

EVALUATING THE EFFECT OF BASIL SEEDS (*OCIMUM BASILICUM*) ON HYPERLIPIDEMIA

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ABSTRACT

Hyperlipidemia has been becoming the major cause of coronary heart diseases (CHD) owing to the sedentary diet habits. Management of hyperlipidemia through diet therapy along with medications is currently the need of the hour. In the light of medical nutritional therapy, basil seeds (*Ocimum basilicum*) were evaluated in the present study to determine their effect on hyperlipidemia. The study was conducted at the University Institute of Diet & Nutrition Sciences, Faculty of Allied Health Sciences, University of Lahore and Major Aziz Bhatti Teaching Hospital (DHQ) Gujrat, Punjab, Pakistan for the period of one year (2021-22). For the purpose, sixty (60) cardiovascular patients from both genders were selected and bifurcated into three groups, having cholesterol levels ≥ 200 mg/dL. The first group of twenty (20) patients (G_0) was given no treatment, G_1 ; (the second group of twenty (20) patients) was treated with 5.0 g basil seeds per patient per day and the third group of twenty (20) patients (G_2) was set on giving 10.0 g basil seeds per patient per day. The whole set of treatment was prolonged up to ninety days. The observations were noted in terms of biomass index (BMI), blood pressure, high-density lipoproteins (HDL), low-density lipoproteins (LDL), total cholesterol (TC), and triglycerides (TG) at 0, 45, and 90 days of the study period. Results exhibited that both doses of basil seeds significantly decreased ($p < 0.001$) biomass index (BMI) from 40.59 to 31.16 (23.22 %), total cholesterol (TC) from 267.77 to 223.64 mg/dl (16.48 %), and triglycerides level (TG) from 250.15 to 207.77 mg/dl (16.94 %) of cardiovascular patients during the whole span of study. The basil seeds (@ 5.0 and 10.0 g per patient per day significantly reduced biomass index (BMI), total cholesterol (TC), and triglycerides (TG) of cardiovascular patients during 45 and 90 days. However, significant effect of basil seeds was observed in 2nd dose i.e. 10.0 g of basil seeds per patient per day. It was concluded that basil seeds have a positive effect on dropping down the total cholesterol, triglyceride and BP levels of cardiovascular patients, thus can be recommended as a good source of dietary management of hyperlipidemia.

KEY WORDS: *Ocimum basilicum*, CHD, basil seeds, hyperlipidemia.

INTRODUCTION

The term "hyperlipidemia" refer to unnaturally high levels of lipids (fats) in the blood. Triglycerides and cholesterol are the two predominant types of fats, found in the

bloodstream (Clebak and Dambro, 2020). When a human body accumulates additional calories that may not be consumed for energy and hence, it reserves in the human body as a fat known as triglycerides. Whole-fat dairy

products and red meat are the major sources of these triglycerides. In addition, triglycerides also rise when a person consumes high volumes of alcohol, fructose, and refined sugar (Sarfraz *et al.*, 2016). On the other hand, cholesterol is naturally produced in the liver and every cell in the body needs it for standby energy. Like triglycerides, cholesterol can be found in fatty meals like cheese, eggs, and red meat. High cholesterol level is also an extensively used term to define hyperlipidemia. Although high cholesterol can be inherited, an unhealthy lifestyle should be frequently blamed (Arshad *et al.*). The most common existing treatments for lowering cholesterol include statins, fibrates, niacin, bile-acid binders, and PCSK9 inhibitors (Agrawal *et al.*, 2018). Migration studies conclusively prove that those people who originated from South Asian countries (Bangladesh, India, and Pakistan), when moved in developed countries are more likely prone to hyperlipidemia (Burkhardt, 2019). Owing to socioeconomic changes and a rise in life expectancy, hyperlipidemia is becoming an epidemic which is spreading in middle and low-income countries from economically better societies Burkhardt (2019); (Bachheti *et al.*, 2022). The American Heart Association's current statistics estimated that around half of the USA, population is victimized due to this pandemic (Reiter-Brennan *et al.*, 2021). Pakistan is suffering from chief menaces of cardiovascular diseases ranging from 30 to 40% of all kinds of mortalities. It is estimated that every 9th Pakistani is suffering from different forms of cardiac diseases (Barolia and Sayani, 2017).

