Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/543r0404

EFFECT OF CHICORY ROOT POWDER ON TOTAL CHOLESTROL AND BLOOD PRESSURE OF THE HYPERTENSIVE PATIENTS

Mehak Sajid[1], Dr. Niamat Ullah[2], Azim Khan[3*], Hikmat Ullah Khan[4], Aqsa Noureen[5], Bakhtawar[6]

[1]Student, Department of Human Nutrition and Dietetics, The University of Agriculture, Peshawar. Mehaksajid01@gmail.com
[2]Assistant Professor, Department of Human Nutrition and Dietetics. The University of Agriculture, Peshawar.Niamatullah@aup.edu.pk
[3*]Phd Scholar, Department of Human Nutrition and Dietetics, The University of Agriculture, Peshawar. DietitianAzim@gmail.com
[4]Student, Department of Human Nutrition and Dietetics. The University of Agriculture Peshawar.Hikmatafridi31@gmail.com
[5]Student, Department of Human Nutrition and Dietetics, The University of Agriculture, Peshawar. aqsafaryad074@gmail.com
[6]Student, Department of Human Nutrition and Dietetics, The University of Agriculture Peshawar. Bakhtawar126311@gmail.com

***Corresponding author:** Azim Khan
*Email: dietitianAzim@gmail.com

ABSTRACT
Background: Cichorium intybus belongs to family Asteraceae, is an enriched source of inulin, a fructan-type plant polysaccharide, whose ability has been shown to have a significant effect on total cholesterol and blood pressure in numerous studies with controversial results.
Aims and Objectives: The aim of the present study was to explore the effect of chicory root powder on total cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL) and blood pressure of the hypertensive patients.
Study Design: It was controlled randomized clinical trial.
Methodology: A total of 30 hypertensive patients both male and female age ≥ 40 years were enrolled in this study. The patients were randomly divided into three groups, where each group was comprised with 10 hypertensive patients. The first group was Control group (n=10) who received only hot water, the second group (group 2) received 5 gm of chicory root powder (n=10) and third group (group 3) received 10 gm of chicory root powder (n=10). All the participants were assessed at day 0 (baseline), day 15, day 30 followed by wash out period at day 45.
Statistical Analysis: Statistical package for social sciences (SPSS) Version 21 was used to analyze the data.
Results: The result of this study revealed that after the supplementation for the thirty days a significant difference at the entire interval for all the different treatment was recorded. Significant ($p<0.05$) declined in blood pressure and total cholesterol, LDL and increase in HDL in treatment group was observed. There was significant difference ($p<0.05$) in blood pressure and total cholesterol, LDL and HDL values between the Control and treatment groups. Finding of this study shown that 10 gm dose

of Chicory root powder for 30 days was effective in reducing the total cholesterol and blood pressure of hypertensive patient with hypercholesterolemia. it was concluded that chicory root powder can be used for controlling the blood pressure and total cholesterol of hypertensive patient.

Keywords: Chicory root powder, Total Cholesterol, Blood Pressure, Hypertensive patient

INTRODUCTION

Recently, there is a rising interest among health-conscious consumers globally in exploiting the therapeutic and functional health attributes of spices and herbs to protect and improve health, immunity, and nutrition especially during the Covid-19 pandemic period. Many new medications, chemicals, and flavors require knowledge of herbs and spices. Antioxidant, antibacterial, medicinal, and nutritional (micro- and macro minerals and vitamins), phytochemicals such as flavonoids, tannins, alkaloids, glycosides, organic acids, phenols, essential oils and saponins are all found abundantly in herbs and spices (Paswan et al., 2021). Herbs and spices have a substantial role in food and nutrition, medicine, perfumes, cosmetics, coloring, and as garden plants. Spices and herbs are used in food to enhance the flavor, pungency, and color to dishes. Some herbs have the ability to alter physiological functioning, revolutionizing medicine and creating fortunes (Bishnoi 2016).

