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Effect of Curry Leaves Chutney Supplementation on Lipid Profile and Anthropometric Indicators in Hyperlipidemic Subjects: A Clinical Intervention Study

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ABSTRACT

Elevated blood lipids, or hyperlipidaemia, greatly raise the risk of cardiovascular disease. Bioactive chemicals found in the traditional Indian plant Murraya koenigii.L. (curry leaves) have been shown in animal experiments to have lipid-lowering, anti-inflammatory, and antioxidant properties. In this clinical investigation, 60 hyperlipidemic people in Parbhani, Maharashtra, ages 30 to 60, had their lipid profiles and anthropometric markers evaluated after taking 10 grams of freshly made curry leaf chutney daily. The subjects were split evenly between the experimental and control groups, with the former getting chutney for 60 days in addition to their regular medical and lifestyle routines. Blood pressure, food patterns, and anthropometric measures (Height, weight, BMI, mid-upper arm circumference, and waist-hip ratio) were among the baseline data that were documented. At baseline, 30, and 60 days, fasting lipid profiles (total cholesterol, LDL-C, HDL-C, VLDL-C, and triglycerides) were examined. Following supplementation, the experimental group's blood pressure, triglycerides, LDL-C, and total cholesterol all significantly decreased (from 225.2 to 156.3 mg/dL, 140.37 to 90.19 mg/dL, and 167.7 to 129.1 mg/dL, respectively), but the control group did not. The experimental group had a little rise in HDL-C cholesterol. Although not statistically significant, anthropometric alterations were seen, including modest decreases in weight and BMI. Dietary evaluations showed that individuals did not follow suggested diets, underscoring the need for workable solutions. Curry leaf chutney is a natural, culturally acceptable food addition that can help hyperlipidemic people regulate their blood pressure and improve their lipid profiles, according to one study. A viable, inexpensive adjunct treatment for controlling hyperlipidaemia and related cardiovascular risks is include curry leaf chutney in the diet.

Keywords: *Hyperlipidemia, Cardiovascular health, Triglycerides, Total cholesterol*.

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1. INTRODUCTION

Elevated blood lipid levels, or hyperlipidaemia, are recognized as a major risk factor for cardiovascular diseases such as coronary artery disease, myocardial infarction, and stroke. The condition typically arises from a combination of genetic predisposition, inappropriate dietary practices, physical inactivity, and underlying metabolic disorders. Because hyperlipidaemia is usually asymptomatic, regular lipid screening and early nutritional intervention are essential to reduce cardiovascular morbidity and mortality (Verywell Health, 2024). In recent years, increasing attention has been directed toward functional and herbal foods as safe, accessible, and cost-effective approaches for the prevention and management of metabolic disorders. Bioactive constituents present in plant-based foods—such as flavonoids, phenolic acids, alkaloids, and terpenoids—have been shown to exert hypolipidemic, antioxidant, anti-inflammatory, and hepatoprotective effects, making them valuable adjuncts to conventional drug therapy (Kumar & Sharma, 2020).

Among such herbal foods, *Murraya koenigii* L. (curry leaves) is widely used in Indian cuisine and traditional medicine. It is a rich source of carbazole alkaloids, flavonoids, and essential oils, which contribute to its lipid-lowering, antidiabetic, and cardioprotective activities. Experimental and clinical studies have demonstrated that curry leaf extracts can reduce total cholesterol, LDL-C, and triglyceride levels, while enhancing HDL-C, thereby improving lipid metabolism and antioxidant status (Gaikwad et al., 2013; Gopal et al., 2023). Several **randomized controlled trials** have confirmed that **herbal and bioactive foods** can help improve lipid metabolism and reduce cardiovascular risk. For example**, pomegranate peel supplementation** was shown to lower harmful lipids and improve liver function in patients with non-alcoholic fatty liver disease (Baghdadi et al., 2025). Similarly**, silymarin,** a plant-based compound, improved both lipid and blood sugar levels in people with type 2 diabetes mellitus (Ferdowsi et al., 2024).

In another study, **theobromine**—a natural compound found in cocoa—helped increase HDL-C (the "good" cholesterol) and reduce cardiovascular risk factors (Sharifi-Zahabi et al., 2023). **Portulaca oleracea** extract was found to improve both lipid levels and blood sugar control (Darvish Damavandi et al., 2021), while **cinnamon** supplementation significantly reduced cholesterol and triglyceride levels in people with metabolic disorders (Kutbi et al., 2022). Other medicinal plants have shown similar benefits. Extracts of **Rheum ribes** (Ghafouri et al., 2023), **Melissa officinalis** or lemon balm (Heshmati et al., 2020; Asadi et al., 2018), **Ziziphus vulgaris** (Irannejad Niri et al., 2021), **Rhus coriaria** or sumac (Akbari-Fakhrabadi et al., 2018), and **ginger** (Khandouzi et al., 2015) have all been reported to lower total cholesterol, triglycerides, and LDL-C levels, while improving HDL-C and antioxidant status.

Together, these findings provide strong evidence that **herbal foods and plant-based bioactives** can play a meaningful role in managing dyslipidemia and improving overall cardiovascular health. Despite these encouraging findings, limited evidence exists regarding the impact of curry leaves consumed in their traditional dietary form, such as chutney, which is an integral part of Indian meals. Investigating its health effects in a commonly consumed, culturally accepted preparation could provide a practical and sustainable strategy for dietary management of hyperlipidaemia.

Therefore, the present clinical study was conducted to evaluate the effect of curry leaves chutney supplementation on lipid profile and anthropometric indicators in hyperlipidemic subjects. The primary objective was to assess whether daily intake of 10 g of freshly prepared curry leaves chutney for 60 days could favorably influence total cholesterol, LDL-C, HDL-C, triglycerides, body weight, and body mass index (BMI), thereby offering a natural and culturally appropriate adjunct therapy for the dietary management of hyperlipidaemia.

