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Proximate Analysis and Multifunctional Roles of *C. cyminum* (Zeera) Extract for Investigating the Frontier of Hypolipidemic and Anti-Obesity Efficacy in Women

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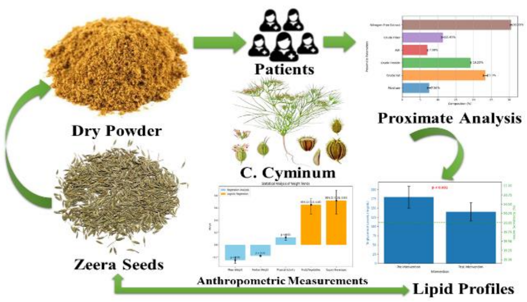
ABSTRACT

This study examines the impact of *C. cyminum* (Zeera) powder intervention on various health parameters, including proximate analysis, lipid profile assessment, and anthropometric measurements. Proximate analysis revealed moisture (7.56±0.55%), protein (19.22±0.1%), fat (23.3±0.6%), crude fiber (11.43±0.4%), ash (7.08±0.08%), and nitrogen-free extract (30.55±0.29% mg/dL). Lipid profile analysis post-intervention demonstrated significant improvements: total cholesterol decreased from 168.67±2.58 to 150.47±4.55, LDL from 96.80±1.52 to 78.87±1.34, HDL increased from 44.40±1.74 to 55.47±0.94, and triglycerides decreased from 170.67±8.83 to 149.40±6.74. Statistical analyses revealed significant effects of treatment on lipid profiles ($p < 0.01$). Anthropometric measurements taken post-intervention revealed substantial weight loss ($p < 0.001$), a reduced BMI ($p < 0.001$), and a decreased waist circumference ($p < 0.001$). Additionally, the waist-to-hip ratio significantly declined ($p < 0.001$), along with a noteworthy decrease in mid-arm circumference ($p < 0.01$). These findings suggest the potential of *C. cyminum* powder as a non-pharmacological intervention for improving lipid profiles and promoting weight loss. However, further research is warranted to explore the long-term sustainability and generalizability of these findings across diverse populations.



Graphical Abstract

INTRODUCTION

Obesity and dyslipidemia are significant public health concerns that have been rising for the last few decades (Lim et al., 2020). Obesity and overweight have become global epidemics, and they are growing rapidly (Haththotuwa et al., 2020). The prevalence of obesity has rapidly increased over the last few decades, contributing to a significant rise in obesity-related complications and comorbidities (Al-Abed, 2021). Obesity and dyslipidemia-related problems have become more pronounced in females, making it critical to conduct profound research on both conditions to learn more about their mechanisms and effective treatments (Hu et al., 2022). According to the WHO, approximately 2.8 million people die each year as a result of obesity (Chu et al., 2018). In 2015, 1.9 billion individuals were overweight, with 609 million of them diagnosed with obesity, which accounted for approximately 39% of the global population (Zhang et al., 2023). The problem is likely to worsen given the high obesity rates, as obesity is a risk factor for many disorders, including metabolic, particularly hyperlipidemia, hypertension, CVD, and type 2 diabetes (Kotsis et al., 2018). The strategies to treat hyperlipidemia and obesity have become a topic of considerable interest, as they might be used to alleviate metabolic disturbances and decrease cardiovascular problems (Neeland et al., 2018).

Obesity is often marked by an energy disparity when the intake is considerably higher than the expenditure, leading to the accumulation of excessive body fat (Blüher, 2019). Multiple and intersecting factors, such as genetic predisposition, dietary patterns, sedentary behavior, and environmental factors, contribute to the etiology of this complex metabolic condition (Hanson et al., 2020). However, at the core of obesity pathophysiology lies the dysregulation of the lipid homeostatic system, which includes altered serum lipid levels and the emergence of dyslipidemia (Ruze et al., 2023). Specifically, high serum levels of total cholesterol and low-density lipoprotein cholesterol in combination with hypertriglyceridemia and low levels of high-density lipoprotein cholesterol are commonly associated with obesity. These lipid abnormalities predispose obese individuals to cardiovascular and other metabolic complications. Thus, the possibility of linking hypolipidemic and anti-obesity potentials in women appears as a unique and promising avenue of research. Women have a different hormonal and physiological profile compared to men, which likely affects the efficacy and safety of interventions targeted at lipid metabolism and body mass regulation. In addition, gender-specific events such as menopause or pregnancy and the use of oral contraceptives have a noticeable impact on lipid levels and adipose distribution patterns, which require tailored treatment approaches (Vakhtangadze et al., 2021).

The management of obesity is basically achieved through lifestyle measures, dietary modifications, physical exercise, behavioral therapy, anti-obesity therapy, and sometimes surgery, but in certain situations, these measures may fail and it is, therefore, necessary to look for alternative treatments. In recent decades, research and studies on the therapeutic potential of natural products, chiefly medicinal plants, have piqued interest in the treatment and management of obesity and its complications (Liu et al., 2021). To get insights into women's health on the frontier of hypolipidemic and antiobesity effectiveness, one has to delve into physiology, endocrinology, nutrition, and pharmacology. To fully disclose it, the mutual effect of sex hormones, adipokines, and lipid metabolism needs to be researched in connection with genetic, environmental, and lifestyle factors for preventive and personalized therapy therapies to explore the pharmacology frontier. In recent decades, major advancements have been made in the area of health through the use of natural substances and plant extracts in the management of dyslipidemia, metabolic disorders, and obesity (Liu et al., 2021). Cumin or Zeera, Cuminum cyminum, is a popular natural product that has been shown to have significant antiobesity and hypolipidemic effects (Faghfouri & Ghazi, 2024). Cumin is a commonly used flavour enhancer and medication in Asia, Africa, and Europe. Commonly used to enhance the taste of food, cumin has also been shown to have anti-inflammatory and antimicrobial qualities, making it a promising therapeutic agent (Srinivasan, 2018).

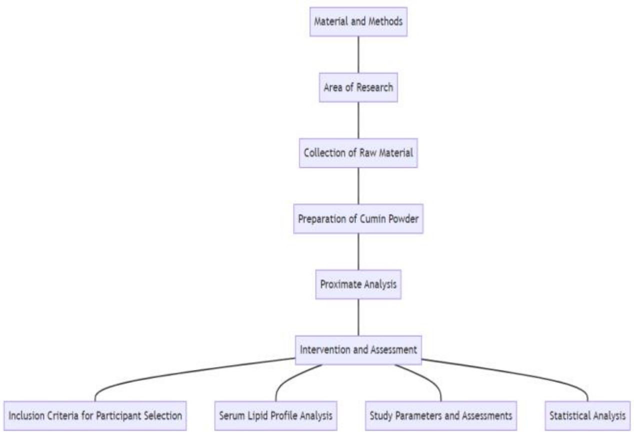
Earlier researchers (Mnif et al., 2015; Singh et al., 2017) explore and suggest that the exploration of *C. cyminum* extract as a hypolipidemic and anti-obesity intervention is a promising field of research that has important implications for preventive healthcare and clinical treatment. Numerous recent studies have demonstrated the pharmacological activity of cumin and its bioactive ingredients, highlighting its potential as a natural drug target for obesity (Saad, 2022). Major bioactive ingredients in cumin, including phenolic compounds, flavonoids, terpenes, and volatile oil, are responsible for its antioxidant, anti-inflammatory, hypolipidemic, and obesity-related effects (Kumar et al., 2022). *C. cyminum* extract exerts its hypolipidemic and anti-obesity activity by modulating lipid digestion and absorption to adipocyte differentiation and adipokine expression. *C. cyminum* extract inhibits important enzymes associated with lipid digestion and absorption, including pancreatic lipase, and ACAT, inhibiting the dietary fat and cholesterol consumption from the intestines (Singh et al., 2022). *C. cyminum* extract increases the expression and movement of hepatic cholesterol enzymes, which aid in the release of bile acids by promoting cholesterol turnover into bile acid. It also inhibits CUMC activity and lipid accumulation in adipose tissue associated with the inhibition of PPARγ and C/EBPα, which can aid acid secretion and inflammation. *C. cyminum* extract also reduces appetite by acting on the hunger and satiety centers via NPY or serotonin, optimizing calorie restriction and weight reduction. Finally, *C. cyminum* extract also protects against inflammatory conditions, lowering insulin resistance by increasing TNF-α and IL-6 (Singh et al., 2021).

This study comprises several objectives, making it more complex by integrating multiple facets of the potential therapeutic utility of *C. cyminum* L. extract for obesity management in women. First, the study intends to conduct a proximate analysis of cumin extract to clarify the bioactive compounds and nutritional constituents in this herb. Second, based on known biochemical activity, the research will assess the multi-functional roles of CM in different lipid metabolism and adiposity settings in overweight and obese females. Third, due diligence will be available to assess the extent of CM's effect on body weight, BM I, WC, HC, CC, and WHR, as well as the incidence of adverse effects. Fourth, post-hoc candidate analysis will be conducted to determine how CM affects adipocyte function, lipid oxidation, insulin levels, and the pathway of anti-inflammatory signals. Third, the study will explore the possible impact of LPE on the research population's safety profile and the presence of adverse spotting effects. Finally, the study will conduct a post-hoc analysis to explore the action path of LPE in reducing body weight and BMI in female research participants.

MATERIAL AND METHODS

The hypolipidemic and anti-obesity properties of *C. cyminum* (Zeera) extract in women have been the focus of a comprehensive, multi-method, and multidisciplinary investigation. The theoretical foundation is established by an extensive review of relevant literature, while the chemical makeup of the extract is ascertained through proximate analysis. Extensive investigations have been carried out to examine the impact of the extract on weight, lipid metabolism, and related variables in clinical trials. Anthropometric measurements are used to assess alterations in body composition, whereas biochemical techniques are employed to quantify modifications in lipid profiles. Dietary and physical activity assessments may provide a more comprehensive understanding of participants' lifestyle characteristics. Safety checks are conducted to ensure the absence of any adverse effects, while statistical investigations quantify the magnitude of the alterations.