According to evidence from both in vitro and

in vivo research, medicinal plant use profoundly modifies essential cellular, molecular, and metabolic systems that regulate the development and pathophysiology of cardiovascular disorders (Shaito *et al.*, 2020). The motivation behind this study is the current socioeconomic situation of our country and the possible side effects of allopathic medications. There is a dire need to have an alternative therapy that should be cost-effective with lesser side effects on the human body. Several studies helped in considering basil seeds (*Ocimum basilicum*) to be antioxidant, cardiac stimulant, hypoglycemic, anti-inflammatory, immunomodulatory, hepatoprotective, and hypolipidemic (Noor *et al.*, 2019; Umar *et al.*, 2010; Khaliq *et al.*, 2017). The present study focused on cardiovascular patients regarding their treatment with *Ocimum basilicum* seeds. Therefore, this study aimed to conduct a clinical trial on cardiovascular patients to assess the lipid-lowering properties of *Ocimum basilicum*.

MATERIALS AND METHODS

The study was carried out at the University Institute of Diet & Nutrition Sciences, Faculty of Allied Health Sciences, University of Lahore, and Major Aziz Bhatti Teaching Hospital (DHQ) Gujrat, Punjab, Pakistan for one year from April 2021 to April 2022. This study was designed to test the anti-hyperlipidemic potential of *Ocimum basilicum* seeds on hyperlipidemic human subjects. The sample size was calculated using the following formula and the information generated from pilot study data:

$$n = \frac{(Z_{1-\beta} + Z_{1-\alpha/2})^2 + (\delta_1^2 + \delta_2^2)}{(\mu_1 - \mu_2)^2}$$

$Z_{1-\alpha/2}$	Confidence interval= 90%
μ_1	Expected mean value of LDL in Control Group =148.01
μ_2	Expected mean value of LDL in Experimental Group= 169.24
δ_1	Expected standard deviation in Control Group= 1.51
δ_2	Expected standard deviation in Experimental Group= 1.53
$Z_{1-\beta}$	Power of the study= 80%
n	Expected sample size in a group= of 20

After a detailed scrutiny process, sixty (60) volunteer cardiovascular patients from both genders between the age group of 30 to 60 years having cholesterol levels ≥ 200 mg/dL were selected. They were also non-diabetic and non-smokers. The cardiovascular patients with total cholesterol levels < 200 mg/dL, pregnant or lactating women, patients with allergies to medications, renal failure, liver cirrhosis, cancer, GIT disorders, or unwilling to give written consent were excluded from the study. The selected sixty patients were divided into three groups; one group of twenty (20) patients was given no treatment (G_0), the second group of twenty (20) patients (G_1) was given 5.0 g basil seeds per patient per day and third group of twenty (20) patients (G_2) was given 10.0 g basil seeds for ninety days. Basil seeds were purchased from the local market and were cleaned through a dry aspirator. The data was recorded for biomass index (BMI), blood pressure, high-density lipoproteins (HDL), low-density lipoproteins (LDL), total cholesterol (TC), and triglycerides (TG) during 45 and 90 days of the study period. The BMI was calculated using the standard formula in accordance with CDC 2000 clinical growth charts as mentioned by Woo, (2009) (Woo, 2009).

$$BMI = \frac{\text{Weight in Kg}}{\text{Height in meter}^2}$$

The blood samples during fasting were taken to evaluate biochemical variables, total cholesterol (TC) and triglycerides (TG). The data was collected and subjected to statistical analysis using SPSS 22.0 software. The mean \pm standard deviation was used for quantitative variables; frequency and percentages were used for qualitative variables.

RESULTS

The data on the body mass index (BMI) of all groups of cardiovascular patients is described in Figure 1. The biomass index (BMI) values of control patients increased from 36.40 to 36.47 (0.19 %) on the 45th day and 36.51 (0.29 %) on the 90th day. The BMI of 2nd group of 20 cardiovascular patients with treatment of 5.0 g of basil seeds per day per patient significantly decreased from 32.79 to 31.42 (4.17 %) and 29.21 (10.58 %) after 45 and 90 days, respectively. The BMI of cardiovascular patients in the 3rd group reduced from 40.59 to 36.65 (9.70 %) and 31.16 (23.22%) after 45 and 90 days, respectively. The decreasing trend of BMI of 20 cardiovascular patients was more prominent with the treatment of basil seeds @ 10.0 g per patient per day in the

case of 3rd group of cardiovascular patients during the whole study period of 90 days.

