustainable development*. 95-104.

- Prasoona, J., Kumari, B. A., Sarkar, S., Kiran, V. K., & Swamy, R. (2020). Development of Instant Chutney Powder with Incorporation of Blanched Carrot and Green Leafy Vegetable Powders. *International Research Journal of Pure and Applied Chemistry*, 1-9.
- Ramcharan, C. (1999). *Culantro: A much utilized, little understood herb. Perspectives on New Crops and New Uses*. ASHS Press, Alexandria, VA.
- Raunelli, P., Liviach, D., Alvis, R., Puente, S., Best, I., & Reátegui, O. 2019. Cytoprotective Effect of the Eryngium foetidum " Sacha Culantro" Methanolic Leaf Extract Versus Sodium Fluoride Exposed Mice using the Micronucleus Test and the Comet Assay. *Pharmacognosy Journal*, 11(3) 461-465.
- Rao, G. N., Rao, P. P., Jyothirmayi, T., & Rao, D. G. (2008). Chemical composition, standardisation and storage studies on raw mango chutney powder. *Journal of Food Science and Technology*, 45(5), 436.
- Rao, P. P., Rao, G. N., Mala, K. S., Balaswamy, K., & Satyanarayana, A. (2013). Preparation and storage stability of flaxseed chutney powder, a functional food adjunct. *Journal of food science and technology*, 50(1), 129-134.
- Reejhsinghani, A. 1977. *Indian Pickles and Chutneys*, Orient Delhi.
- Saenz, M. T., Fernandez, M. A., Garcia, M. D. 1997. Anti-inflammatory and analgesic properties from leaves of Eryngium foetidum L. (Apiaceae). *Physiotherapy Research*, 11 (5): 380-384.
- Satyanarayana, A., Giridhar, N., Balaswamy, K., Shivaswamy, R., & Rao, D. G. (2001). Studies on development of instant chutneys from pudina (mint, Mentha spicata) and gongura (Hibiscus sp.). *Journal of Food Science and Technology*, 38(5), 512-514.
- Sayeri Dutta et al. 2017, Antibacterial Activity of Spiny Coriander (Eryngium Foetidum Linn.) On Gram Positive and Gram Negative Bacteria. *Int J Recent Sci Res*. 8(9), pp. 19959-19962.
- Sengupta, R. (2014). Dry fruit chutney. *International Journal of Food and Nutritional Sciences*, 3(3), 185.
- Simon, O. R., Singh, N. 1986. Demonstration of anticonvulsant properties of an aqueous extract of Spirit Weed (Eryngium foetidum L.) *The West Indian medical journal*, 35 (2): 121-5.
- Singh, B. K., Ramakrishna, Y., & Ngachan, S. V. 2014. Spiny coriander (Eryngium foetidum L.): a commonly used, neglected spicing-culinary herb of Mizoram, India. *Genetic resources and crop evolution*, 61(6):1085-1090.
- Thomas, P. S., Essien, E. E., Ntuk, S. J., & Choudhary, M. I. 2017. Eryngium foetidum L. essential oils: chemical composition and antioxidant capacity. *Medicines*, 4(2):24.
- Trease and Evans
- Veerapandian, C., John, S. G., Kuppaswamy, K., Ramanathan, G., & Ravi, P. 2014. Quality kinetics and storage stability studies of ready to eat peanut chutney. *Journal of Nutritional Health and Food Engineering*, 1 1-7.
- Yuhlung, C. C., Bhattacharyya, M. 2014. Practice of ethno medicine among the Chothe tribe of Manipur, North East India. *Int. J. Pharmac. Biol. Arch*. 5(3):138- 149.