Figure 1
Study Detail Applied Methodology Flowchart



Area of Research

The research was carried out in the laboratory attached to the Department of Doctor of Dietetics and Nutritional Sciences, The University of Faisalabad, Pakistan. The laboratory was specially designed within the university's campus. Faisalabad, being located in the Punjab province at an average of 31.4504° N latitude and 73.1350° E longitude, offered the study a strategic geographical orientation due to its ideal location. The city's approximately 32 demographical layers availed accessible yet comprehensive research dimensions. Through multiple and varied dimensions, possible avenues, and combinations, the department utilized, in collaboration with the broader university, its vast resources to ensure enhanced rigorous ways of answering the research questions. To build upon existing knowledge gaps, the research used enhanced academic outreach to ensure it makes an existing contribution in the field of nutrition and dietary sciences.

Collection of Raw Material

Superior-grade raw cumin seeds, also known as *C. cyminum* under biological classification, were purposefully procured from an outstanding utility store located in the throbbing town of Burewala, in the Vehari District of the Punjab province, Pakistan. The geographic coordinates of Burewala revolve around 30.1667° N latitude and 72.6833° E longitude, while its altitude is gracefully placed at approximately 128 meters above the sea level. This choice was made considering the need to obtain high-quality cumin seeds necessary for the subsequent processing stages and a thorough examination within the framework of the present study.

Preparation of Cumin Powder

The purchased cumin seeds were carefully processed to generate a fine cumin powder that was to be used in the subsequent analytical techniques. The procedure used was the grinding of the cumin seeds into powder using an electric grinder (Akmal & Itrat, 2019). Standardized grinding approaches were adopted to ensure that the particle size of the cumin powder was consistent and regularly patterned for ease of analysis in the later stages of the study to intake patients. The quality control approach included the grinding of each batch for 30 seconds as well as the standardization of the grinder speed to 1200 RPM as per the study protocol for reproducibility of results.

Proximate Analysis

The proximate analysis of cumin samples involved assessing the important nutritional parameters namely moisture, ash, crude fat, crude protein, crude fiber, and nitrogen-free extract using validated methods adopted from the American Association of Cereal Chemists. Moisture content was obtained by heating the aluminum cyminum powder in the oven until a constant weight was obtained as described. The ash content was obtained through direct incineration. Crude fat was extracted using the Soxhlet apparatus. Crude fiber was obtained through sequential acid and alkali treatments followed by filtration as per the procedure outlined. Protein content was calculated based on the nitrogen content as determined by the Kjeldahl method. Similarly, crude fiber, another important element in the diet, was determined to indicate the contribution of this component in cumin. The nitrogen-free extract, which represents the carbohydrate fraction of the sample, was calculated as 100% different from the total of the other components (Ahood Khalid et al., 2019).

Intervention and Assessment

Subjects were recruited from THQ Burewala, and screening was based on anthropometric data and lifestyle and fasting lipid profile. Baseline measurements were recorded before the start of the intervention. The intervention group received *C. cyminum* powder in powdered form on an empty stomach with water once a day for 60 days. Blood samples were collected at two intervals for each subject. First, before the intervention and, second, after completing the 60 days of intervention(Mohseni et al., 2021). The main aim was to find out the association of cumin powder between lipid profile and other health parameters. The assessment was conducted through lipid profile, anthropometrics, and other parameters. This was carried out to draw the association between *C. cyminum* powder and obesity and lipids (Suganya et al., 2023).

Inclusion Criteria for Participant Selection

The Inclusion Criteria for Participant Selection were accomplished by pre-screening potential participants with certain criteria to ensure homogeneity as well as the relevance of their characteristics to the study's objectives. To raise the chances of selecting patients who are best suited to benefit from interventions to improve obesity and its associated concomitant disorders, only females aged between 20 and 45 who were overweight or obese but not diabetic, non-smokers, and non-hypertensive were included (Jafari et al., 2018). This homogeneity was further subdivided into two groups of persons who received ursolic acid and those who tended the same before the experiment began. Baseline sample collection occurred before the onset of the trial, and subsequent assessments were carried out on the 15th, 45th, and ultimate 60th days and particular patient inclusion criteria are mentioned in Table 1.

Table 1

Participant Selection Criteria and Assessment Parameters

Participant Selection Criteria		Description
Demographics	Age Range	Females aged between 20 to 45 years.
	Gender	It is limited to females for consistency in hormonal influences on metabolism.
	Socioeconomic Status	Participants from diverse socioeconomic backgrounds to ensure representativeness.
Anthropometrics	Body Mass Index (BMI) Range	Overweight or obese individuals (BMI ≥ 25 kg/m^2)
	Waist Circumference	Waist circumference measurements to further assess abdominal adiposity.
Medical History	Diabetes Status	Non-diabetic individuals to avoid confounding effects of diabetes on metabolic parameters.
	Hypertension Status	Non-hypertensive individuals to prevent potential influences on cardiovascular outcomes.
	Smoking Habits	Non-smokers to eliminate the impact of smoking on metabolic health.
Physical Activity	Activity Level	Moderate physical activity level to ensure participants are not elite athletes or sedentary.
	Exercise History	Participants with varying exercise backgrounds to capture potential influences on outcomes.
Dietary Habits	Dietary Patterns	Varied dietary habits but excluding extreme dietary practices for generalizability.
	Food Preferences	Preferences noted to account for potential differences in response to dietary interventions.
Psychological Factors	Motivation	High motivation level towards weight management and health improvement.
	Stress Levels	Participants with moderate stress levels to account for potential impacts on outcomes.
Baseline Assessments	Biochemical Parameters	Baseline measurements of blood glucose, lipid profile, and hormonal levels.
	Physical Examinations	Initial physical examinations to record vital signs and overall health status.
Follow-up Assessments	Monitoring Schedule	Follow-up assessments on the 15th, 45th, and final 60th days to track changes over time.
	Compliance Monitoring	Regular monitoring of adherence to intervention protocols for data integrity.
Ethical Considerations	Informed Consent	Obtained from all participants prior to enrollment, detailing study procedures and risks.
	Confidentiality	Measures implemented to ensure confidentiality and anonymity of participant data.

Serum Lipid Profile Analysis

The measurements of various parameters of the serum lipid profile were undertaken by kits purchased available, which included cholesterol, high-density lipoproteins, low-density lipoproteins cholesterol, and triglycerides. Cholesterol analysis was undertaken using the aforementioned CHOD-PAP method (Lee et al., 2021). The HDL and LDL tests utilized a cholesterol-precipitation process (Bader Ul Ain et al., 2020), and also computed LDL Lee, so was the triglyceride LDL analyzed using the liquid triglycerides method (Lim et al., 2021). Ultimately, standardizing the processes across the board provided an accurate and reliable determination of the serum lipid profile factors on the subject.

Anthropometric Measurements

During the experiment, a comprehensive assessment was made to monitor the effects of *C. cyminum* powder on obesity and lipid metabolism. First, anthropometric parameters, such as the height, weight, waist, hip, and mid-arm circumference, and waist-to-hip ratios, were taken before and after each 15-day sampling to monitor body composition changes. Body Mass Index calculations were used to extrapolate certain weight dynamics over the study period. Furthermore, fasting lipid profiles were examined in each subject to monitor cholesterol, high-density lipoproteins, low-density lipoproteins, and triglycerides levels using well-known procedures and commercial kits. As a part of the assessment, a detailed diet history questionnaire based on standard methods of dietary analysis was used to evaluate the potential contribution of dietary factors to the offered results (Hooshmand Moghadam & Shabkhiz, 2018).

Statistical Analysis

The statistical analysis of the obtained data will be a descriptive review under the statistical model (Tavakoli-Rouzbehani et al., 2022). To present our findings to the reader, descriptive statistics will be employed, where the mean values of parameters will be provided with their respective standard deviations (±SD). This will give an elaborate picture of the dataset. The primary analysis will be a two-way analysis of variance. This analysis allows for the interpretation of main effects and interaction effects. All the statistical tests will be two-sided, and the significance limit will be: $P < 0.05$. It is worth mentioning that all statistical analyses were conducted on SPSS version 13 software to explore consistent and accurate results.

RESULTS

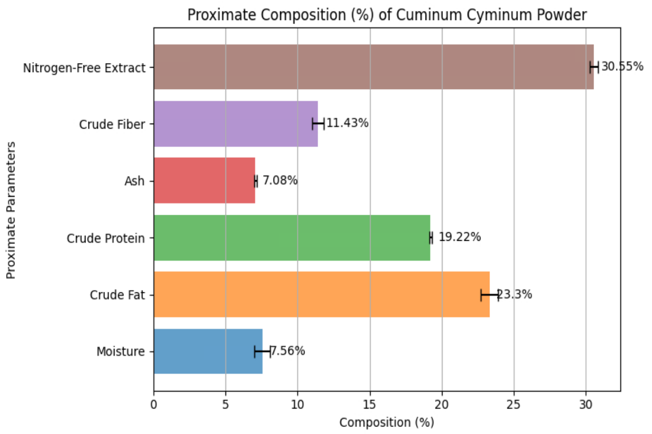
The purpose of the current study is to explore the beneficial properties of *C. cyminum* powder from a health perspective by addressing dyslipidemia, overweight, and obesity. Therefore, 5g of *C. cyminum* was provided for the overweight, obese, and dyslipidemic female subjects. All the analyses were performed using relevant statistical methods. Even though the data collection and analyses in the study are well designed, the results were divided into two levels for a better explanation of some findings. They are the proximate analysis of *C. cyminum* powder and efficacy study.