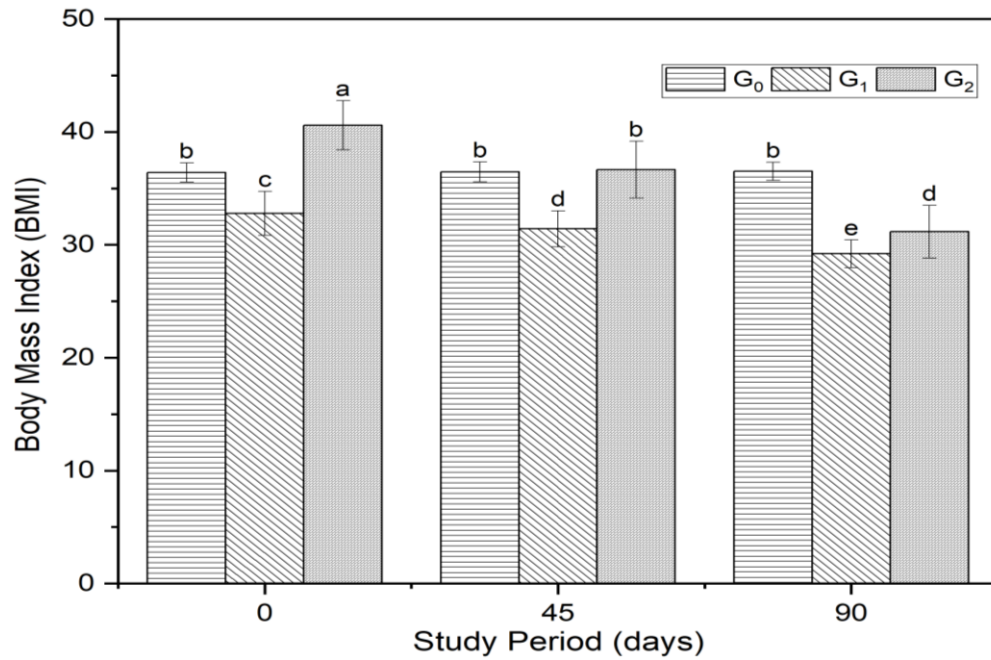


Figure 1. Effect of basil seed treatment on Body Mass Index (BMI).

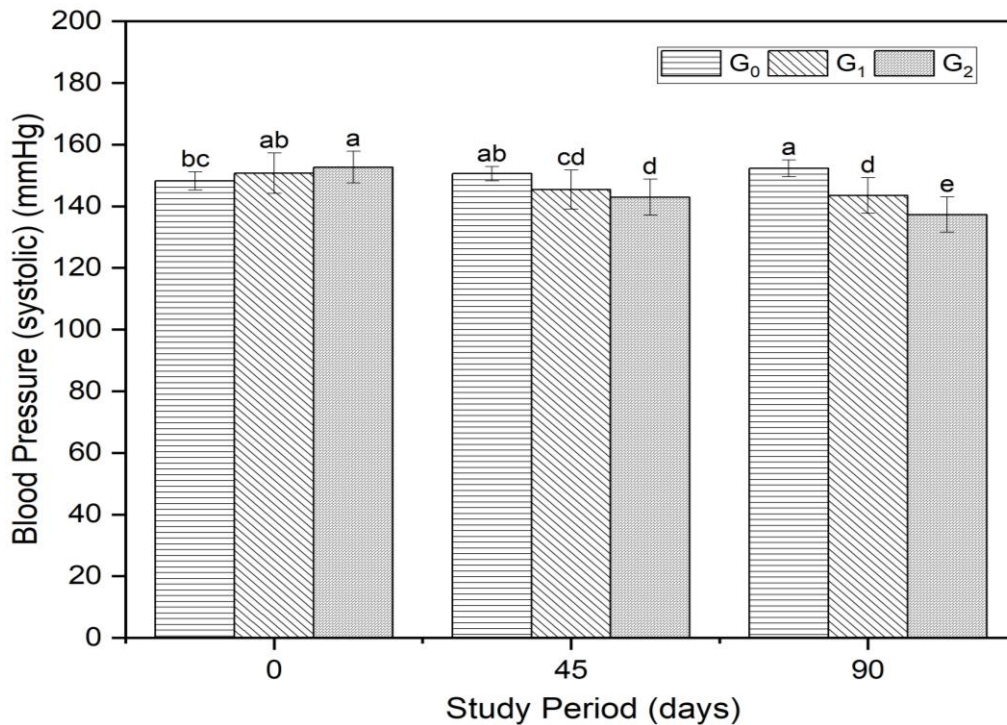


Figure 2. Effect of basil seed treatment on Blood Pressure (Systolic).

The data regarding the impact of basil seeds on the blood pressure (systolic) of cardiovascular patients is portrayed in Figure 2 which showed that the blood pressure