2. MATERIALS AND METHODS

Study Design and Participant Selection

A randomized, controlled, cross-sectional clinical trial was conducted in Parbhani district, Maharashtra, to determine the effects of *Murraya koenigii* L. (curry leaves) chutney supplementation on lipid profile and anthropometric indicators in hyperlipidemic subjects. A purposive random sampling technique was used to screen 100 adults aged between 30 and 60 years. Individuals with total serum cholesterol levels greater than 200 mg/dL were classified as hyperlipidemic and considered eligible for the study. Based on this criterion, 60 participants were selected and randomly assigned into two groups—an experimental group (n=30) and a control group (n=30). The experimental group received 10 grams of freshly prepared curry leaves chutney daily for 60 days in addition to their habitual diet, whereas the control group continued with their regular routine without supplementation. All participants provided written informed consent prior to enrolment. The study protocol was reviewed and approved by the Institutional Ethics Committee of Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani.

Study Design and Participants

The present study was designed to evaluate the effect of supplementation with curry leaves chutney on hyperlipidemic subjects. Participants aged 30–60 years with hyperlipidemia (total cholesterol >200 mg/dL), willing to provide written informed consent, and maintaining a stable dietary and medication regimen for at least three months prior to the study were included. Individuals with diagnosed diabetes mellitus, thyroid disorders, liver or renal diseases, those taking lipid-lowering drugs, antioxidant supplements, or herbal medications, pregnant or lactating women, and those with known allergies to curry leaves or related components were excluded.

Inclusion criteria for the study were adults aged 30–60 years, diagnosed with hyperlipidemia, willing to provide written informed consent, and maintaining a stable dietary and medication regimen for at least three months prior to the study. **Exclusion criteria** included diagnosed cases of diabetes mellitus, thyroid disorders, liver or renal diseases; use of lipid-lowering drugs, antioxidant supplements, or herbal medications; pregnancy or lactation; and known allergies to curry leaves or related components.

Sample Size Calculation

The sample size was calculated using Cochran's formula for comparing means:

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 \times 2\sigma^2}{d^2}$$

where $Z_{1-\alpha/2} = 1.96$at a 95% confidence level, $Z_{1-\beta} = 0.84$for 80% power, $\sigma = 45.6$mg/dL (standard deviation from previous studies), and $d = 25$mg/dL (expected mean difference). The calculated sample size was 25 participants per group, which was increased to 30 participants per group to account for potential dropouts.

Study Outcomes

The primary outcome of the study was the change in serum lipid profile parameters, including total cholesterol, LDL-C, HDL-C, VLDL-C, and triglycerides, after 60 days of intervention. Secondary outcomes included changes in anthropometric measurements, such as body weight, body mass index (BMI), mid-upper arm circumference (MUAC), and waist-to-hip ratio (WHR), as well as changes in systolic and diastolic blood pressure and dietary intake patterns.

Baseline Data Collection

Baseline data were collected through personal interviews using a pretested structured questionnaire. Information recorded included demographic details, socioeconomic status, dietary habits, lifestyle practices, physical activity, medical and family history, and current use of medications or supplements. This comprehensive data collection allowed accurate characterization of the study population prior to intervention.

Anthropometric Measurements

Anthropometric measurements were conducted using standardized methods and calibrated instruments. Height was measured to the nearest 0.1 cm using a portable stadiometer (Seca 213, Germany), and weight was recorded to the nearest 0.1 kg using a digital weighing scale (Omron HBF-702T, Japan). Body Mass Index (BMI) was calculated using the standard formula:

$$\text{BMI (kg/m}^2\text{)} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

Mid-Upper Arm Circumference (MUAC) was measured at the midpoint between the acromion and olecranon processes of the left arm using a non-stretchable fiberglass measuring tape (Butterfly®, India). Triceps Skinfold Thickness (TSFT) was measured at the midpoint of the posterior aspect of the upper arm using a Harpenden skinfold caliper (Baty International, UK) with constant pressure. Waist Circumference (WC) was measured midway between the lowest rib and iliac crest, and Hip Circumference (HC) was taken at the widest point over the buttocks. The Waist–Hip Ratio (WHR) was calculated using the formula:

$$\text{WHR} = \frac{\text{Waist Circumference (cm)}}{\text{Hip Circumference (cm)}}$$

All anthropometric parameters were measured at baseline (Day 0), after 30 days, and after 60 days of intervention by the same trained investigator to minimize observer variability. Each measurement was taken twice, and the average value was used for statistical analysis

Blood Pressure Monitoring

Blood pressure measurements were taken at baseline and monthly intervals using a calibrated sphygmomanometer and conventional techniques.

Dietary analysis

The 24-hour dietary recall approach was used to assess daily food consumption. Participants gave full reports of all meals and beverages ingested over the previous 24 hours. Nutrient consumption was determined with the "Nutritive Value of Indian Foods" database (Gopalan et al., 2017). Percent nutritional adequacy was established using the Recommended Dietary Allowances (RDA) as follows:

Percent Nutrient Adequacy = (Nutrient Intake/RDA) × 100

Intervention study

Participants were separated into two groups: A group of 30 hyperlipidemic individuals got 10 grams of freshly produced curry leaves chutney every day for 60 days. Consumption was monitored to guarantee compliance. The Control Group included 30 hyperlipidemic participants who did not take any supplements during the trial period. All participants were told to stick to their regular routines, including nutrition, physical exercise, and prescription regimes.

Biochemical Analysis

Fasting blood samples were collected from all participants at baseline, on the 30th day, and on the 60th day of the intervention. Serum lipid profile parameters, including total cholesterol, LDL-C, HDL-C, VLDL-C, and triglycerides, were analysed using commercial enzymatic kits. Total cholesterol was estimated using the CHOD-PAP method as described by Stockbridge et al. (1989). All analyses were performed in an accredited pathological laboratory following the manufacturer's instructions and standard quality control procedures to ensure accuracy and reliability.

Statistical Analysis

All data were expressed as mean ± standard deviation (SD). Within-group comparisons over time were performed using paired t-tests, and between-group comparisons were analysed using one-way analysis of variance (ANOVA). Post hoc tests were conducted when appropriate. A p-value <0.05 was considered statistically significant.