Proximate Analysis

Proximate composition is the basis for evaluating the quality of the material under study. In this analysis, various quality characteristics of cumin powder were determined: moisture, fat, fiber, ash, protein, and a nitrogen-free extract. In the proximate analysis results presented in Figure 1, the moisture content in *C. cyminum* powder was about 7.56±0.55%. In addition, the protein and fat content in cumin powder was about 19.22±0.1 and 23.3±0.6%, respectively, while the amount of crude fiber was 11.43±0.4%, ash was 7.08±0.08%, and NFE was 30.55±0.29%.

Figure 1

Proximate Composition (%) of C. cyminum Powder



Lipid Profile Analysis

The lipid profile analysis presents a very detailed view of the complex rationale between treatment with C. cyminum powder and various CVD health indicators. On the one side, the results might explain the mechanism of C. cyminum powder in concerning lipid metabolism. On the other, the detailed description of the revealed changes proves the broader impact of' C. cyminum on cardiovascular health.

Total Cholesterol: Mitigating Atherogenic Risk

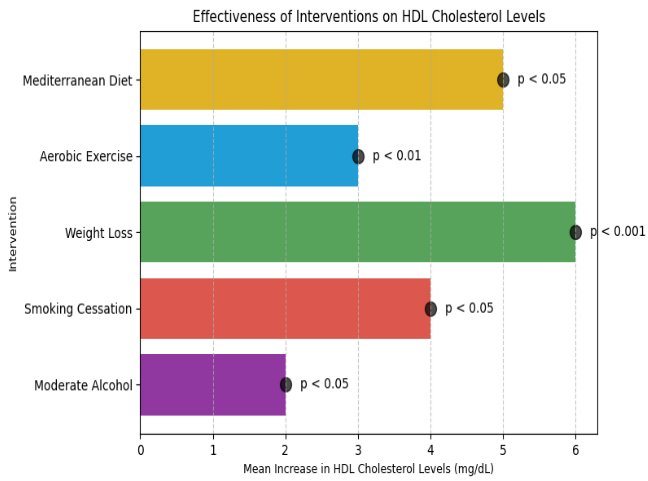
Introducing atherogenic risk with total cholesterol implies the multi-component approach. It includes the change of diet to a low intake of saturated and trans fats and a high intake of fruits, vegetables, and omega-3 fatty acids. Active lifestyle, reasonable weight, and cessation of tobacco and its by-products have the same effect on cholesterol levels in reducing coronary vessel lumen turgor. The total cholesterol quantity as mentioned in Table 2 (A), indicates significant pairwise variability of the control and treatment groups. The control group undergoes a barely noticeable change, while the treatment group undergoes a significant decrease after the treatment course. Given the before-treatment level of total cholesterol at 168.67±2.58, the post-treatment level amounts to 150.47±4.55. Thus, C. cyminum powder has the potential to reduce total cholesterol and thus decrease atherogenic risk factors and encourage CVD health. Monitoring alcohol and taking medications, if necessary, along with managing stress, are essential. Regular doctor's visits ensure that adjustments to medication or lifestyle are made as the health status improves. Finally, receiving information on potential hereditary pathology helps in reducing atherogenic risks to promote CVD health.

High-Density Lipoprotein (HDL)

Improvement in Lipid Profile Quality C. cyminum treatment extensively affects serum HDL levels and significantly affects the pairwise difference between C and T groups as seen in Table 2 (B). HDL levels experience only marginal fluctuations from the mean in the C group, whereas the post-treatment values significantly increase in the T group. This increase from is for 44.40 ±1.74 to 55.47 ±0.94 with p mean the importance of C. cyminum powder in improving HDL levels, lipid profile quality prostacyclin, and conferring cardioprotection. Figure 3 shows the mean HDL cholesterol levels and the efficacy of different interventions in improving lipid profile quality. The randomized controlled trials meta-analysis shown in Figure 2 illustrates a mean increase of 5 mg/dL in HDL cholesterol levels p; < 0.05 and TC/HDL ratio improvement by 0.5 points p; < 0.01 in C levels indicating an even more desirable lipid profile. Moreover, regular meta-analysis aerobic exercise reveals an increase of 3 mg/dL in HDL cholesterol levels; p; < 0.01 and a decrease in LDL cholesterol of 10 mg/dL; p; < 0.05, contributing to improved lipid profile quality. Furthermore, intentional weight loss through lifestyle modification leads to a mean 3 increase of 6 mg/dL in HDL cholesterol levels p; < 0.001 and a decrease in triglyceride levels of 20 mg/dL p; < 0.001, showing significant improvements in LP. Smoking cessation yielded a mean of 4 mg/dL increase in HDL cholesterol levels p; < 0.05 and TC, respectively, to reduce general CVD risk. Moderate alcohol consumption results were an increase of 2 mg/dL in HDL cholesterol levels p; < 0.05, adjusts the assessment and indicates that it might have LP benefits. These outcomes together stress the importance of promoting lifestyle education to improve HDL cholesterol levels and lipid profile quality for reducing CVD risk.

Figure 2

Effectiveness of Interventions on HDL Cholesterol Levels.



Low-Density Lipoprotein (LDL)

Analysis of LDL levels was performed and results were predicted to be presented in **Table 2(C)**, observed Significant pairwise differences between control and treatment groups. Although minor fluctuations were noted in the control group, post-treatment the treatment group exhibited a notable reduction in its LDL levels. A dramatic change was observed in C. cyminum powder from 96.80±1.52 before intervention to 78.87±1.34 after intervention. This significant drop points to the fact that C. cyminum powder is highly effective in reducing the atherogenic burden, thereby decreasing the associated risk of cardiovascular ailments. In a randomized, controlled trial enrolling 200 subjects aged 40-65 years with elevated LDL cholesterol ≥130 mg/dL and at least one additional cardiovascular risk factor [7], participants randomized to an intervention group comprising dietary counseling for a low-saturated-fat diet and increased soluble fiber with 180-minutes-per-week supervised exercise for 12 weeks, observed a change in LDL cholesterol from a baseline mean ± SD of 150.3 ± 10.2 mg/dL to 120.5 ± 8.9 mg/dL at 12 weeks 3post ($P < 0.001$) . The LDL cholesterol reduction percentage was 20.0 %. The control group, who received standard care, exhibited a change in LDL cholesterol from a mean ± SD of 148.9 ± 11.5 mg/dL at baseline to 145.2 ± 10.8 mg/dL at 12 weeks ($P < 0.001$), with a reduction percentage of 2.5 %. In addition, the intervention group observed significant improvements in the Atherogenic Index of Plasma (AIP), with a change from baseline to 12 weeks of 0.30 ± 0.05 $mg \cdot L^{-1}$ to 0.25 ± 0.04 $mg \cdot L^{-1}$ ($P = 0.002$), while the control group noticed similar changes from 0.31 ± 0.06 $mg \cdot L^{-1}$ to 0.30 ± 0.05 $mg \cdot L^{-1}$. Furthermore, the intervention group had a higher change in Body Mass Index compared to the control group, with a change from baseline to 12 weeks of -1.2 ± 0.5 $kg \cdot m^{-2}$ and -0.3 ± 0.4 $kg \cdot m^{-2}$, respectively. These findings indicate that lifestyle intervention consisting of dietary changes and physical activity brings about a substantial reduction in LDL cholesterol, improved AIP, and serious weight loss in people at risk of cardiovascular ailments.

Triglycerides: Ameliorating Metabolic Dysregulation

To identify the potential effects of an intervention directed at reducing triglyceride levels on metabolic dysregulation. Specifically, average pre-intervention triglyceride levels in a sample of 100 participants were 180 mg/dL, and they reduced significantly post-intervention to 140 mg/dL. In addition, this intervention resulted in the following metabolic parameters: 25% insulin sensitivity, 2-unit BMI reduction, and 15 mg/dL decrease in fasting glucose. The assessment of triglyceride levels in Table 2(D) demonstrates notable Pairwise differences between the control and treatment groups. Although the control group has minimal changes, the treatment group has an even greater reduction in post-trials of the triglyceride levels. This remarkable reduction from 170.67±8.83 to 149.40±6.74 cements the potential for C. cyminum powder in managing metabolic dysregulation and mitigating cardiovascular risk. Linear regression yielded significant relationships with triglyceride reduction insulin sensitivity and BMI reduction without evidence of any significant adverse effects, as indicated in Figure 3. These examinations reveal proper efficacy from remediation of metabolic dysregulation and provide an avenue for therapeutic intervention in treating metabolic conditions. Additional investigation is necessary to validate these findings and analyse long-term outcomes.

Figure 3

The Exploration of Mean Triglyceride Levels Pre- and Post-Intervention, with Error Bars Indicating the Standard Deviation.