(systolic) of 20 cardiovascular patients was significantly increased as 2.35 mmHg (1.59%) and 4.10 mmHg (2.77 %) after 45 and 90 days, respectively, in G_0 (the group which receives no treatment of basil seeds). However, the blood pressure (systolic) of the second group (G_1) of 20 cardiovascular patients significantly decreased as 5.35 mmHg (3.55%) after 45 days and 7.25 mmHg (4.81%) after 90 days, respectively, where 5.0 g basil seed per patient per day was given. It is further noted that the blood pressure (systolic) of 20 cardiovascular patients in group 3rd (G_2) was further reduced when a double dose of basil seeds i.e 10.0 g per patient per day was given. The data also reveals that all group means are statistically different from each other, and the basil seeds have a significant effect on lowering the blood pressure (systolic) of cardiovascular patients, especially where 10.0 g of basil seeds per patient were given daily for 45 and 90 days. Similarly, the data in connection with blood pressure (diastolic) of cardiovascular patients illustrates that the blood pressure (diastolic) of 20

cardiovascular patients (G_0) present in group 1st with no treatment significantly increased from 94.8 to 96.6 mmHg after 45 days and then further increased to 98.0 mmHg when noted after 90 days (Figure 3). The blood pressure (diastolic) of the second group of 20 cardiovascular patients (G_1) significantly decreased from 97.2 to 93.2 mmHg (4.12 %) after 45 days and further decreased to 90.3 mmHg (7.10 %) after 90 days, where 5.0 g basil seed per patient was given daily. The patients in the 3rd group (G_2) were given 10.0 g basil seeds per patient daily and in this group, the reduction in blood pressure (diastolic) was more acute due to the daily double dose of basil seeds as compared with the 2nd group of patients. The decrease was from 98.6 to 91.9 mmHg (6.80 %) after 45 days and 86.15 mmHg (12.63 %) after 90 days. Statistical analysis also reveals that the means of group 1st significantly increased while the means of group 2nd and 3rd patients significantly decreased under the effect of treatments given in the shape of basil seeds doses.

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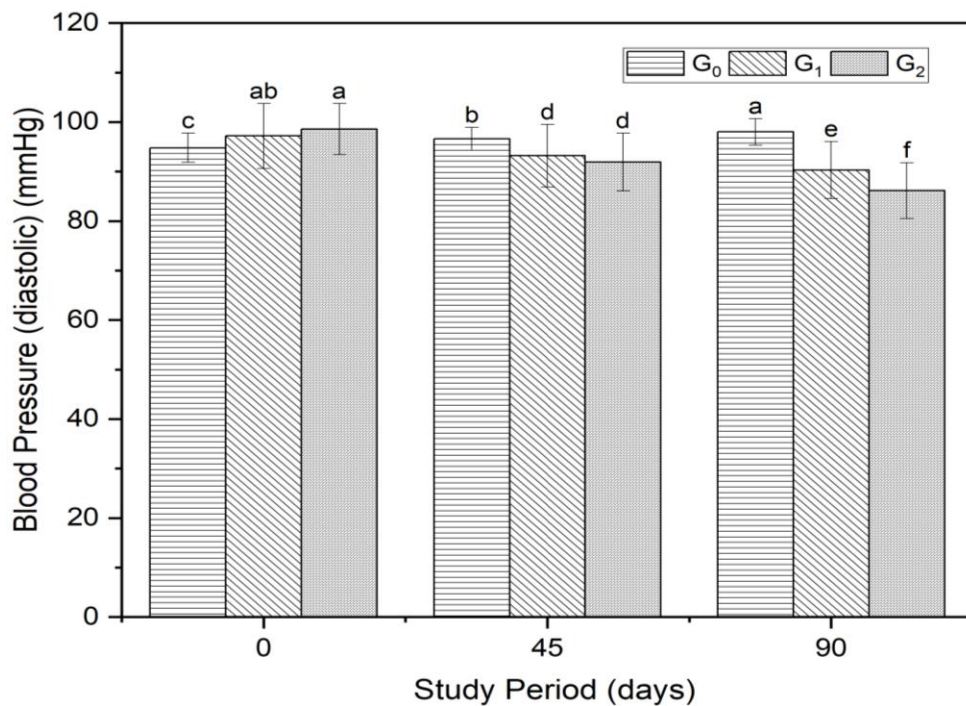


Figure 3: Effect of basil seed treatment on Blood Pressure (diastolic).