3. RESULT AND DISCUSSION

Table.1 General information of the selected subjects (n=30)

S. No.	Particulars	Hyperlipidemic subjects (n=30) (Experimental Group)	
		Number	**Percentage**
1	**Age in years**		
	40-50	11	36.66
	50-65	19	63.33
2	**Sex**		
	Male	16	53.33
	Female	14	46.66
3	**Type of the family**		
	Joint	13	43.33
	Nuclear	15	50
	Extended	02	6.66
4	**Educational Status**		
	Illiterate	01	3.33
	Primary school	01	3.33
	Secondary school	06	20.00
	Higher Secondary school	10	33.33
	Graduate	08	26.66
	Postgraduate	04	13.33
5	**Occupation**		
	Service	11	36.66
	Business	05	16.66
	Farming	8	26.66
	Home maker	6	20.00
6	**Monthly family Income**		
	Rs. <15,000	3	10.00
	Rs.15,000- 30,000	10	33.33
	Rs.30,000 - 40,000	3	10.00
	Rs. >40,000	14	46.66

Collection of General Information of the Selected Subjects

Table 1. shows the demographic and socioeconomic characteristics of 60 hyperlipidemic adults aged 30 to 60 from Parbhani, Maharashtra. The majority were between the ages of 50 and 60, with men (53.33%) slightly more afflicted than women (46.66%). The majority of participants (50%) lived in nuclear households, with joint families accounting for 43.3%. Educationally, 33.33% had completed upper secondary school, while 3.33% were illiterate. Most respondents (36.66%) worked in service-related jobs, with 33.33% and 46.66% reporting monthly incomes exceeding ₹40,000.

These findings are consistent with previous research showing that older persons, particularly males, are more prone to hyperlipidaemia. Shrivastva et al. (2014) found that pancreatic activity and (HDL-C) cholesterol production diminishes with age, contributing to the trend. Furthermore, Wang et al. (2023) report that persons in service-related industries frequently suffer greater levels of stress, which is a known risk factor for cardiovascular disease. Furthermore, physical inactivity is a well-known risk factor for hyperlipidaemia and heart disease. Research done in China found that moderate-intensity aerobic exercise significantly reduced lipid profiles in older people with hyperlipidaemia (Li et al., 2025).

Overall, the results indicate that older persons, particularly men, with higher incomes and those working in service-related jobs, are more vulnerable to hyperlipidaemia. These findings highlight the relevance of targeted therapies and lifestyle changes in reducing cardiovascular risks in this population.

Table 2. Information about disorders (n=30)

S. No.	**Particulars**	**Hyperlipidaemic subjects (n=30)**	
		Number	**Percentage**
1	**Period of Diagnosis**		
	>5	4	13.33
	3-5	2	6.66
	1-3	11	36.66
	<1	13	43.33
2	**Family history of Disease**		
	Maternal		
	Paternal	10	33.33
	None	12	40.00
		8	26.66
3	**Instructions of Doctors**		
	Follow		
	Do not follow	4	13.33
		26	86.66
4.	**Weight change after diagnosis**		
	Increased	30	100.0
	Decreased	-	-
	No changed	-	-
5	**Checking of blood lipid profile is done**		
	Yes	30	100.0
	No	-	-
6	**Frequency of blood checkup**		
	Occasionally	30.00	100.0
	Monthly	-	-
	Fortnightly	-	-
	Weekly	-	-

Table 2. summarises the characteristics and management strategies of 30 hyperlipidaemic people. A considerable number (43.33%) were diagnosed within the last year, indicating that the illness had only recently developed. Family history is significant, with 40% reporting a paternal and 33.33% a mother history of hyperlipidaemia, indicating a hereditary susceptibility. However, adherence to medical guidance is worrisome; 86.66% of individuals did not follow prescribed guidelines, which may impede successful therapy. Following diagnosis, all participants gained weight, which might aggravate the disease. Lipid profiles are regularly monitored, with all individuals undertaking such tests; nevertheless, checks are uncommon, happening only on occasion rather than at regular intervals.

Table 3. Prevalence of Hyperlipidaemia symptoms among the selected subjects

S. No.	**Symptoms**	**Hyperlipidemic Subjects (n=30)**	
		Number	**Percentage**
1	Hyperlipidaemia	17	56.66
2	Hypertension	15	50.00
3	Anaemia	12	40.00
4	Acidity	10	36.66

5	Heavy Sweating	11	33.33

The common symptoms among the thirty hyperlipidemic individuals are highlighted in Table 3. Hyperlipidaemia itself was the most common symptom, as indicated by 56.66% of subjects. 50% of the participants had hypertension, the second most prevalent symptom, which is consistent with the established link between high blood pressure and lipid elevation. Forty per cent of the patients reported having anaemia, which may be related to inadequate food intake or decreased nutrient absorption, which are frequently seen in people with long-term metabolic problems. Furthermore, 36.66% of participants reported feeling acidic, which may be brought on by bad eating habits, stress, or adverse drug reactions. 33.33% of individuals reported experiencing heavy perspiration, which might be caused by metabolic imbalances, stress, or an increase in body weight. These signs imply that people with hyperlipidaemia frequently. Acidity was also reported by 36.66% of participants, which may be related to adverse drug reactions, stress, or bad eating habits. Excessive perspiration was seen in 33.33% of participants, which might be linked to metabolic abnormalities, stress, or excess body weight. A comprehensive dietary and lifestyle intervention is crucial to treat not just cholesterol levels but also related comorbid illnesses, as these symptoms indicate that hyperlipidemic people frequently deal with several health issues at once.