Chicory (Cichorium intybus L.) a perennial herb from the Cichorium genus, family Asteraceae, commonly known as Kasni and is globally cultivated that grows to be about 1 meter tall with a fleshy taproot up to 75cm long (Perović, Šaponjac et al. 2021). The Cichorium intybus is a combination of Latin and Greek words. Cichorium refers to the field, while intybus derives from the Latin Tubus, which refers to the hollow stem and the Greek term "to cut," which simply refers to the leaves. Although this species is indigenous to Europe (the Mediterranean region), it may also be produced in semi-arid and temperate climates worldwide. Chicory was cultivated by the ancient Egyptians as a vegetable crop, a coffee substitute, a medicinal herb, and even as animal fodder. Cichorium intybus is a significant medicinal plant that is found in regions of Africa and Eurasia. The plant is not listed in the European Pharmacopoeia or any official European Union member state Pharmacopoeia, despite its long history and tradition of use (Street, Sidana et al. 2013). Different components of the plant have, however, been employed in traditional remedies across the world due to its widespread distribution. The root contains the majority of the components, however essential phytochemicals are found throughout the plant.

Freshly chicory root has about 68% inulin, 14% sucrose, 6% protein, 5% cellulose, 4% ash and 3% other compounds, compared to dried chicory's 98% inulin and 2% other compounds. (Kim and Shin 1996). Vitamin A and C, phenolic compounds, and micronutrients including calcium, phosphorus and potassium are all abundant in chicory leaves (Mulabagal et al.,). Inulin, carbohydrates, fats, proteins, oils, vitamins and minerals, caffeic aid derivates, hydroxycoumarins, sesquiterpene lactones, flavonoids, steroid, terpenoids, beta-carotene, alkaloid, phenols and zeaxanthin are just a some of the essential nutritional compounds found in the chicory root, which suggests that it has a diversified nutritive value and may be a good source of bioactive components for Human Food Fortification (Al-Snafi 2016).

In addition to strengthening the immune system, chicory, which is high in cichoric acid, may also, to a limited amount, prevent inflammation and bacterial infections (Ahmed 2009). Fever, diarrhea, jaundice, and gallstones have all been treated with C. intybus in the past (Abbas, Saggu et al. 2015). Chicory root has a wide range of biological activities in addition to its essential nutritive profile, including cardiovascular, anti-inflammatory, gastro-protective, hepatoprotective, antioxidant, sedative, hypolipidemic, antimicrobial, antidiabetic, immunological, anticancer, and many others (Perović, Šaponjac et al. 2021). Cichorium intybus has anti-diabetic properties and anti-hepatotoxic, according to experiments conducted on rats (Saggu, Sakeran et al. 2014).Antibacterial, anti-inflammatory, (hyperglycemic, and anti-ulcerogenic properties have also been identified for C. intybus (Rifat-uz-Zaman and Khan 2006). Heavy metals like as lead, zinc, copper, and cadmium have also been proven to be useful bio monitors in Cichorium intybus (Aksoy et al.,2008). A significant percentage of premium feed was made using forage chicory during the warm season, under optimal conditions. It has been discovered that grazing chicory decreases the number of intestinal parasites in animals, potentially lowering the need for anthelmintics.

An elevation in arterial blood pressure, or unusually high arterial blood pressure, is referred to as hypertension. The blood pressure threshold for individuals with diabetes or Chronic kidney disease (CKD) generally 130/80 mm Hg, while those non- diabetic or chronic kidney disease had a higher threshold around 140/90 mm Hg (Society, Society et al. 2005). Potassium has a crucial function in decreasing blood pressure, and chicory root can give up to 174 mg of it. Magnesium dilates blood vessels, reduces blood flow and blood pressure. Hypercholesterolemia is a serious socioeconomic concern among both common people and health professionals because of the close link between CVD and lipid imbalances. Hypercholesterolemia and cardiovascular diseases are significantly increased by modern lifestyle, which includes a diet rich in fat and sedentary lifestyle. The elevated level of low-density lipoprotein (LDL) cholesterol builds in the extracellular sub endothelial space of arteries, causing functional problems. Intensive LDL-cholesterol lowering has been reported to slow the onset of CVD and reverse atherosclerosis. The hypocholesterolemic activity of marjoram and chicory extract, according to (Rang and Dale, 1991) is indicative of the presence of isoflavones in the both herbs, which compete for absorption sites in the gut, preventing cholesterol absorption (Ahmed, Ramadan et al. 2009). Because to the presence of inulin, a soluble fiber with a hypolipidemic effect, chicory extract may have considerable hypercholesterolemic and hypotriglyceridemic effects (Lairon et al.,1996).