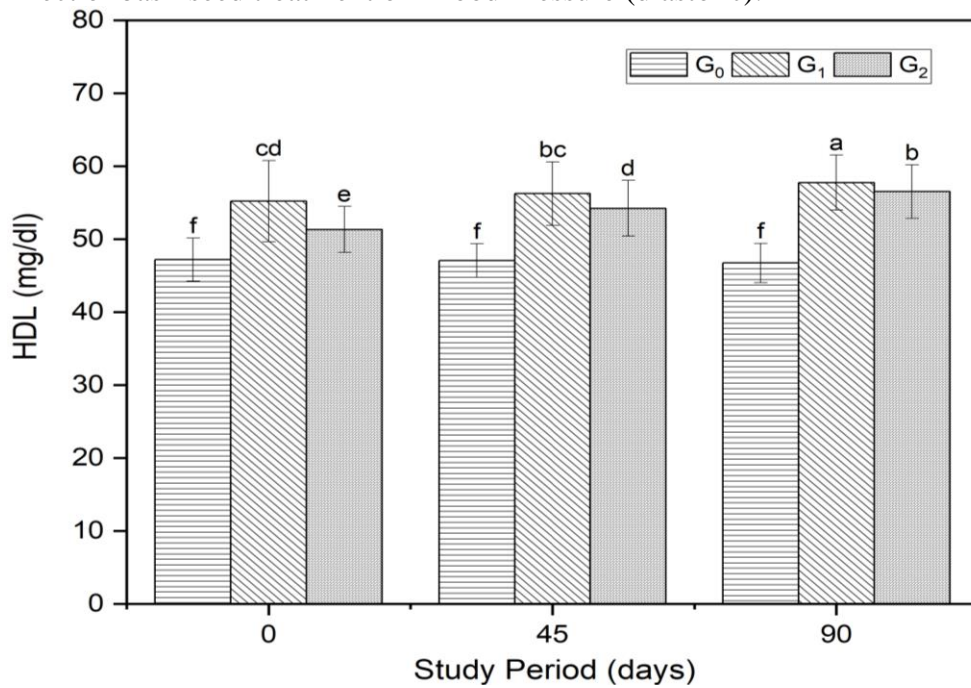


Figure 4. Effect of basil seed treatment on high density lipoproteins (HDL).

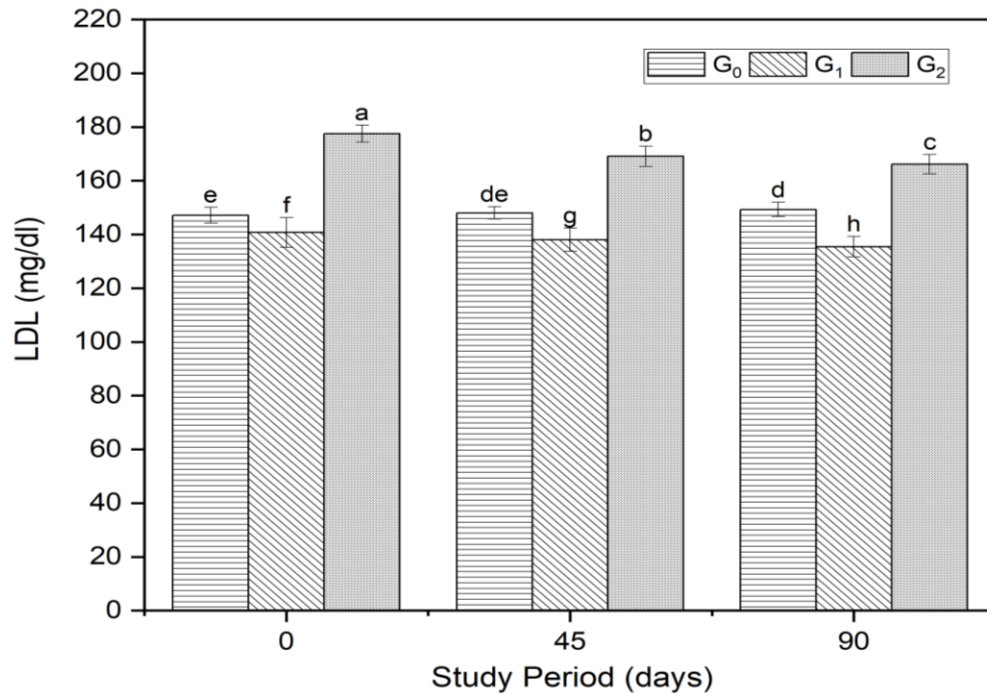


Figure 5. Effect of basil seed treatment on low density lipoproteins (LDL).

The effect of basil seeds on high-density lipoprotein (HDL) in cardiovascular patients is presented in figure 4. It is apparent from the data that the HDL of 20 cardiovascular patients present in group 1st with no treatment (G₀) slightly decreased as 0.15 mg/dl (0.31 %) after 45 days and 0.48 mg/dl (1.01 %) after 90 days. But in the case of 2nd group of 20 cardiovascular patients with treatment of 5.0 g of basil seeds per patient per day, HDL considerably increased as 1.04 mg/dl (1.89 %) and 2.55 mg/dl (4.63 %) after 45 and 90 days, respectively. The increasing trend of HDL was more prominent in the case of 20 cardiovascular patients of the 3rd group where basil seeds @ 10.0 g per patient per day were given during the whole study period of 90 days. The HDL of cardiovascular patients in the 3rd group increased to 2.90 (5.64 %) and 5.19 (10.11 %) mg/dl after 45 and 90 days, respectively. It is also observed that the means of group 1st slightly decreased but under the

influence of both doses of basil seeds, the means of group 2nd and 3rd patients significantly increased after 45 and 90 days of the study period. It is evident from the data that in the case of 1st group where no treatment was given HDL of cardiovascular patients slightly increased, while in 2nd and 3rd group of cardiovascular patients where 5.0 and 10.0 g basil seeds, respectively were given per patient daily, significant enhancement in HDL is witnessed after 45 and 90 days. The reducing trend of HDL under the influence of both doses of basil seeds i.e. @ 5.0 and 10.0 g per patient per day for 45 and 90 days as portrayed in figure 4.