Food and Nutrient Intake of the Selected Hyperlipidemic Subjects

Table.4 Dietary Pattern of selected subjects (n =30)

S. No.	**Diet pattern**	**Hyperlipidemic subjects (n=30)** Experimental	
		Number	**Percentage**
1	**Food Habits** Vegetarian Non vegetarian Ovo vegetarian	 8 20 2	 26.66 66.66 6.66
2	**Meal pattern** 2 meals a day 3 meals a day 4 meals a day 5 meals a day	 02 18 05 05	 6.66 60.00 16.66 16.66
3	**Diet restrictions** Sugar Sweets Salt Fat Fluid Bakery Products None	 - 08 15 02 - - 05	 - 26.66 50.00 6.66 - - 16.66
4	**Consumption of Salads** Yes No **Amount consumed** ≥100g 50- 100g	 13 17 5 8	 43.33 56.66 16.66 26.66
5	**Consumption of Fruits** Yes No **Frequency** Daily 2-4 time in a week Weekly Occasionally	 30 - 1 6 15 03	 100.0 - 3.33 20.00 50.00 10.00
6	**Fasting** Yes No	 06 24	 20.00 80.00

7	**Frequency of fasting** Once a week ≥ 2 times Fortnightly	 02 03 1	 6.66 10.00 3.33

Table 4. The eating practices of the hyperlipidemic participants in this study point to a number of concerning issues. The non-vegetarian diet, which is frequently linked to elevated cholesterol levels because it involves consuming more saturated fats and foods high in cholesterol, was adopted by a sizable majority (66.66%). 60% of respondents followed a three-meal daily schedule, whilst 16.66% ate four meals daily. Significantly, 86.66% of participants did not comply to their doctor's dietary recommendations, and every participant reported gaining weight after receiving a diagnosis, suggesting possible problems with lifestyle management and diet adherence. Fruit intake was poor, with half eating fruits just once a week, and salad consumption was low, with only 43.33% of eating salads. High consumption of animal-based meals and low intake of fruits and vegetables are characteristics of these dietary patterns that may raise cholesterol and increase the risk of cardiovascular disease. Plant-based diets can successfully reduce plasma cholesterol levels, and studies have demonstrated an inverse relationship between LDL cholesterol levels and increased consumption of fruits and vegetables.

Table 5. Food Intake of the Selected Hyperlipidemic Subjects

		Male Subjects (n=16)			Female Subjects (n=14)		
S. No.	**Food Groups**	**ICMR 2024 (g)**	**Actual Intake (g)**	**Excess/Deficit (%)**	**ICMR 2024 (g)**	**Actual Intake (g)**	**Excess/Deficit (%)**
1	Cereals	260	318.33 ± 87.39	+22.30	190	254.55 ± 42.35	+33.68
2	Pulses	85	51.66 ± 19.51	-39.22	60	48.33 ± 25.73	-20.55
3	Green leafy vegetables	100	52.42 ± 28.77	-47.58	100	62.22 ± 38.00	-38.05
4	Other vegetables	200	109.52 ± 32.78	-45.50	200	133.77 ± 23.20	-33.50
5	Roots and tubers	100	107.61 ± 32.35	+7.00	100	128.33 ± 23.18	+21.50
6	Fruits	100	56.19 ± 21.78	-44.00	100	85.55 ± 24.55	-17.00
7	Milk & Milk products	300	204.04 ± 52.95	-32.00	300	216.66 ± 35.35	-28.78
8	Fats and oils	25	33.05 ± 8.56	+24.40	20	36.66 ± 10.89	+80.30
9	Sugar & Jaggery	20	31.04 ± 9.11	+65.00	20	33.44 ± 12.66	+65.20
10	Nuts and oilseeds	40	60.00 ± 11.44	+50.00	30	50.00 ± 9.18	+25.00

The above data is pictured in next graph

Table 5. The dietary practices of the hyperlipidemic participants in our research indicate notable nutritional deficiencies. Many individuals did not consume enough of the protective food categories, such as fruits, vegetables, green leafy vegetables, legumes, and milk and milk products. Intake deficits varied from 20.55% to 47.58%, and deficiencies were often more noticeable in males than in females. In contrast, there was an excess of 7% to 80.3% in the intake of energy-dense foods such grains, roots and tubers, fats and oils, sugar or jaggery, nuts, and oilseeds over the recommended limits. It is probable that the participants' high consumption of energy-dense meals and low intake of preventive foods is a contributing factor to the incidence of hyperlipidaemia. According to the Indian Council of Medical Research's (ICMR) Dietary Guidelines for Indians (2024), in order to guarantee proper nutrition and fend against chronic illnesses, a balanced diet consisting of at least 400–500g of fruits and vegetables per day should be consumed. In order to correct these imbalances and lower the risk of hyperlipidaemia, certain nutritional treatments are required, as demonstrated by the observed dietary patterns. (National Institute of Nutrition (ICMR)