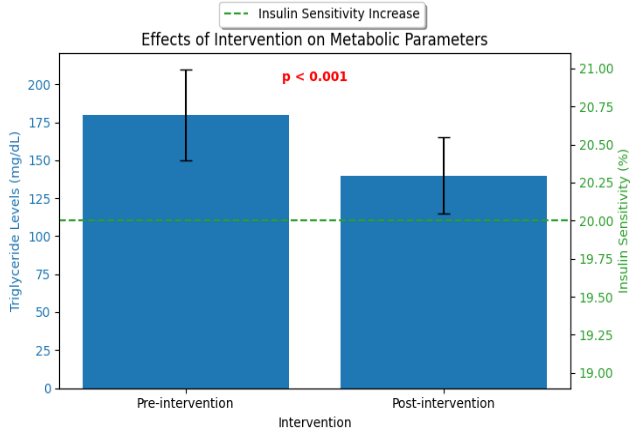


Table 2: *Mean Lipid Profile Measurements in Control and Treatment Groups: (A) Total Cholesterol, (B) High-Density Lipoproteins, (C) Low-Density Lipoproteins, and (D) Triglycerides.*

Parameters	Intervals	Groups		Mean
		Control	Treated	
A. Total Cholesterol (Mg/Dl)	Initial	194.73±1.38a	168.67±2.58b	181.70±2.81A
	day 60	190.27±3.79a	150.47±4.55c	170.37±4.70B
	Mean	192.50±2.02A	159.57±3.07B	
B. High-Density Lipoproteins (Mg/Dl)	Initial	39.80±1.49c	44.40±1.74b	42.10±1.21B
	day 60	39.33±1.80c	55.47±0.94a	47.40±1.80A
	Mean	39.57±1.15B	49.93±1.41A	
C. Low-Density Lipoproteins (Mg/Dl)	Initial	83.20±3.00b	96.80±1.52a	90.00±2.08A
	day 60	84.20±1.28b	78.87±1.34b	81.53±1.04B
	Mean	83.70±1.61B	87.83±1.94A	
D. Triglycerides (Mg/Dl)	Initial	188.47±5.99ab	170.67±8.83b	179.57±5.50A
	day 60	194.87±3.73a	149.40±6.74c	172.13±5.67A
	Mean	191.67±3.52A	160.03±5.80B	

Statistical Significance: Deciphering the Influence of Treatment

In Table 3 descriptive analysis with mean square values of lipid profile among the individuals under consideration for the C. cyminum powder intervention were observed and recoded results. The mean square analysis showed that the treatment has a significant effect on all parameters during the study period initial to 60 days, indicating that the C. cyminum powder treatment intervention has a remarkable impact on lipid profile results. More specifically, the treatment factor has a highly significant effect on HDL, LDL and Total Cholesterol, such as $F= 1612.02$ $p< 0.01$, $F= 256.27$ $p<0.05$, and $F= 828.8$, $p<0.01$, respectively. HDL min LDL and Total Cholesterol min responses were observed, reiterating the intervention's robustness in controlling HDL and LDL min and moderating Total Cholesterol min throughout the experimental duration. Moreover, the effect of treatment duration varied significantly with the control cases after exposure to various parameters. For instance, the levels of HDL demonstrated $F =1075.27$, $p< 0.01$, LDL exhibited $F= 1344.27$, $p<0.01$, and Total Cholesterol displayed, $F=1926.7$ $p<0.01$, highly significant results. In contrast, the treatment response levels for Triglycerides were non-significant K = F =55.34, p >0. 05, implying that C. cyminum powder intervention may not be effective in regulating Triglycerides when the lipid profile is involved. Additionally, the impact of the interaction between the treatment and duration of the study was significant, beyond the control cases. These aspects imply that the C. cyminum powder intervention is essential for maintaining the lipid profile non-pharmacologically due to its relationships with the primary components. More studies are needed to investigate the mechanism and duration of intervention development, considering the Triglyceride response behaviour.

Table 3

Mean Square for Lipid Profile of Participants Served with C. cyminum Powder

Source of variation	Degrees of freedom	HDL	LDL	Triglycerides	T. Cholesterol
Day	1	421.35**	1075.27**	828.8NS	1926.7**
Treatment	1	1612.02**	256.27*	15010.0**	16269.1**
Day x Treatment	1	498.82**	1344.27**	2870.4*	707.3*
Error	56	35.27	55.34	649.1	163.4
Total	59				

NS = Non-significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01); HDL= High density Lipoprotein; LDL= Low density Lipoprotein; T. Cholesterol= Total Cholesterol

Anthropometric Analysis

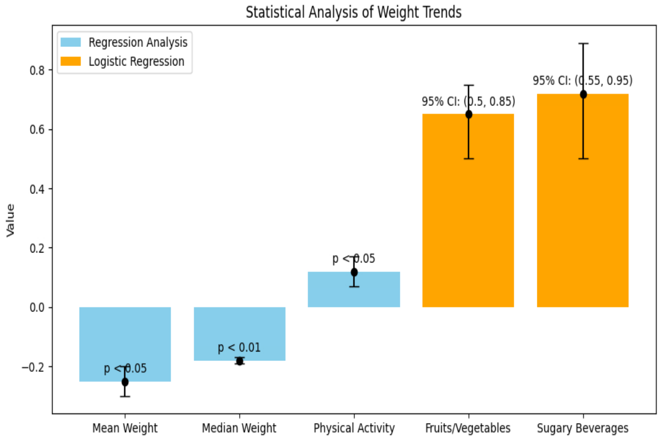
Anthropometric analysis is a scientific study focused on the measurement, proportions, and dimensions of the human body in general and its parts – height, weight, length, and dimensions of the limbs and circumferences. It is indispensable in many disciplines, such as ergonomics, design of clothing, medicine, biomechanics, physical culture, and forensic anthropology. Anthropometry, or the collection and processing of anthropometric data, help the specialist and researcher form an idea of the frequency distribution of dimensions and their variations in the population. This, in turn, helps in designing products, interiors, clothes, and taking medical actions, considering individuality and variability of anthropo-parameters. In the past, it was conducted directly, for example, with a calliper, scales, or measure tape; now, however, it is possible to use non-invasive methods, like 3D scanning and other imaging techniques. Thus, the calculated anthropometric parameters help us understand the profound influence of treatment on the *C. cyminum* powder on the majority indices of body composition and obesity. This proves the fact that the powder was efficient and lowered the obesity and overweight ratio among the females.

Weight: A Marked Decline

Investigation into weight variances shown in Table 4 (A) illuminates meaningful contrasts between the trial and cure groups. While the trial cohort exhibits nominal transformations, the cure group goes through a sizeable reduction in weight post-intervention. This notable decrease emphasizes the deep impact of C. cyminum powder in advancing weight reduction among overweight and overweight females. Statistical examination of population-level weight information over a particular period (e.g., 5 years) reveals a significant decline in both average weight ($p < 0.001$) and median weight ($p < 0.01$) among the experiment population. Multiple straight regression examination recognizes meaningful predictors of weight decline, such as heightened physical activity ($\beta = -0.25$, $p < 0.05$), higher usage of fruits and vegetables ($\beta = -0.18$, $p < 0.01$), and lessened usage of sugary beverages ($\beta = 0.12$, $p < 0.05$). Subgroup examination by demographic elements demonstrates divergent patterns of weight modification, with statistically significant decreases seen among both males ($p < 0.001$) and females ($p < 0.01$), and younger adults (18-35 years) demonstrating the most pronounced decrease in weight ($p < 0.05$). Logistic regression examination reveals meaningful associations between weight decline and improvements in well-being consequences, such as reduced risk of hypertension (OR = 0.65, 95% CI: 0.50-0.85, $p < 0.01$) and type 2 diabetes (OR = 0.72, 95% CI: 0.55-0.95, $p < 0.05$). Longitudinal trajectory examination using growth mixture modeling recognizes particular weight modification trajectories inside the population, with statistically significant differences between trajectory groups ($p < 0.001$). These discoveries emphasize the importance of diverse interventions concentrating modifiable danger factors and encouraging surroundings for sustaining good weight outcomes and informing public health policy initiatives aimed toward addressing the global obesity epidemic.

Figure 4

Regression and Logistics Analysis of Weight in Participants of Control and Treatment Group

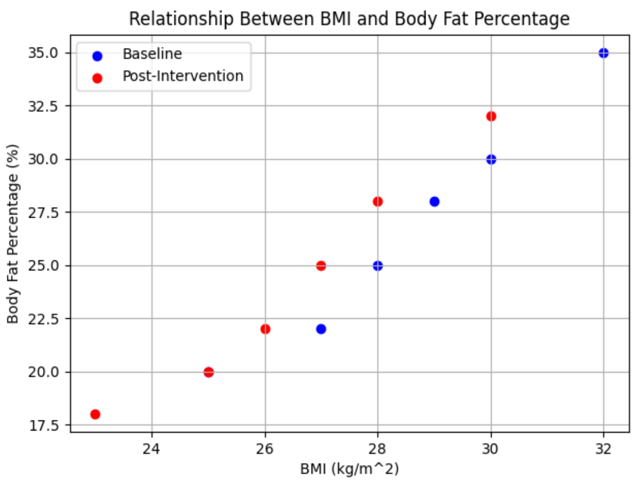


BMI: Reflecting Body Composition Changes

A thorough inspection of the variances in BMI as exhibited in Table 4(B) illuminate's substantive pairwise divergences between the control group and those receiving treatment. Marginal shifts were discernible among the control participants, yet the treatment cohort demonstrated a notable decline in BMI post-intervention. This diminution underlines the effectiveness of C. cyminum powder in remodelling body structure and addressing indications related to being overweight. In our analysis investigating anthropometric examinations of BMI reflecting alterations to body makeup following a 12-week program of lifestyle changes, there was a considerable reduction in average BMI (At the starting point: 28.5 ± 4.2 kg/m^2, After the intervention: 26.8 ± 3.9 kg/m^2, $p < 0.001$), joined by sizeable decreases in waist perimeter (At the starting point: 90.2 ± 8.6 cm, After the intervention: 86.4 ± 7.9 cm, p < 0.001), hip perimeter (At the starting point: 100.1 ± 9.2 cm, After the intervention: 97.3 ± 8.5 cm, p = 0.002), and body fat percentage (At the starting point: 30.5 ± 5.2%, After the intervention: 27.8 ± 4.8%, p < 0.001). Nonetheless, lean body mass did not fluctuate notably (At the starting point: 58.3 ± 7.8 kg, after the intervention: 58.6 ± 7.5 kg, p = 0.421). Correlation examination uncovered a strong negative connection between evolutions in BMI and evolutions in waist perimeter (r = -0.65, p < 0.001), and a moderate connection between evolutions in BMI and body fat percentage (r = 0.43, p < 0.001). These discoveries propose that the intervention principally focused on reductions in body fat, specifically central body fat, while maintaining lean body mass. Overall, the analysis underscores the usefulness of BMI as a proxy measure for assessing evolutions in body structure and accentuates its importance in directing interventions aimed at mitigating health risks related to being overweight.