The data regarding low-density lipoprotein (LDL) in cardiovascular patients is described in Figure 5. The data states that the low-density lipoprotein (LDL) of 20 cardiovascular patients (G₀) present in group 1st significantly improved from 147.13 to 148.00 mg/dl (0.59 %) after 45 days and then

further increased to 149.28 mg/dl (1.46 %) when noted after 90 days. The LDL of the second group of 20 cardiovascular patients (G₁) significantly decreased from 140.72 to 138.06 mg/dl (1.89 %) after 45 days and

further decreased to 135.46 mg/dl (3.74 %) after 90 days. The reduction of LDL in patients of the 3rd group (G₂) was noted from 177.51 to 169.09 mg/dl (4.74 %) after 45 days and 166.14 mg/dl (6.41 %) after 90 days.

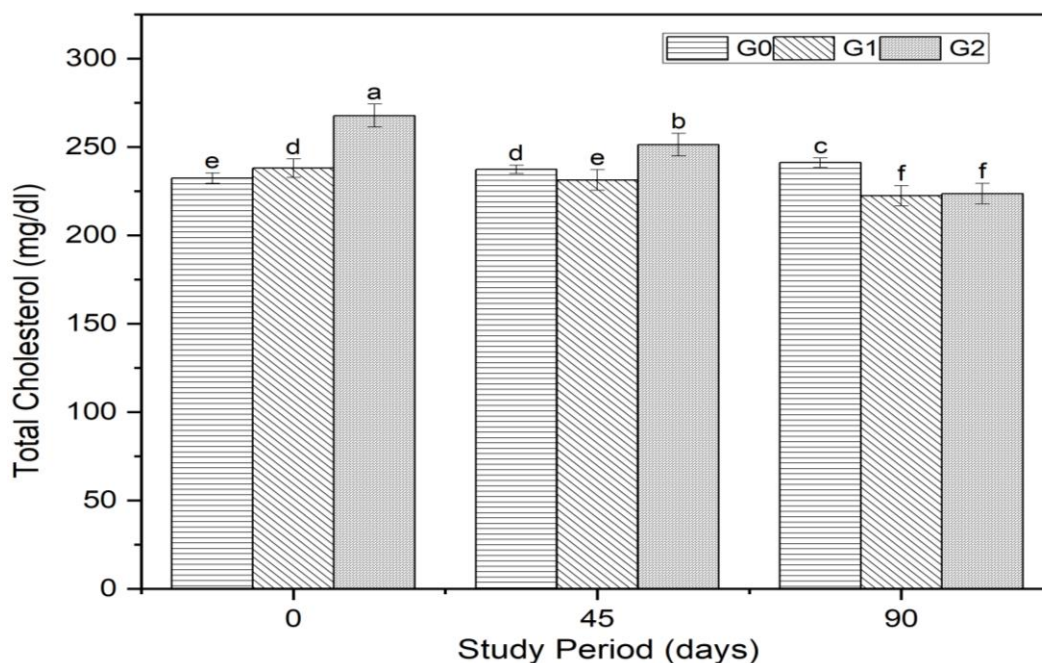


Figure 6. Effect of basil seed treatment on Total Cholesterol (TC).

The data pertaining to total cholesterol (TC) shows that the TC of 20 cardiovascular patients existing in group 1st with no treatment (G₀) increased from 232.36 to 237.37 mg/dl (2.16 %) and 241.19 mg/dl (3.83 %) after 45 and 90 days, respectively (Figure 6). Total cholesterol (TC) of cardiovascular patients in 2nd group with the treatment of 5.0 g of basil seeds per patient per day significantly decreased from 238.01 to 231.35 mg/dl (2.80 %) and 222.44 (6.54 %) after 45 and 90 days, respectively. The data further reveals that TC of the 3rd group of 20 cardiovascular patients decreased from 267.77 to 251.41 mg/dl (6.11 %) and 223.64 mg/dl (16.48 %) after 45 and 90 days, respectively.