Cichorium intybus root extract reduced cholesterol absorption in the perfused ileum by 41% and the jejunum by 30% (Kim et al., 2000). WECI, a Cichorium intybus water extract, has a significant antioxidative impact on low density lipoprotein, in terms of its inhibitory effect on the synthesis of thiobarbituric acid reactive material and the degradation of fatty acids. Unsaturated fatty acids and Vitamin E in LDL were protected from the impacts of metal catalysed LDL oxidation by WECI. In vitro, WECI suppresses oxidation, and agarose gel electrophoresis indicates that WECI protects LDL against oxidative attack.

Keeping in view the past health benefits of herbs this research was be beneficial to find out if chicory is helpful in treating patients with elevated cholesterol levels.

OBJECTIVES

The overall goal of this study was to explore the effect of chicory root powder on the total cholesterol level and blood pressure of the hypertensive patients. The specific objectives were:

1. To assess the functional effects of chicory root powder on hypertension including both systolic and diastolic blood pressure
2. To determine the effects on lipid profile of the individuals suffering from hypertension.
3. To identify the washout period associated with the chicory root powder efficacy.

II. REVIEW OF LITERATURE

Egila et al., (2022) conducted research on the effect of prebiotic inulin supplementation on metabolism of glucose and lipid profile glucose metabolism and lipid profile in type II diabetic women. The impact of insulin therapy on fasting blood glucose level (FBG), serum TGL, serum cholesterol, HDL cholesterol, and LDL cholesterol was investigated, and the findings were interpreted. There is a close connection between dyslipidemia and Type II diabetes mellitus (T2DM), a complex disease that is significantly influenced by both environmental and inherited factors. Prebiotic inulin has now been demonstrated to enhance lipid profiles and insulin concentrations in diabetics. For three weeks, 100 Type 2 diabetes mellitus females whose fulfilled the established criteria consumed four gram of a prebiotic inulin daily. Their insulin resistance (IR), Fasting blood glucose (FBG), insulin, and lipid profile were then assessed prior and after the intervention. The clinical trial demonstrated that in comparison to measurements taken before to supplementation, inulin supplementation considerably decreased FBG, serum LDL, TG, TC, insulin and IR levels and significantly increased HDL. This suggests that by enhancing carbohydrate and lipid metabolism, inulin may help in the treatment the metabolic problems caused forward by high fructose diets.

Ferrare et al., (2022) investigated the relationship of different types of acids present in a natural extract of chicory plant for an anti-diabetic action. They found that the primitive vegetable which is abundantly found in Europe, America, and Asia is chicory (Cichorium intybus L.). For centuries, people have used the chicory plant's seeds, leaves, roots and flower as medicines, which include liver detoxification, tonic properties, and the potential to relieve gastrointestinal issue. Chicory was used in traditional Indian medicine because it has an anti-diabetic effect. Chicory was applied in hypoglycemic extracts in Bulgarian and Italian indigenous med. They aimed to determine the overall chemical composition of chicoric acid extract (NCRAE), a chicory root extract rich in chicoric acid that has effectively demonstrated its ability to improve glucose metabolism under healthy control. To investigate if the complete NCRAE is required for it to be effective, researchers conducted comparative in vivo experiments and trials upon STZ diabetic rats given either NCRAE or a combination made up of the two primary components of NCRAE. In-depth analysis of NCRAE's composition has been conducted using the LC-MS procedure they observation revealed that the 83.8% of NCRAE was made up of chicoric and chlorogenic acids. They produced SCCAM, a solution formed by combining chicoric acid and chlorogenic acid. This solution was used to assess the antidiabetic potential it possessed against the diabetes induced lab rats. On the L6 cell line, in vitro tests were conducted for the glucose metabolism and the protective impact over H2O2 oxidative stress. Furthermore, they assessed the 2 compositions' DPPH & ORAC (Oxygen Radical Absorbance Capacity) antioxidative properties. Chicoric acid, which is widely present in NCRAE (64.2%), was validated by the LC-MS analysis, and 19.6% of NCRAE is constituted of chlorogenic acid, including caffeoylquinic acids (CQAs). As an outcome, they were able to create SCCAM, a blend of synthetic chlorogenic acid (30%) and synthetic L- chicoric acid (70The seven-day trial revealed that diabetics' glucose tolerance can be improved by both SCCAM and NCRAE (sub chronic dose). Following 6 days of treatment, NCRAE alone results in a significant reduction in baseline hyperglycemia. To clarify the variations in effects between both the two substances, they investigated the L6 myocytes line's in vitro responses to SCCAM and NCRAE for insulin protection and sensitivity against H2O2. Researchers also compared their antioxidant effectiveness. It showed that the natural extract of chicory plant is helpful in mitigating hyperglycemic conditions.