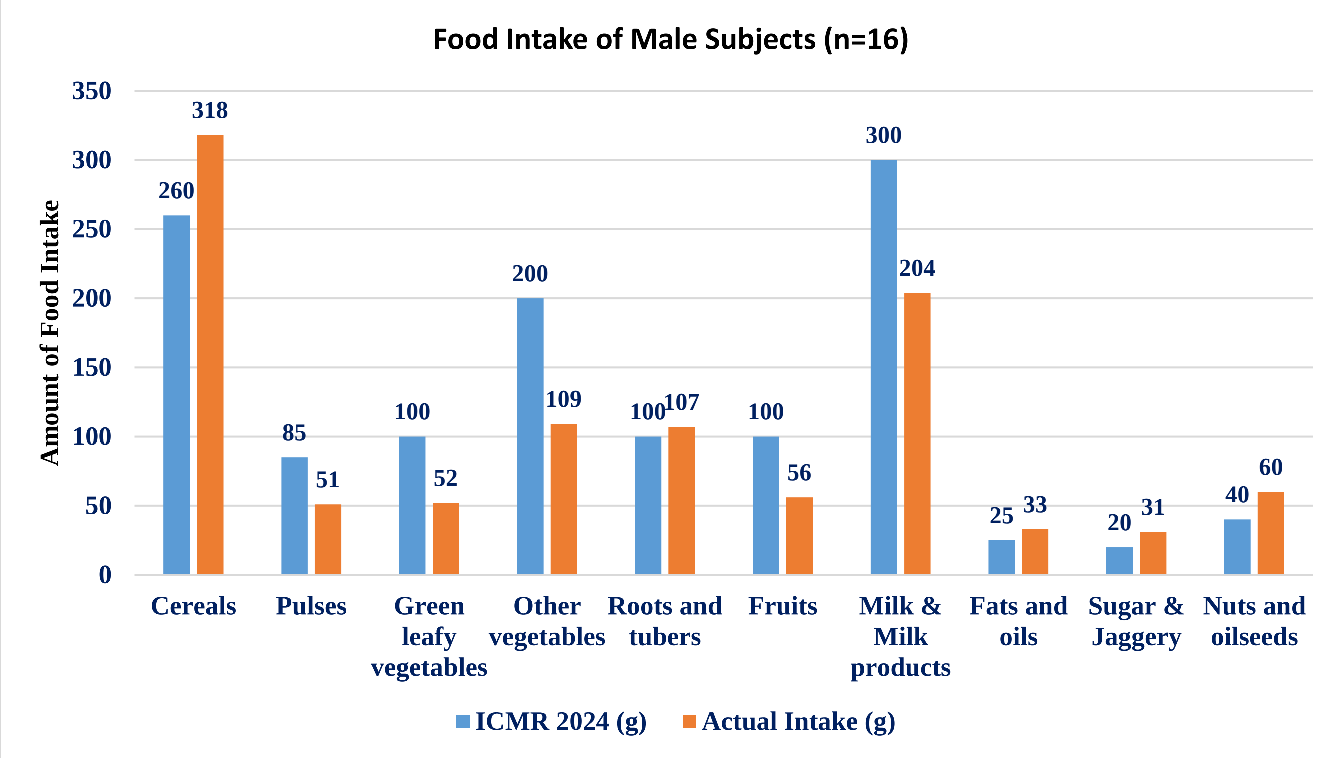

Fig.1 Food intake of selected hyperlipidaemic male subjects

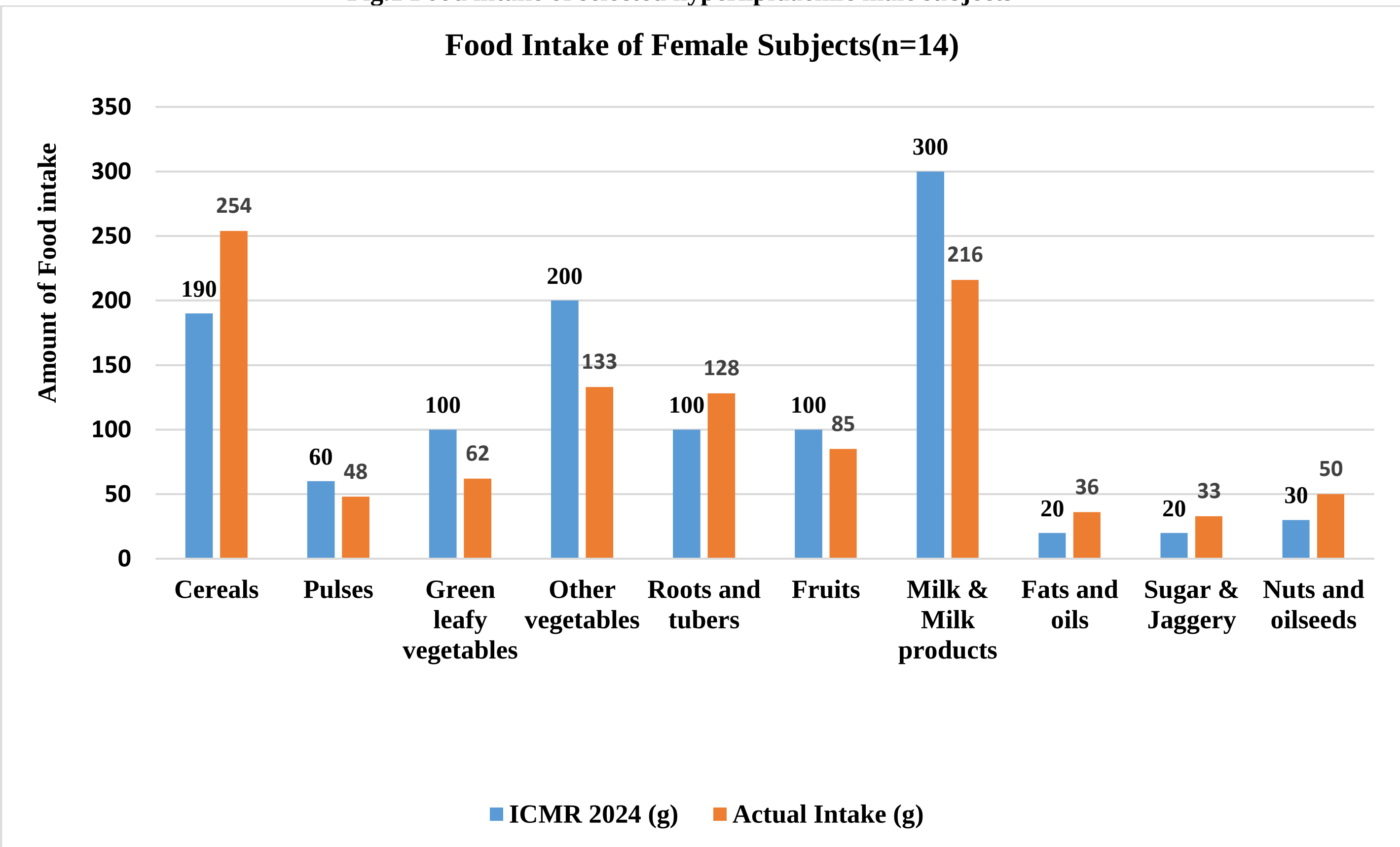

Fig.2 Food intake of selected hyperlipidaemic male subjects

Table 6. Nutrient intake of the selected Hyperlipidemic subjects (n=30)