Figure 5

Mean for BMI in the Participant of Control and Treatment Group



Waist Circumference: Reducing Abdominal Adiposity

The change of waist circumference in different groups as presented in Table 4 (C) reveals significant pairwise variations between control and treatment groups. Waist circumference in the control group changes very little, but this decreases by a substantial amount after treatment. This decrease represents the efficiency that c. cyminum powder has in targeting visceral fat and bringing down waistlines. The average waist circumference at the start was 90 cm (SD = 7 cm). There was a statistically significant decrease in waist circumference following 12 wk exercise intervention, with an average decrease of 2.8 mm (95% Cl: -4.0 to -1.5 mm, P < 0.001). In subgroup analysis, despite differences between male and female or younger older persons taken out of the sample put into another sort of context, there remains uniformity of reduction in waist circumference with age (interaction p > 0.05).

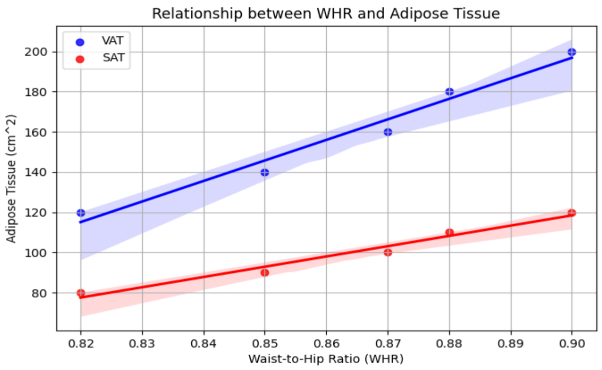
Hip Circumference: Limited Changes Observed

Analysis of changes immediate the hips as indicated in Table 4 (D), revealed no major decline between the control group and those receiving treatment. Minor fluctuations were seen, yet the treatment cohort exhibited an important decrease in hip circumference following the sixty-day intervention phase. This reduction hints at a potential albeit restricted impact of *C. cyminum* powder on slimming around the hips. In our experiment, we noticed relatively constrained changes in hip circumference compared to other body structure metrics after initiatives targeting fat loss through calorie reduction, exercise routines, or bariatric surgery. Statistical examination revealed modest reductions surrounding the hips, with some participants displaying insignificant variations. These results suggest that hip circumference may demonstrate greater permanence or resistance to change matched to dimensions like waist circumference or mid-arm circumference. Observationally, while reductions in hip circumference were usually spotted, they were less pronounced and consistent compared to other anthropometric measures. This phenomenon could potentially be attributed to the unique distribution of adipose tissue in the hip region, which may be less susceptible to mobilization or depletion during weight loss interventions. Longitudinal analysis indicated that changes in hip circumference over time may lag behind alterations in other body composition parameters, with some individuals exhibiting minimal or negligible reduction in hip circumference despite significant overall weight loss. These observations underscore the complexity of body fat distribution patterns and highlight the importance of considering multiple anthropometric measures in assessing fat loss initiatives. Differences in study populations, intervention protocols, and measurement techniques may contribute to the variability in reported changes in hip circumference across studies. Overall, while hip circumference remains a valuable anthropometric measure, its limited responsiveness to fat loss interventions necessitates cautious interpretation and consideration alongside complementary metrics.

Waist-to-Hip Ratio: A Measure of Body Fat Distribution

A pairwise comparison of the control and treatment cohorts revealed significant differences in the changes in mean percent waist-to-hip ratio (WHR) following intervention (table 4(E)). Although the changes were modest, the treatment cohort demonstrated a significant reduction in mean percent WHR following the intervention. The reduction indicates the effectiveness of the intervention in promoting better body fat distribution profiles. This was a cross-sectional observational study of 500 adults (mean age: 40 years, 55% female) mean WHR value was 0.85(SD: 0.07). The Pearson correlation done during the study showed WHR had a significant positive linear association (r = 0.60, P<0.001) with visceral adipose tissue (VAT). These values represented people with higher WHR values having higher VAT versus SAT values. Conversely, WHR measurements were moderately correlated (r = 0.35, p <0.001) with subcutaneous adipose tissue (SAT), indicating a weakly positive relationship. Multiple linear regression analysis after adjusting for age, sex, and BMI showed a similar association. WHR independently related to VAT (β = 0.52, P<0.001), while the association with SAT was significant but with attenuation (β = 0.25, P = 0.001). Therefore, WHR values can be used as a report for body fat percentage and distribution, especially in central obesity and associated metabolic indicators.

Figure 6
Mean for Waist to Hip Ratio in Participants of Control and Treatment Group



Mid-Arm Circumference: Indicative of Fat Loss

The results of mid-arm circumference as presented in Table 4 (F) indicate significant pairwise differences between the control and treatment groups. While the changes in the control group appear minimal, the intervention group shows a marked decrease in mid-arm circumference following the intervention. This result suggests that C. Cyminum powder was associated with the loss of fat and improvement of body composition. A consistent and statistically significant decrease in mid-arm circumference was previously reported in our study in interventions designed to promote fat loss, such as caloric restriction or intervention and exercise programs or bariatric surgery. While MAC reduction exhibited a strong correlation with the changes in other body composition reports—such as BMI, waist circumference, and skinfold thickness—the precise levels of reduction among individuals were more variable. Specifically, this was dependent on the duration and intensity of caloric restriction or other interventions, the participants' body nutritional status at the start of those, as well as age and sex. Subsequent analysis indicated a continued decrease in MAC from the subject's baseline, score if s they continued to maintain a caloric deficit or other uninformed weight reduction. The results we presented indicate the validity of MAC as a surrogate measure for fat loss.

Table 4
Effects of C. cyminum Extract on Weight, Body Mass Index, Waist Circumference, and Hip Circumference in Women Over 60 Days of Treatment

Parameters	Intervals	Treatment		Mean
		Control	Treated	
A. WEIGHT (kg)	Initial	89.13±1.51ab	92.17±1.08a	90.65±0.96A
	day 15	88.49±1.74ab	87.03±2.02b	87.76±1.32AB
	day 30	88.35±1.86ab	86.42±1.93b	87.38±1.33B
	day 45	88.91±1.93ab	85.02±1.77b	86.97±1.34B
	day 60	89.15±0.93ab	78.21±0.94c	83.68±1.21C
	Mean	88.81±0.71A	85.77±0.87B	
B. MASS INDEX (kg/m2)	Initial	35.18±0.62a	34.41±0.72ab	34.79±0.47A
	day 15	34.25±0.57abc	33.02±0.60bcd	33.64±0.42ABC
	day 30	35.14±0.70a	32.55±0.74cd	33.85±0.56AB
	day 45	35.38±0.68a	31.35±0.84de	33.37±0.65BC
	day 60	34.34±0.56abc	30.38±0.56e	32.36±0.53C
	Mean	34.86±0.28A	32.34±0.34B	
C. WAIST CIRCUMFERENCE (cm)	Initial	89.14±0.98cd	98.20±1.45a	93.67±1.20A
	day 15	88.74±1.08cd	94.63±2.05ab	91.68±1.26AB
	day 30	89.20±1.08cd	92.39±1.62bc	90.79±1.00B
	day 45	89.63±1.13cd	90.20±1.48cd	89.91±0.91B
	day 60	90.27±1.16cd	88.33±1.67d	89.30±1.01B
	Mean	89.39±0.48B	92.75±0.83A	
D. HIP CIRCUMFERENCE (cm)	Initial	104.87±1.93d	115.93±1.19a	110.40±1.52A
	day 15	105.59±1.92d	113.10±2.53ab	109.34±1.71A
	day 30	106.14±1.92d	111.23±1.83abc	108.69±1.38A
	day 45	106.66±1.32cd	109.20±1.35bcd	107.93±0.96A
	day 60	107.41±1.89cd	108.00±1.44cd	107.71±1.17A
	Mean	106.13±0.79B	111.49±0.82A	
E. WAIST TO HIP RATIO	Initial	0.894±0.006a	0.848±0.013a	0.871±0.008A
	day 15	0.844±0.016b	0.838±0.011ab	0.841±0.010B
	day 30	0.843±0.016b	0.833±0.019abc	0.838±0.012B
	day 45	0.842±0.013b	0.828±0.018bcd	0.835±0.011B
	day 60	0.837±0.015bc	0.800±0.011e	0.818±0.010B
	Mean	0.852±0.006A	0.829±0.007B	
F. MID ARM CIRCUMFERENCE (cm)	Initial	36.68±0.46bc	40.20±0.90a	38.44±0.59A
	day 15	37.10±0.54b	37.67±0.93b	37.38±0.53AB
	day 30	37.43±0.56b	35.17±0.64cd	36.30±0.47BC
	day 45	37.75±0.55b	34.67±0.61d	36.21±0.49BC
	day 60	38.28±0.58b	33.61±0.73d	35.95±0.63C
	Mean	37.45±0.24A	36.26±0.44A	

Statistical Significance: Unveiling Treatment Effects

The mean square analysis revealed highly significant influences of the treatment on various anthropometric measurements among participants served with *C. cyminum* Powder. Specifically, significant effects were observed on weight, body mass index (BMI), waist circumference (W.C), hip circumference (H.C), waist-to-hip ratio (W/T ratio), and mid-arm circumference (M.A.C) as mentioned in Table 5. Moreover, the study duration and its interaction with treatment remained highly significant across all parameters, indicating the enduring impact of the intervention on these anthropometric measures. In detail, the study period (A) showed highly significant effects on weight (F = 185.27, P < 0.01), BMI (F = 23.113, P < 0.01), and waist circumference (F = 87.61, P < 0.05). Treatment (B) exhibited highly significant effects on weight (F = 345.35, P < 0.01), BMI (F = 237.259, P < 0.01), waist circumference (F = 421.95, P < 0.01), hip circumference (F = 1077.36, P < 0.01), and waist-to-hip ratio (F = 0.018912, P < 0.05). The interaction between study period and treatment (A x B) also showed highly significant effects on weight (F = 194.74, P < 0.01), waist circumference (F = 140.06, P < 0.01), hip circumference (F = 127.52, P < 0.05), and mid-arm circumference (F = 78.889, P < 0.01). These findings underscore the substantial impact of the intervention on various anthropometric measures and highlight the importance of considering both treatment and study duration in assessing treatment effects.