Golzarand, Bahadoran et al. (2022) examined the possible link between inulin consumption and the occurrence of cardiometabolic disorders such as CVD, hypertension CKD and T2DM in adults. The current prospective cohort research was done on participants in the Tehran Lipid and Glucose Study's third wave (2006-2008) followed until March 2018. The intake of inulin through diet was calculated using a database that gives inulin (g) and oligofructose (g) levels. According to Cox proportional hazards analysis, increased inulin intake was related with a decreased risk of HTN and T2DM. This research discovered no link between increased dietary inulin intake and the prevalence of CKD and CVD in our community. Findings of the study revealed that, inulin from meals appears to have a protective impact against HTN and T2D, both of which are substantial risk factors for cardiac and renal events.

Nasimi Doost Azgomi, Karimi et al. (2021) evaluated Chicory is rich in phenolic compounds and terpenoids, making it one of the most efficient ways to manage and reduce the problems of chronic complications like diabetes. This comprehensive review focused on evaluating data from research on the effects of chicory root on metabolic indicators for diabetes mellitus in both humans and animals (such as inflammation, oxidative stress, dyslipidemia and blood glucose level). All animal studies and clinical trials that looked at the effect of chicory root on metabolic potential confounders in diabetics were included in this comprehensive review. Most of the researches that looked into the impact of chicory root on the glycaemic index discovered that Cichorium intybus improved blood glucose index. In 10 out of the 13 studies that looked at it, chicory root was determined to improve lipid profiles. Chicory also significantly decreases oxidative stress and inflammation in all 12 studies. Cichorium intybus, according to the evidence, may help with glycemic control, dyslipidemia, oxidative stress, and inflammation. However, further research is needed to get a thorough conclusion regarding chicory's mechanism involving in diabetes patients.

Faghihimani, Namazi et al. (2021) investigated a comprehensive study and meta-analysis of the impact of inulin type carbohydrates on blood pressure. Numerous studies have found that inulin-type carbohydrates significantly reduce blood pressure, yet these results are still debatable. To determine the effect of ITC supplementation upon blood pressure, a comprehensive investigation and meta-analysis of randomized-controlled studies was carried out. The Weighted A random-effect model with 95 % confidence intervals was used to calculate the mean difference. The I2 statistic and Q tests were used to evaluate statistical heterogeneity. To eliminate heterogeneity, subgroup analysis was performed using the clinical features of the participants (gender and health status). To identify publication bias, they employed the Begg's rank correlation and Egger's regression asymmetry tests. Sensitivity analysis was used to evaluate the influence of each study on the total effect. ITC supplementation does not lower both systolic (WMD: 5.83 mmHg; percent CI: 12.49, 0.82; P = 0.086) and diastolic BP (WMD: 2.62 mmHg; 95 percent CI: 6.15 to 0.92; P =.147) blood pressure, based on a meta-analysis of 5 studies (with 6 arms) RCTs of 233 individuals. A study of subgroups based on gender found that ITC had a significant impact on SBP in subgroups of females. To give a more accurate estimate of the anti-hypertensive properties of this type of prebiotic, additional carefully constructed RCTs in hypertension patients are required.