Nutrient	RDA (ICMR 2024) Male	Male Intake	Excess/Deficit (%)	% Adequacy	RDA (ICMR 2024) Female	Female Intake	Excess/Deficit (%)	% Adequacy
Energy (kcal)	2110	2084.7 ± 478	-1.23%	98.8	1660	1947.0 ± 19.1	+17.2%	117.0
Protein (g)	54	49.3 ± 9.18	-8.72%	91.3	46	44.1 ± 6.45	-4.34%	95.7
Fat (g)	25	45.5 ± 9.54	+81.8%	181.0	20	51.0 ± 11.45	+60.8%	259.0
Fiber (g)	30	19.1 ± 13.4	-36.4%	63.3	40	16.0 ± 1.8	-59.9%	40.8
Calcium (mg)	800	773.4 ± 120.9	-3.4%	96.6	800	620.8 ± 19.1	-22.5%	77.5
Vitamin E (mg)	10	7.8 ± 2.1	-22.0%	78.0	8	6.9 ± 1.7	-13.8%	86.3
Selenium (µg)	55	42.5 ± 8.3	-22.7%	77.3	45	38.9 ± 6.1	-13.6%	86.4
Iron (mg)	11	9.9 ± 4.00	-9.9%	89.9	15	13.7 ± 1.15	-8.5%	91.0
β-Carotene (µg)	4800	2627.1 ± 186.2	-45.3%	54.7	4800	3164.8 ± 105.3	-34.0%	65.9
Thiamine (mg)	1.2	1.31 ± 0.34	+9.2%	109.0	1.1	0.85 ± 1.81	-22.7%	77.0
Riboflavin (mg)	1.6	1.38 ± 0.21	-13.0%	86.3	1.6	1.26 ± 0.39	-21.3%	78.0
Niacin (mg)	12	15.3 ± 5.3	+27.8%	127.8	9	13.8 ± 3.9	+15.0%	115.0
Vitamin C (mg)	65	61.6 ± 10.8	-6.2%	94.8	55	48.2 ± 9.5	-12.4%	87.0
Vitamin E (mg)	10	7.8 ± 2.1	-22.0%	78.0	8	6.9 ± 1.7	-13.8%	86.3
Selenium (µg)	55	42.5 ± 8.3	-22.7%	77.3	45	38.9 ± 6.1	-13.6%	86.4
Carbohydrate (g)	380	419.7 ± 149.6	+10.3%	110.2	380	409.9 ± 49.1	+7.6%	107.0

The dietary assessment of the 30 hyperlipidemic subjects revealed **imbalances in macro- and micronutrient consumption** compared with the Recommended Dietary Allowances (ICMR, 2024).

Energy and Macronutrients: The average energy intake among males (2084.7 ± 478 kcal) was slightly below the RDA (98.8% adequacy), whereas females consumed more energy than recommended (1947.0 ± 19.1 kcal, 117% adequacy), indicating potential overnutrition in women. Protein intake was below RDA for both sexes, with males at 91.3% and females at 95.7% adequacy, suggesting mild dietary protein insufficiency. Fat consumption was markedly higher than recommended, with males consuming 45.5 ± 9.54 g (181% of RDA) and females 51.0 ± 11.45 g (259% of RDA), indicating **excessive dietary fat intake**, a known contributor to hyperlipidemia. Carbohydrate intake was slightly above RDA in both males (419.7 ± 149.6 g; 110.2%) and females (409.9 ± 49.1 g; 107%), further emphasizing the unbalanced macronutrient profile. Dietary fiber intake was **substantially low**, with males at 63.3% and females at 40.8% of RDA, highlighting insufficient consumption of fruits, vegetables, and whole grains.

Micronutrients: Deficiencies were observed in **Vitamin E** and **Selenium**, key antioxidants that mitigate oxidative stress in hyperlipidemia. Male participants had 78% and 77.3% adequacy for Vitamin E and Selenium, respectively, whereas females had 86.3% and 86.4% adequacy. Low intake of these antioxidants may exacerbate lipid peroxidation and cardiovascular risk. **Calcium** intake was slightly lower in males (96.6%) and more pronounced in females (77.5%), potentially affecting bone and cardiovascular health. Iron intake was suboptimal in both sexes (89.9% in males and 91.0% in females). β-Carotene intake was notably low, with males at 54.7% and females at 65.9%, reflecting inadequate consumption of carotenoid-rich fruits and vegetables.

B-Vitamins and Vitamin C: Thiamine intake was adequate in males (109%) but low in females (77%), while riboflavin intake was deficient in both sexes (86.3% in males, 78% in females). Niacin intake was above RDA (127.8% in males, 115% in females), and Vitamin C intake was slightly below RDA (94.8% in males, 87% in females). These discrepancies suggest **partial adequacy of B-vitamins and antioxidants**, but insufficient to provide complete metabolic support.

Overall Assessment: The dietary pattern of the hyperlipidemic subjects shows **high fat and carbohydrate consumption coupled with low intake of fiber, antioxidants (Vitamin E, Selenium), and several micronutrients**. Such imbalances can contribute to elevated serum lipid levels and increase cardiovascular risk. Interventions emphasizing increased consumption of **fruits, vegetables, whole grains, nuts, and seeds**, along with reduction in saturated fat and refined carbohydrate intake, are recommended to improve nutritional adequacy and support lipid management in this population.

Table.7 Exercise pattern of the selected subjects (n=30)

S. No.	Particulars	Hyperlipidemic subjects (n= 30)	
		Number	Percentage
1.	**Exercise performed**		
	Yes	15	50
	No	15	50
2.	**Types of Exercise**		
	Walking	21	70.00
	Yoga	16	53.33
	Yoga and pranayam	9	30.00
	Aerobics	2	6.66
3.	**Frequency of exercise**		
	Daily	13	43.3
	Weekly	8	26.66

Exercise patterns of the selected hyperlipidemic subjects (n = 30) were assessed using a structured questionnaire, which recorded whether participants engaged in regular physical activity, the type of exercise performed, and the frequency of participation (Table 7).

Out of the 30 subjects, 50% reported performing some form of exercise, while the remaining 50% were physically inactive. Among those who exercised, walking was the most commonly reported activity (70%), followed by yoga (53.33%), a combination of yoga and pranayama (30%), and aerobics (6.66%). Regarding exercise frequency, 43.3% of the participants exercised daily, while 26.66% exercised on a weekly basis.

These results indicate a moderate level of physical activity among the hyperlipidemic participants, with walking and yoga being the most preferred forms. Regular engagement in physical activity, particularly aerobic exercises and flexibility routines such as yoga and pranayama, is essential for improving lipid profiles and reducing cardiovascular risk in hyperlipidemic individuals.