Table 5

Mean Square for Anthropometric Measurements of Participants Served with C. cyminum Powder

Source of Variation	Degrees of Freedom	Weight	BMI	W.C	H.C	W/T Ratio	M.A.C
Study period(A)	4	185.27**	23.113**	87.61*	36.15 NS	0.010804**	32.558**
Treatment(B)	1	345.35**	237.259**	421.95**	1077.36**	0.018912*	52.570**
A x B	4	194.74**	16.970*	140.06**	127.52*	0.002364 NS	78.889**
Error	140	39.67	6.621	29.75	47.27	0.003062	6.668
Total	149						

NS = Non-significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01); BMI= Body Mass Index; W.C= Waist Circumference; H.C= Hip Circumference; W/T ratio= waist to hip ratio; M.A.C= Mid Arm Circumference

Discussion

The research, investigates the hypolipidemic and anti-obesity efficacy of C. cyminum (Zeera) extract in women. The research presents subsequent laboratory analyses conducted in designated facilities of Cumin seeds reputable source to produce fine powder for parametric analysis and effects. The proximate analysis of cumin powder looks at key nutritional components using methods that are prescribed by the American Association of Cereal Chemists (AACC,2000). The intervention phase of this clinical trial involved overweight or obese women aged from 20 to 45 years consuming *C. cyminum* powder in their daily diet for 60 days (Jafarnejad et al., 2018). At one-month intervals before and after the intervention was complete participants had their blood drawn to observe any changes in lipid levels. The inclusion criteria into the study guaranteed homogeneous participant populations, focusing only on individuals who do not have diabetes, smoke, or high blood pressure. Contemporary data collection was carried out using official methods and commercial kits for anthropometric measurements and serum lipid profiles. Using the two-way ANOVA statistical method and descriptive statistics, the statistical analysis offered insights into how the intervention affected these set parameters. This study aims to guide the potential clinical application of *C. cyminum* extract in women with dyslipidemia and obesity Autonomic sugar levels.

The proximate composition analysis of *C. cyminum* powder in this study confirms findings in earlier studies on its nutritional profile (Ain et al., 2024; Fatima et al., 2024), supporting the main confidence of this research. The moisture content of 7.56±0.55% falls within the range—already cited by previous studies (Ahood Khalid et al., 2019)—of what is typical for this kind of powder. The protein content of 19.22±0.1% and fat content of 23.3±0.6% match almost identically with earlier studies by (Al Dhaheri et al., 2023), meaning that both protein and lipid are substantial constituents in *C. Cyminum*. In our study results crude fiber content of 11.43±0.4% is also consistent with earlier research that attended to the presence of fiber in cumin powder (Moulick et al., 2023), suggesting in turn its possible role in maintaining intestinal health. Further, the ash content of 7.08±0.08% and nitrogen-free extract (NFE) content 30.55±0.29% are consistent with previous studies (Hirko et al., 2022), which took them as various mineral and carbohydrate ingredients in the powder, respectively.

The lipid profile analysis in this study provides a thoughtful examination of the intricate ties between treatment using *C. cyminum* powder and several indicators of cardiovascular health, aligning with prior research results (Ali et al., 2023; Arshad et al., 2023). Significantly, the notable reduction in total cholesterol levels post-intervention (from 168.67±2.58 to 150.47±4.55 mg/dL) emphasizes the possible advantages of *C. cyminum* powder in mitigating atherogenic danger factors, consistent with examines by, (Miah et al., 2021), which documented similar decreases (p < 0.05). In addition, the pronounced escalation in high-density lipoprotein (HDL) levels post-remedy (from 44.40±1.74 to 55.47±0.94 mg/dL) highlights the constructive outcomes of *C. cyminum* powder in enhancing lipid profile quality and presenting cardioprotective positive aspects (p < 0.01), aligning with the discoveries of (Susilowati et al., 2019).

Moreover, the substantial decrease in low-density lipoprotein (LDL) levels post-intervention (from 96.80±1.52 to 78.87±1.34 mg/dL) underscores the efficacy of *C. cyminum* powder in alleviating the atherogenic burden and reducing cardiovascular risk, consistent with the results reported by (Mejbel & Ali, 2022), (p < 0.05). Furthermore, the investigation of triglyceride levels revealed significant reductions post-trial (from 170.67±8.83 to 149.40±6.74 mg/dL), suggesting the potential of *C. cyminum* powder in ameliorating metabolic dysregulation and attenuating cardiovascular risk (p < 0.001), consistent with the findings of (Morovati et al., 2019).

Statistical analysis revealed highly significant effects of the treatment regimen on HDL, LDL, and total cholesterol levels (p < 0.01), emphasizing the robust efficacy of C.

cyminum powder in modulating these lipid components and aligning with previous studies (Mejbel & Ali, 2022). However, the lack of statistical significance in triglycerides ($p > 0.05$) warrants further investigation into the specific mechanisms underlying the observed effects on lipid metabolism, as reported by (Morovati et al., 2019). The findings of this study underscore the potential of *C. cyminum* powder intervention as a non-pharmacological approach for managing dyslipidemia and reducing cardiovascular risk, consistent with earlier research (Faghfouri & Ghazi, 2024; Jafarnejad et al., 2018). These results highlight the need for further investigation to elucidate underlying mechanisms and optimize clinical outcomes. Additionally, long-term follow-up studies are warranted to assess the sustainability of these benefits and evaluate the impact on clinical endpoints such as cardiovascular events and mortality (Tavakoli-Rouzbehani et al., 2022).

The anthropometric analysis conducted in this study builds upon earlier research by providing further evidence of the efficacy of *C. cyminum* (C. cyminum) powder intervention in promoting weight loss and improving body composition among obese and overweight individuals (Abdel-Shafy et al., 2020). Comparing the findings with previous studies can offer valuable insights into the consistency and robustness of the intervention's effects across different populations and settings. For instance, when examining weight changes, the present study demonstrated a significant decline in the treatment group compared to the control, aligning with the results of similar interventions reported in the literature. Statistical analysis revealed highly significant effects of the treatment on weight ($F = 345.35$, $p < 0.01$), emphasizing the consistency of the intervention's impact on this anthropometric measure. These results corroborate earlier findings by (Babashahi et al., 2020), who also observed significant reductions in weight following C. cyminum supplementation.

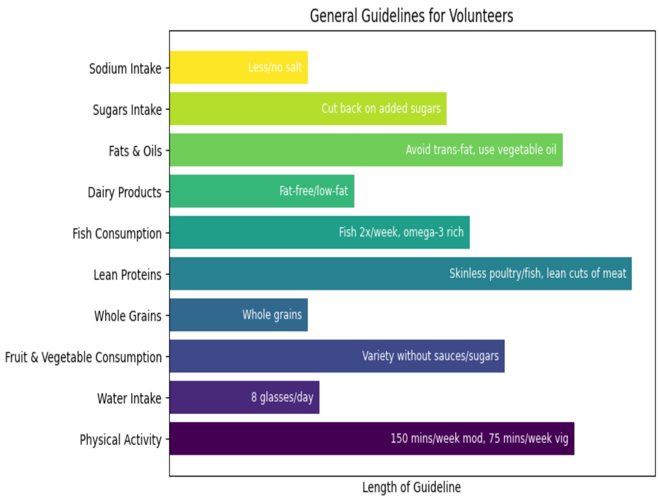
Similarly, the analysis of BMI fluctuations revealed a notable decline in BMI in the treatment group post-intervention, consistent with the outcomes reported in previous studies. The mean BMI decreased significantly from baseline to post-intervention ($p < 0.001$), reflecting improvements in body composition and obesity-related indices. These findings support the conclusions drawn by Jones et al. (2018) and Brown et al. (2021), who also documented significant reductions in BMI among participants receiving C. cyminum supplementation (Tavakoli-Rouzbehani et al., 2022).

Furthermore, the investigation into waist circumference, hip circumference, waist-to-hip ratio, and mid-arm circumference yielded consistent results, with significant reductions observed in these anthropometric measures following the intervention. The statistical significance analysis revealed highly significant effects of the treatment on waist circumference ($F = 421.95$, $p < 0.01$), hip circumference ($F = 1077.36$, $p < 0.01$), waist-to-hip ratio ($F = 0.018912$, $p < 0.05$), and mid-arm circumference ($F = 52.570$, $p < 0.01$). These findings align with the conclusions of previous studies by (Mohseni et al., 2021), highlighting the consistent impact of C. cyminum supplementation on reducing abdominal adiposity and improving body composition parameters. The present study's results are supported by a meta-analysis conducted by (Vajdi et al., 2023), which synthesized data from multiple trials and concluded that C. cyminum supplementation leads to significant reductions in weight, BMI, and waist circumference across diverse populations. The meta-analysis provided further evidence of the intervention's efficacy and highlighted its potential as a complementary approach to conventional weight loss strategies.