The data in connection with the triglycerides

level (TG) of cardiovascular patients (Figure 7) shows that the triglycerides level (TG) of 20 cardiovascular patients (G₀) present in group 1st (control) significantly enhanced from 207.79 to 210.27 mg/dl (1.19 %) after 45 days and 212.14 mg/dl (2.09 %) after 90 days of the study period. The TG of the second group of 20 cardiovascular patients (G₁ = basil seeds @ 5.0 g per patient per day) significantly decreased from 190.86 to 183.27 mg/dl (3.98 %) after 45 days and it further decreased to 178.55 mg/dl (6.45 %) after 90 days. The reduction of TG in patients of 3rd group (G₂, basil seeds @ 10.0 g per patient per day) was noted from 250.15 to 225.57 mg/dl (9.83 %) after 45 days and 207.77 mg/dl (16.94 %) after 90 days.

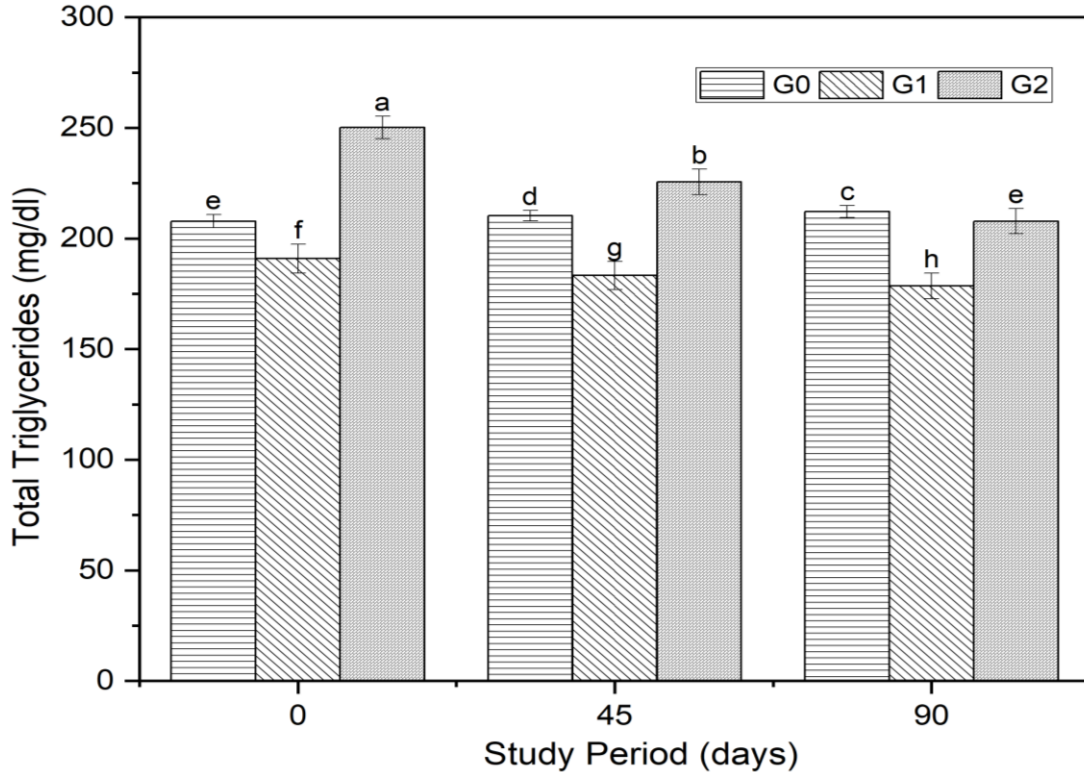


Figure 7. Effect of basil seed treatment on Total Triglycerides (TG).

DISCUSSION

Hyperlipidemia is a leading cause of death all over the world. Itinerant studies clearly show that individuals of South Asian origin (India, Pakistan, and Bangladesh) are particularly vulnerable to hyperlipidemia when moving to affluent countries, with rates at least 1.5- to 2-fold higher as compared with natives (Burkhardt, 2019). Many interventions have been introduced and approved by the health authorities to reduce hyperlipidemia. However, a major influence is given to dietary interventions. In doing so, different herbal plants have been investigated for their pharmaceutical as well as nutraceutical potential to prevent and ameliorate hyperlipidemia. Previous studies have found

basil seeds to exhibit multiple beneficial effects in reducing BMI and lipid metabolism (Burkhardt, 2019). Elevated values of BMI have been significantly related to obesity and thus stressing the probing relationship between coronary heart disease CHD and hyperlipidemia (Willett *et al.*, 1995) In a survey, it was discovered that high BMI accounted for 4.0 million deaths in the year 2015, i.e. more than two-thirds of which were caused by cardiovascular disease (CVD) (Correia-Costa *et al.*, 2019).