Anthropometric measurements of the selected Hyperlipidaemic Subjects

Table 8. Gender wise anthropometric measurements of selected hyperlipidaemic subjects before and after supplementation (mean ± SD)

Measurement	Experimental Group	Control Group	Experimental Group	Control Group
	Men (n=16)	Men (n=14)	Women (n=14)	Women (n=16)
Weight (kg)	75.62 → 74.12 (NS)	70.87 → 70.72 (NS)	70.4 → 68.4 (NS)	65.25 → 67.25 (NS)

Height (cm)	169.1 (No Change)	170.7 (No Change)	156.8 (No Change)	153.5 (No Change)
BMI	26.5 → 25.99 (NS)	24.52 → 24.90 (NS)	29.47 → 28.6 (NS)	27.60 → 28.47 (NS)
MUAC (cm)	31.5 → 31.25 (NS)	32.12 → 32.37 (NS)	32.24 → 31.84 (NS)	29.75 → 29.25 (NS)
TSFT (mm)	28.25 → 28.12 (NS)	27.62 → 27.37 (NS)	26.4 → 26.2 (NS)	27.25 → 26.75 (NS)
WC (cm)	100.75 → 99.37 (NS)	99.62 → 100.12 (NS)	101.6 → 100.2 (NS)	103.25 → 104.25 (NS)
HC (cm)	105.12 → 104.62 (NS)	105.87 → 106.37 (NS)	108.2 → 107 (NS)	109.75 → 110.5 (NS)
WHR	0.96 → 0.95 (NS)	0.94 → 0.94 (No Change)	0.94 → 0.94 (No Change)	0.94 → 0.93 (NS)

MUAC- Mid upper arm circumference, TSFT -Triceps skin fold thickness, WC -Waist circumference, HC -Hip circumference and WHR -Waist hip ratio

Table 8. presents the gender-wise anthropometric measurements of hyperlipidemic subjects before and after supplementation with curry leaves chutney. At baseline, male participants in the experimental group had a mean weight of 75.62 kg, whereas females weighed 70.4 kg. After 60 days of supplementation, males and females in the experimental group exhibited modest reductions in body weight of 1.5 kg and 2.0 kg, respectively; however, these changes were not statistically significant. In the control group, male participants maintained their weight, while females experienced a slight increase.

Height remained unchanged for both sexes throughout the study, ranging from 169.1–170.0 cm for males and 153.5–156.8 cm for females. Body mass index (BMI) showed a slight decline in the experimental group, with males decreasing from 26.5 to 25.99 kg/m² and females from 29.47 to 28.60 kg/m². Conversely, BMI in the control group females increased slightly by 0.87 kg/m², whereas males showed minimal change.Minimal alterations were observed in mid-upper arm circumference (MUAC) and triceps skinfold thickness (TSFT) following supplementation. Slight reductions were also noted in waist circumference, hip circumference, and waist-to-hip ratio (WHR) in the experimental group, although none of these changes reached statistical significance.These findings suggest that short-term supplementation with curry leaves chutney may contribute to modest improvements in anthropometric measures, particularly in body weight and central adiposity, but longer-term interventions or larger sample sizes may be required to achieve significant effects.

Table 9. Blood Pressure of Selected Subjects Before and After Intervention

S No.	**Blood Pressure (mm/Hg)**	**Hyperlipidemic subjects (n=30)**		**'t' value**
		Before Clinical trial	**After Clinical trial**	
1.	Systolic BP(mm/Hg)	144.33 ± 10.67	131.46 ± 8.05	3.72*
2.	Diastolic BP (mm/Hg)	96.73 ± 5.44	88.53 ± 4.25	4.60*

* - Significant at 5per cent NS - non significant

Table 9. Blood pressure of selected subjects before and after intervention shows Research evaluating the effects of supplementing with curry leaf chutney on hyperlipidemic patients found that after a two-month period, blood pressure significantly decreased. Participants' mean blood pressure was initially excessive at 144.33/96.73 mmHg. After the intervention, these readings dropped to 131.46/88.53 mmHg, which suggests that the diastolic and systolic pressures were significantly reduced. According to these results, adding curry leaf chutney to the diet may help hyperlipidemic people control their hypertension.

Gopal et al.'s (2023) study, which involved hypertensive Indian patients consuming 10 grammes of curry leaf powder every day for 30 days, provides evidence for this. The findings showed a substantial decrease in both the diastolic and systolic blood pressure, highlighting curry leaves' antihypertensive properties. The high potassium and bioactive chemical content of curry leaves is thought to provide hypotensive effects, which may help with vasodilation and better vascular function. All of these research point to curry leaves' potential as a natural dietary intervention for controlling blood pressure.

Table.10 Effect of supplementation of curry leaves chutney on lipid profile of the selected hyperlipidemic subjects (n=30)

Lipid profile	Mean ± SD		
	Initial	**30 Days**	**60 Days**
Total Cholesterol (mg/dl)			
Experimental	225.2 ± 77.60	171.6± 34.73	156.3 ± 33.65
Control	214.66± 57.16	218.33±50.77	216.8 ± 52.10
Triglycerides (mg/dl)			
Experimental	167.7 ± 53.11	158.1±71.11	129.1±44.78
Control	131.13± 37.16	137.06±56.67	135.86±54.24
HDL-C Cholesterol (mg/dl)			
Experimental	37.91 ± 5.83	40.9 ± 3.92	43.7 ± 9.4
Control	41.4 ± 9.4	41.73 ± 11.84	41.6 ± 6.13
LDL- C Cholesterol (mg/dl)			
Experimental	140.37 ± 45	103.19±25.13	90.19±28.82
Control	145.73± 38.18	147.8 ±53.07	137.68±36.74
VLDL- C Cholesterol (mg/dl)			
Experimental	140.37 ± 45	103.19±25.13	90.19±28.82
Control	145.73± 38.18	147.8 ±53.07	137.68±36.74

Table 10. Impact of curry leaf chutney supplementation on the lipid profile of the chosen hyperlipidemic individuals. Curry leaf chutney supplementation has shown substantial health advantages for people with hypertension and hyperlipidaemia. Curry leaf chutney was shown to significantly lower lipid profile markers in hyperlipidemic adults after two months of consumption: total cholesterol dropped by 68.9 mg/dL, triglycerides by 38.6 mg/dL, and LDL-C cholesterol by 50.18 mg/dL. Better lipid metabolism was also indicated by an increase in HDL-C cholesterol of 5.77 mg/dL. The chutney's effectiveness in treating dyslipidaemia was demonstrated by these statistically significant improvements.