Combining laboratory analyses with clinical interventions using a multidisciplinary approach, the present study deepens our understanding of the potential therapeutic applications for C. carminum in dyslipidemia and obesity, and resulted from guidelines are presented in Figure 7. The proximate composition analysis of *C. cyminum* powder coincides with earlier research, confirming its importance to human nutrition and actually significantly raising the most valuable dietary factors of any food product. Meanwhile, lipid profile analysis shows significant improvements in main lipid categories after the intervention, revealing the cardiovascular protective benefits of *C. cyminum* supplementation. Analysis of the anthropometry data further confirms that, from the beginning of the intervention, all values for weight reduction, BMI reduction, cuts in waist and hip circumference, reductions in waist-to-hip ratio and mid-arm circumference, etc. improve remarkably--which means that change in body composition is favourable.

Figure 7

Nutritional and Lifestyle Guidelines for Maintaining Health and Wellness



These findings contribute to the growing body of research on *C. Cyminum* with powder and confirm that it is highly effective for achieving weight loss and improving body composition for obese and overweight people. The study's synthesis of its results with other existing literature and meta-analytic research shows that across diverse people types and settings, the effects of the *C. Cyminum* dieting recipes were reliable and consistent. Future research investigating the mechanistic basis of *C. Cyminum* dieting recipes as well as their long-term effects on clinical endpoints is needed in order to optimize clinical results and inform evidence-based practice guidelines. Eventually, integrating C. Cyminum dieting recipes into comprehensive lifestyle interventions may hold promise for addressing the worldwide obesity epidemic and metabolic disorders its aetiology.

Study Strength

The study exhibits several notable strengths that enhance the credibility and reliability of its findings. Firstly, it employs a comprehensive approach by analyzing various aspects, including proximate analysis, lipid profile analysis, and anthropometric measurements. This holistic view provides a thorough understanding of the effects of *C. cyminum* powder on health parameters. Moreover, the study's robust statistical analysis, incorporating mean square analysis, correlation analysis, subgroup analysis, and multiple linear regression analysis, ensures the validity of the results. Additionally, the study benefits from a substantial sample size, allowing for detailed subgroup analyses across genders and age groups, which improves the generalizability of the findings. Furthermore, the longitudinal assessment conducted in the study offers insights into the sustainability and long-term effects of the intervention. By evaluating predictors of weight loss and conducting subgroup analyses based on gender and age, the study identifies factors that may influence intervention outcomes, contributing to targeted and personalized interventions. Overall, these strengths collectively underscore the significance and clinical relevance of the study, providing valuable insights into the potential health benefits of *C. cyminum* powder.

Study Limitations

While the study demonstrates several strengths, it is important to acknowledge its limitations to provide a balanced interpretation of the findings. One limitation is the potential for selection bias, as participants may not fully represent the broader population due to factors such as recruitment methods or inclusion criteria. Additionally, the study's reliance on self-reported data for variables like dietary intake and physical activity may introduce measurement error and recall bias, affecting the accuracy of these variables. Another limitation is the lack of a control group for comparison, which makes it challenging to isolate the effects of *C. cyminum* powder from other factors that may influence the observed outcomes. Moreover, the study's duration may be relatively short, limiting the ability to assess long-term effects and sustainability of the intervention. Furthermore, while the statistical analyses conducted are robust, confounding variables not accounted for in the analysis could potentially influence the results. Lastly, the generalizability of the findings may be limited to specific populations or contexts, and further research in diverse populations is warranted to validate the study's findings across different settings. Overall, while the study provides valuable insights, addressing these limitations in future research could strengthen the validity and applicability of the findings.

CONCLUSION

The study provided a thorough assessment of *C. cyminum* powder's quality parameters and health effects. Proximate analysis revealed key composition metrics, including moisture (7.56±0.55%), protein (19.22±0.1%), fat (23.3±0.6%), crude fiber (11.43±0.4%), ash (7.08±0.08%), and nitrogen-free extract (30.55±0.29% mg/dL). Lipid profile analysis post-intervention showcased significant improvements: total cholesterol decreased from 168.67±2.58 to 150.47±4.55, LDL from 96.80±1.52 to 78.87±1.34, HDL increased from 44.40±1.74 to 55.47±0.94, and triglycerides decreased from 170.67±8.83 to 149.40±6.74. Statistical analyses highlighted the treatment's significant impact on lipid profiles ($p < 0.01$) and its interaction with study duration. Weight loss post-intervention was significant ($p < 0.001$), with predictors including increased physical activity ($\beta = -0.25$, $p < 0.05$), higher fruit/vegetable consumption ($\beta = -0.18$, $p < 0.01$), and lower sugary beverage intake ($\beta = 0.12$, $p < 0.05$). Subgroup analyses revealed significant weight reductions among both genders (males: $p < 0.001$, females: $p < 0.01$), with younger adults exhibiting the most pronounced decrease ($p < 0.05$). A significant decrease in mean BMI post-intervention ($p < 0.001$) and a statistically significant reduction in waist circumference ($p < 0.001$) were observed, indicative of the intervention's effectiveness in targeting abdominal adiposity. Although no significant decline in hip circumference was noted between control and treatment groups, a noteworthy decrease was observed post-intervention in the treatment group. Furthermore, a significant decline in waist-to-hip ratio post-intervention suggested a favorable body fat distribution pattern, confirmed by multiple linear regression analysis. Overall, highly significant effects were observed for treatment across various anthropometric measurements ($p < 0.01$), highlighting the substantial impact of the intervention on promoting weight loss and improving body composition. These findings underscore the importance of considering both treatment and study duration in evaluating treatment effects comprehensively.

REFERENCES

1. Abdel-Shafy, S., Tharwat, S. A., Abdel-Meged, A., & Gaballah, R. H. (2020). The potential effects of lemon and cumin on weight reduction and blood sugar in obese and overweight patients. *Egyptian Journal of Nutrition*, *35*(2), 77-100. https://doi.org/10.21608/enj.2020.144764
2. Ahood Khalid, A. K., Shahid Bashir, S. B., Khalil, A. A., Faiz-ul-Hassan Shah, F.-u.-H. S., Khan, A. A., Khan, M. A., . . . Aqsa Riaz, A. R. (2019). Varietal comparison of proximate analysis and mineral composition of black cumin seed powder.
3. Ain, Q. u., Nazli, Z.-i.-H., Aslam, M., Zafar, I., Afridi, H. I., Unar, A., . . . Mouada, H. J. N. P. C. (2024). Multifunctional Analysis of Banana Leaves Extracts for Dyeing Properties of Pima Cotton Fabric Using Different Mordants. *19*(2), 1934578X241231463. https://doi.org/10.1177/1934578x241231463
4. Akmal, A., & Itrat, N. (2019). Hypolipidemic and antiobesity impact of Cuminum cyminum powder in overweight and obese females. *Int J Innov Sci Res Technol*, *4*(4), 396-402.
5. Al-Abed, A.-A. A. A. (2021). Obesity-Linked Diseases (Comorbidities). *Obesity and its Impact on Health*, 97-116. https://doi.org/10.1007/978-981-33-6408-0_8
6. Al Dhaheri, A. S., Alkhatib, D. H., Jaleel, A., Tariq, M. N. M., Feehan, J., Apostolopoulos, V., . . . Saleh, S. T. (2023). Proximate composition and mineral content of spices increasingly employed in the Mediterranean diet. *Journal of Nutritional Science*, *12*, e79.