In the current study, it is evident that in the 1st group where no treatment was given, the BMI of cardiovascular patients slightly increased, while in 2nd and 3rd group of cardiovascular patients where 5.0 and 10.0 g basil seeds were

given per patient per day, respectively. Therefore, a significant reduction in BMI was observed after 45 and 90 days in these groups. Figure 1 illustrates the reduction of BMI of cardiovascular patients under the influence of both doses of basil seeds i.e. @ 5.0 and 10.0 g per patient per day after 45 and 90 days. However, the reduction is more acute in the case of 10.0 g basal seeds per patient per day. A similar study with 4 g of basil seeds per day for four weeks, has revealed BMI reduction in obese patients (Putadechakum and Mo, 1992). The results of current investigation are also in accordance with the study by Obaid & Khalil (2021), who depicted that basil seed extracts significantly reduce the BMI of female rats following 56 days study (Obaid and Khalil, 2021). The results showed a significant effect of basil seeds on the reduction of biomass of cardiovascular patients (Obaid and Khalil, 2021; Elumalai *et al.*, 2019; Calderón Bravo *et al.*, 2021; Karam *et al.*, 2016; Akbarian *et al.*, 2016). Plant-based herbal medications have also been utilized as an alternative treatment for a variety of health issues, all over the world and their use may have an impact on the regulation of blood pressure instead of using standard drugs (Thangsuk *et al.*, 2021). The findings of the current investigation relating to blood pressure control are in accordance with the results of a study conducted by Umar *et al.* (2010), who investigated the possible antihypertensive effects of *Ocimum basilicum* extract in renovascular hypertensive rats (Umar *et al.*, 2010). They concluded that *Ocimum basilicum* significantly reduced systolic and diastolic blood pressure and cardiac hypertrophy. Similarly, through an extensive survey on medicinal plants, it was concluded that herbal medications based on

medicinal plants like basil might reduce the utilization of traditional allopathic medicines to manage hypertension and diabetes mellitus (Davids *et al.*, 2016). While managing dyslipidemia, it is necessary to adopt such dietary habits through which we may reduce the elevated levels of low-density lipoproteins (LDL) also known as bad cholesterol, and simultaneously, the levels of high-density lipoproteins (HDL) also called good cholesterol should be raised (Mehraban *et al.*, 2021). In our current study, the basil seeds significantly reduce the levels of LDL (6.41% decline) and prominently enhanced the HDL levels (10.11% increase). This might be due the presence of dietary fiber and unique phenolic acids in basil seeds (Khursheed *et al.*, 2022; Nazir and Wani, 2021), these phenolic compounds might be responsible for lowering the LDL levels through an anti-oxidative mechanism in which the antioxidant enzymes like sodium oxide dismutase, catalase, and peroxidase activate and support the lipid metabolism (Azimi *et al.*, 2014). Moreover, due to the presence of dietary fibers and other nutraceutical compounds in basil seeds, the total caloric contribution is also low, resulting in increased values of HDL. The results of current research are also in line with the findings of Khan *et al.*, who found that herbal supplements can lower fasting blood sugar (FBS), total cholesterol (TC), LDL cholesterol (LDLc), and triglyceride (TG) levels in type 2 diabetic patients (Khan *et al.*, 2003). Likewise, Azimi *et al.*, produced similar results while studying the effects of spices on markers of glycemic control, lipid profile, oxidative stress, and inflammation in type 2 diabetes patients (Azimi *et al.*, 2014). In our current investigation, a positive association of

BMI with Total Cholesterol (TC) can be observed. According to the data presented in Figures 2 and 3; 1st group, where no treatment was given, the total cholesterol (TC) and triglycerides levels (TG) of cardiovascular patients increased significantly, whereas, in the case of 2nd and 3rd groups of cardiovascular patients where 5.0 and 10.0 g basil seeds per patient per day were given, TC and TG statistically reduced after 45 and 90 days. The reduction of TC and TG was more prominent in the case of 10.0 g basal seeds per day. The results were very promising in the reduction of high levels of total cholesterol and triglycerides which are the major causes of cardiovascular diseases (Amrani *et al.*, 2006; Touiss *et al.*, 2019) Basil seeds exhibit a remarkable fatty acid profile from nutritional and functional point of view. Since basil seeds contains substantial amounts of α -linolenic acid (ALA) and linoleic acid (LA) which are essential fatty acids for humans, therefore, they are helpful in reducing the total cholesterol levels as well as total triglycerides (Martínez Martínez *et al.*, 2022).

CONCLUSION

The current study concluded that both doses of basil seeds (@ 5.0 and 10.0 g per patient per day significantly reduced biomass index (BMI), total cholesterol (TC), and triglycerides level (TG) of cardiovascular patients during 45 and 90 days of the study period. It was also noted that the effect of basil seeds to lower high blood pressure levels, and LDL of cardiovascular patients was more prominent in the case of 10.0 g of basil seeds per patient per day than 5.0 g of basil seeds per patient per day.

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