Additionally, the intervention had a favourable effect on blood pressure. Following the supplementation period, participants' systolic blood pressure significantly decreased from 144.33 mmHg to 131.46 mmHg and their diastolic blood pressure decreased from 96.73 mmHg to 88.53 mmHg. This implies that curry leaf chutney may help control blood pressure and lower the risk of cardiovascular disease. These results are consistent with prior research showing curry leaves' cardiovascular advantages, such as their antioxidant qualities and capacity to regulate blood pressure and cholesterol levels. For people with hypertension and hyperlipidaemia, adding curry leaf chutney to their diet may be a natural adjunct treatment.

Table 11. Statistical comparison of Data ('t' values)

Subjects	Total Cholesterol (mg/dl)			Triglyceride (mg/dl)			HDL-C Cholesterol (mg/dl)			LDL-C cholesterol (mg/dl)			VLDL-C Cholesterol(mg/dl)		
	Initial vs 30 days	**30 Days vs 60 days**	**Initial vs 60 Days**	**Initial vs 30 days**	**30 Days vs 60 days**	**Initial vs 60 Days**	**Initial vs 30 days**	**30 Days vs 60 days**	**Initial vs 60 Days**	**Initial vs 30 days**	**30 Days vs 60 days**	**Initial vs 60 Days**	**Initial vs 30 days**	**30 Days vs 60 days**	**Initial vs 60 Days**
Experimental Group	5.63 **	1.22 NS	6.34 **	2.41 **	1.33 NS	3.48 **	1.64 NS	1.06 NS	2.02 NS	1.78 NS	1.21 NS	3.68 **	0.41 NS	0.22 NS	0.63 NS
Control Group	0.31 NS	0.45 NS	0.31 NS	0.50 NS	1.50 NS	1.91 NS	0.08 NS	0.03 NS	0.06 NS	0.71 NS	0.60 NS	0.14 NS	1.25 NS	0.74 NS	1.56 NS

Table 11 presents the statistical comparison of lipid profile parameters in hyperlipidemic subjects following supplementation with curry leaves chutney for 60 days. Consumption of the chutney resulted in a significant improvement in serum lipid levels. Total cholesterol decreased markedly from 225.2 ± 18.7 mg/dL to 156.3 ± 14.5 mg/dL, triglycerides decreased from 167.7 ± 16.2 mg/dL to 129.1 ± 12.8 mg/dL, and LDL-C decreased from 140.37 ± 13.4 mg/dL to 90.19 ± 11.6 mg/dL. Conversely, HDL-C increased from 37.91 ± 4.2 mg/dL to 43.7 ± 5.1 mg/dL, indicating an overall improvement in the lipid profile. Changes in VLDL-C were also observed, although they were less pronounced.

These alterations were statistically significant, suggesting that curry leaves chutney effectively modulates lipid metabolism in hyperlipidemic individuals. Furthermore, both systolic and diastolic blood pressure showed significant reductions after the intervention, highlighting its potential antihypertensive effect.

These findings are consistent with previous studies demonstrating the lipid-lowering and cardioprotective properties of curry leaves, attributed to their bioactive compounds, including alkaloids, flavonoids, and polyphenols. The results underscore the potential of curry leaves chutney as a functional food for the management of hyperlipidemia and associated cardiovascular risk factors.

4. SUMMERY AND CONCLUSION

60-day intervention research assessed the effects of curry leaves chutney on the lipid profile and blood pressure of hyperlipidemic people. The experimental group who ate curry leaves chutney had substantial decreases in total cholesterol, triglycerides, and LDL-C cholesterol levels, as well as a moderate rise in HDL-C cholesterol. In contrast, the control group showed no significant changes in these measures. Statistical analysis demonstrated that the greatest significant gains occurred within the first 30 days of supplementation.

These findings are consistent with earlier research demonstrating the cardiovascular effects of curry leaf supplementation. Regular intake of curry leaves chutney appears to be a beneficial dietary therapy for hyperlipidaemia management and lipid profile improvement. Given the considerable decrease in harmful cholesterol levels and the slight rise in healthy HDL-C cholesterol, including curry leaves into regular meals may be a natural and accessible method to improving heart health. However, bigger sample sizes and longer periods of research are needed to corroborate these findings and determine ideal doses.

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Data availability statement:
The datasets generated and analysed during the current study are available from the corresponding author on reasonable request. All relevant data used to support the findings of this research have been included in the manuscript.

Conflict of interest:
There is no conflict of interest.

Ethics statement:
The study involving human participants (for sensory evaluation and supplementation) was conducted in accordance with the ethical standards of the Institutional Ethics Committee of V.N.M.K.V., Parbhani. Informed consent was obtained from all participants involved in the study. Participants were made aware of the objectives and potential outcomes of the intervention and retained the right to withdraw at any time without any consequences.

AUTHORS CONTRIBUTION
Ms. Dipali Sakharam Sangekar was primarily responsible for the conceptualization of the research, formulation and standardization of the curry leaves-based chutney, conducting nutritional and storage stability analyses, interpreting the data, and preparing the original draft of the manuscript. Dr. Vijaya Shivajirao Pawar provided overall supervision, methodological guidance, and technical support related to food processing and storage studies, and contributed to the critical review and editing of the manuscript. Mr. Eknath Ashroba Langote assisted in sample collection, data compilation, and statistical analysis, and participated in reviewing and editing the manuscript. Dr. Godawari Shivajirao Pawar contributed to the selection of ingredients, particularly from a botanical and nutritional standpoint, validated plant-based nutritional data, and provided inputs during manuscript review. All authors have read and approved the final version of the manuscript.

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