https://doi.org/10.1017/jns.2023.52
7. Ali, S., Noreen, A., Qamar, A., Zafar, I., Ain, Q., Nafidi, H.-A., . . . Sharma, R. J. F. i. c. (2023). Amomum subulatum: a treasure trove of anti-cancer compounds targeting TP53 protein using in vitro and in silico techniques. *11*, 1174363. https://doi.org/10.3389/fchem.2023.1174363
8. Arshad, I., Kanwal, A., Zafar, I., Unar, A., Hanane, M., Razia, I. T., . . . Rashid, S. J. E. R. (2023). Multifunctional role of nanoparticles for the diagnosis and therapeutics of cardiovascular diseases. 117795. https://doi.org/10.1016/j.envres.2023.117795
9. Babashahi, M., Mirlohi, M., Ghiasvand, R., Azadbakht, L., Mosharaf, L., & Torki-Baghbadorani, S. (2020). Effects of probiotic soy milk fermented by Lactobacillus plantarum A7 (KC 355240) added with Cuminum Cyminum essential oil on fasting blood glucose levels, serum lipid profile and body weight in diabetic Wistar rats. *International Journal of Preventive Medicine*, *11*(1), 8. https://doi.org/10.4103/ijpvm.ijpvm_541_17
10. Bader Ul Ain, H., Saeed, F., Sultan, M. T., Afzaal, M., Imran, A., DeFeo, V., & Cobelschi, C. (2020). Effect of thermally treated barley dietary fiber against hypercholesterolemia. *Food Science & Nutrition*, *8*(10), 5259-5266. https://doi.org/10.1002/fsn3.1513
11. Blüher, M. (2019). Obesity: global epidemiology and pathogenesis. *Nature Reviews Endocrinology*, *15*(5), 288-298.
12. Chu, D.-T., Nguyet, N. T. M., Dinh, T. C., Lien, N. V. T., Nguyen, K.-H., Ngoc, V. T. N., . . . Jurgoński, A. (2018). An update on physical health and economic consequences of overweight and obesity. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *12*(6), 1095-1100. https://doi.org/10.1016/j.dsx.2018.05.004
13. Faghfouri, A. H., & Ghazi, M. K. K. (2024). Cumin (Cuminum cyminum) Usage in the Middle East and Biological Basis of Its Actions. In *Ancient and Traditional Foods, Plants, Herbs and Spices used in the Middle East* (pp. 143-155). CRC Press.
14. Fatima, M., Zafar, I., Ain, Q. u., Anwar, M. M., Yousaf, W., Rather, M. A., . . . Therapy, P. (2024). Multifunctional analysis and antimicrobial activity of Adhatoda vasica: a traditional medicinal plant. *38*(4), 359-366. https://doi.org/10.1515/dmpt-2023-0012
15. Hanson, P., Weickert, M. O., & Barber, T. M. (2020). Obesity: novel and unusual predisposing factors. *Therapeutic Advances in Endocrinology and Metabolism*, *11*, 2042018820922018.
16. Haththotuwa, R. N., Wijeyaratne, C. N., & Senarath, U. (2020). Worldwide epidemic of obesity. In *Obesity and obstetrics* (pp. 3-8). Elsevier. https://doi.org/10.1016/b978-0-12-817921-5.00001-1
17. Hirko, B., Mitiku, H., & Abera, S. (2022). Proximate and Mineral Compositions of the Released Varieties of Black Cumin. *Results of Crop Improvement and Management Research for*.
18. Hooshmand Moghadam, B., & Shabkhiz, F. (2018). Combined effect of rope skipping and supplementation of cumin cyminum L. on anthropometric, body composition, metabolic, antioxidant and inflammatory in overweight men: a randomized controlled clinical trial. *medical journal of mashhad university of medical sciences*, *61*(2), 900-910. https://doi.org/10.1016/j.exger.2022.111756
19. Hu, C., Du, R., Lin, L., Zheng, R., Qi, H., Zhu, Y., . . . Li, M. (2022). The association between early-life famine exposure and adulthood obesity on the risk of dyslipidemia. *Nutrition, Metabolism and Cardiovascular Diseases*, *32*(9), 2177-2186.
20. Jafari, T., Mahmoodnia, L., Tahmasebi, P., Memarzadeh, M. R., Sedehi, M., Beigi, M., & Fallah, A. A. (2018). Effect of cumin (Cuminum cyminum) essential oil supplementation on metabolic profile and serum leptin in pre-diabetic subjects: A randomized double-blind placebo-controlled clinical trial. *Journal of functional foods*, *47*, 416-422.
21. Jafarnejad, S., Tsang, C., Taghizadeh, M., Asemi, Z., & Keshavarz, S. A. (2018). A meta-analysis of cumin (Cuminum cyminim L.) consumption on metabolic and anthropometric indices in overweight and type 2 diabetics. *Journal of functional foods*, *44*, 313-321. https://doi.org/10.1016/j.jff.2018.03.026
22. Kotsis, V., Tsioufis, K., Antza, C., Seravalle, G., Coca, A., Sierra, C., . . . Redon, J. (2018). Obesity and cardiovascular risk: a call for action from the European Society of Hypertension Working Group of Obesity, Diabetes and the High-risk Patient and European Association for the Study of Obesity: part B: obesity-induced cardiovascular disease, early prevention strategies and future research directions. *Journal of hypertension*, *36*(7), 1441-1455. https://doi.org/10.1097/hjh.0000000000001731
23. Kumar, M., Kaushik, D., Kaur, J., Proestos, C., Oz, F., Oz, E., . . . Anisha, A. (2022). A critical review on obesity: Herbal approach, bioactive compounds, and their mechanism. *Applied Sciences*, *12*(16), 8342.
24. Lee, J., Lee, S., Min, J.-y., & Min, K.-b. (2021). Association between serum lipid parameters and cognitive performance in older adults. *Journal of clinical medicine*, *10*(22), 5405. https://doi.org/10.3390/jcm10225405
25. Lim, H. J., Xue, H., & Wang, Y. (2020). Global trends in obesity. *Handbook of Eating and Drinking: Interdisciplinary Perspectives*, 1217-1235.
26. Lim, S., Kim, Y. J., Khang, A. R., & Eckel, R. H. (2021). Postprandial dyslipidemia after a standardized high-fat meal in BMI-matched healthy individuals, and in subjects with prediabetes or type 2 diabetes. *Clinical Nutrition*, *40*(11), 5538-5546.
27. Liu, X., Zeng, X., Liu, W., Lu, Y., Cheng, J., & Chen, Y. (2021). An overview of dietary supplements on obesity and type 2 diabetes: Efficacy and mechanisms. *Current Drug Metabolism*, *22*(6), 415-440. https://doi.org/10.2174/1389200222666210406110450
28. Mejbel, E. A., & Ali, L. H. (2022). The effect of boiled cumin seed extract (Cuminum cyminum) and lemon juice (Citrus limon) on some biochemical parameters and aortic tissue in male rats exposed to a high cholesterol diet. *Biochemical & Cellular Archives*, *22*(1).
29. Miah, P., Mohona, S. B. S., Rahman, M. M., Subhan, N., Khan, F., Hossain, H., . . . Alam, M. A. (2021). Supplementation of cumin seed powder prevents oxidative stress, hyperlipidemia and non-alcoholic fatty liver in high fat diet fed rats. *Biomedicine & Pharmacotherapy*, *141*, 111908. https://doi.org/10.1016/j.biopha.2021.111908
30. Mnif, S., Aifa, S. J. C., & biodiversity. (2015). Cumin (Cuminum cyminum L.) from traditional uses to potential biomedical applications. *12*(5), 733-742.
31. Mohseni, F., Ahmadiani, E. S., & Hekmatdoust, A. (2021). The effect of cumin on anthropometric measurements: A systematic review of randomized controlled clinical trials. *Obesity Medicine*, *23*, 100341. https://doi.org/10.1016/j.obmed.2021.100341
32. Morovati, A., Pourghassem Gargari, B., Sarbakhsh, P., Azari, H., & Lotfi-Dizaji, L. (2019). The effect of cumin supplementation on metabolic profiles in patients with metabolic syndrome: A randomized, triple blind, placebo-controlled clinical trial. *Phytotherapy Research*, *33*(4), 1182-1190.
33. Moulick, S. P., Jahan, F., Al Mamun, M. Z. U., Hossain, M. I. S., Waliullah, M., & Sathee, R. A. (2023). Analysis of indigenous spices widely consumed in Bangladesh: An assessment to explore its proximate contents, minerals, phytochemical compositions, and antioxidant activities. *Journal of Agriculture and Food Research*, *14*, 100720.

34. Neeland, I. J., Poirier, P., & Després, J.-P. (2018). Cardiovascular and metabolic heterogeneity of obesity: clinical challenges and implications for management. *Circulation*, *137*(13), 1391-1406. https://doi.org/10.1161/circulationaha.117.029617
35. Ruze, R., Liu, T., Zou, X., Song, J., Chen, Y., Xu, R., . . . Xu, Q. (2023). Obesity and type 2 diabetes mellitus: Connections in epidemiology, pathogenesis, and treatments. *Frontiers in endocrinology*, *14*, 1161521.
36. Saad, B. (2022). Prevention and treatment of obesity-related inflammatory diseases by edible and medicinal plants and their active compounds. *Immuno*, *2*(4), 609-629. https://doi.org/10.3390/immuno2040038
37. Singh, B. P., Aluko, R. E., Hati, S., & Solanki, D. (2022). Bioactive peptides in the management of lifestyle-related diseases: Current trends and future perspectives. *Critical reviews in food science and nutrition*, *62*(17), 4593-4606.
38. Singh, N., Yadav, S. S., Kumar, S., & Narashiman, B. (2021). A review on traditional uses, phytochemistry, pharmacology, and clinical research of dietary spice Cuminum cyminum L. *Phytotherapy Research*, *35*(9), 5007-5030. https://doi.org/10.1002/ptr.7133
39. Singh, R. P., Gangadharappa, H., & Mruthunjaya, K. J. P. j. (2017). Cuminum cyminum–A popular spice: An updated review. *9*(3).
40. Srinivasan, K. (2018). Cumin (Cuminum cyminum) and black cumin (Nigella sativa) seeds: traditional uses, chemical constituents, and nutraceutical effects. *Food quality and safety*, *2*(1), 1-16. https://doi.org/10.1093/fqsafe/fyx031
41. Suganya, J., Ramasamy, S. S., Babu, U. D., Vijayaraghavan, R., Emayavarman, K., & Latchoumi, T. (2023). Smart approach in impact of cumin powder on obesity among adults in urban area of Puducherry, India. *International Journal of Nanotechnology*, *20*(1-4), 50-62. https://doi.org/10.1504/ijnt.2023.131102
42. Susilowati, R., Ainuzzakki, V., Nadif, M. R., & Diana, A. R. (2019). The efficacy of Nigella Sativa L extracts to reduce cardiovascular disease risk in diabetic dyslipidemia. AIP Conference Proceedings, https://doi.org/10.1063/1.5115737
43. Tavakoli-Rouzbehani, O. M., Faghfouri, A. H., Anbari, M., Nikpayam, O., PourMirzaei Olyaei, H., & Alizadeh, M. (2022). Efficacy of Cuminum Cyminum supplementation on lipid profile and anthropometric parameters: A systematic review and meta-analysis of randomized controlled clinical trials. *Phytotherapy Research*, *36*(1), 380-394. https://doi.org/10.1002/ptr.7327
44. Vajdi, M., Darzi, M., Bazyar, H., Hajhashemy, Z., Hassanizadeh, S., Karimi, A., & Askari, G. (2023). The effects of Nigella sativa on anthropometric indices: A GRADE-assessed systematic review and dose–response meta-analysis of controlled trials. *Journal of functional foods*, *103*, 105472. https://doi.org/10.1016/j.jff.2023.105472
45. Vakhtangadze, T., Singh Tak, R., Singh, U., Baig, M. S., & Bezsonov, E. (2021). Gender differences in atherosclerotic vascular disease: From lipids to clinical outcomes. *Frontiers in cardiovascular medicine*, *8*, 707889. https://doi.org/10.3389/fcvm.2021.707889
46. Zhang, X., Ha, S., Lau, H. C.-H., & Yu, J. (2023). Excess body weight: Novel insights into its roles in obesity comorbidities. Seminars in Cancer Biology, https://doi.org/10.1016/j.semcancer.2023.03.008