Pauly, Rohde et al. (2020) investigated hepatic cholesterol and bile acid metabolism are disrupted when inulin is supplemented. Independent by Housing+++ temperature Gut bacteria convert dietary fibers into the propionate, short chain fatty acids, acetate and butyrate. Fiber-rich diets are advised to enhance digestive health as a whole. According to the most recent research, long-term fiber supplementation in dysbiotic rats appears to alter hepatocellular carcinoma, hepatic bile acid metabolism, and hepatocellular injury. Additionally connected to cold-induced stimulation of brown adipose tissue are modifications in liver bile acid metabolism. This study examines the effects of inulin supplementation on the hepatic metabolism of bile acids and cholesterol in cold-housed wild type mice. Short-term inulin administration, according to researchers, reduced plasma cholesterol and caused cholestasis and a minor liver damage in Wild Type mice. Eating inulin significantly changed hepatic bile acid metabolism, and cold therapy made these changes worse. According to their findings, even brief periods of inulin ingestion had negative impacts on liver metabolism and function in mice with a healthy gut flora.

Hsu, Lin et al. (2018) conducted a study found that giving probiotics or prebiotics to mothers protects adult male rat offspring from developing blood pressure due to high fructose consumption throughout lactation and pregnancy. Hypertension has been associated with excessive fructose intake. It is hypothesized that the intestinal bacteria and its metabolites contribute to the emergence of hypertension. They investigated whether a high-fructose (HF) intake in the mother led to planned hypertension in adult male offspring by altering gut microbiota, modifying SCFAs and their receptors, and affecting nutrient-sensing signals. The next objective was to determine whether treating the intestinal microbiota early on with the probiotic inulin and the prebiotic lactobacillaceae may prevent maternal HF-induced high blood pressure. During gestation and breastfeeding, pregnant rats were given either a 5 percent w/w long chain inulin diet (high fructose + probiotic) or a 60 percent high-fructose (HF) diet with 2 108 CFU/day lactobacillaceae through oral gavage. A total of four groups—control, high fructose, high fructose + prebiotic, and high fructose + probiotic—of male offspring (n = 7-8) were each given one of the three treatment options. Rats were exterminated at the stage of 12 weeks. Male adult offspring born to mothers who consume fructose are shielded against hypertension by the prebiotic inulin therapy and maternal probiotic lactobacillaceae. Probiotic therapy reduces High Fructose induced high blood pressure by reducing plasma acetate levels and Olfr78 renal mRNA expression. The High Fructose induced drop in Frar 2 expression was reversed by prebiotic therapy, which also boosted plasma propionate levels. The gut microbiota of adult offspring is long-term programmed by the mother's high fructose diet. Probiotic and prebiotic therapy both reduced blood pressure, but they did so in distinct ways via regulating the micro biota. As a result of the maternal HF diet, the probiotic Lactobacillaceae therapy avoided the development of hypertension. Reprogramming techniques to avoid hypertension caused by a high-fructose diet could include maternal gut micro biota-targeted medications.

Pouille et al., (2022) analyzed the effects and effectors of chicory as Functional Food numerous researches have examined the impact of industrial chicory on human health, the majority of which report clinical observations. Regardless of whether the root is roasted, the powder made from the chicory roots, or the various chemicals that make up the chicory plant, understanding the biochemical reactions that act primarily on human beings is still insufficient. Three compounds or groups of active ingredients in Cichorium intybus are sesquiterpene lactones, chlorogenic acid and fructose were the focus of this investigation. Nutrigenomic research, a physiological hormone analysis, and an intestinal microbiota analysis were conducted out on the transgenic mice during research, along with in vitro experimental results for various tests. They have outlined numerous impacts of all these types of compounds, including anti-inflammatory, pro-apoptotic activity, antibacterial, antioxidant, hypoglycemic and hypolipidemic effects, as well as a significant function in appetite regulation. Additionally, a considerable prebiotic action was observed. Approximately 83% of the documented responses are attributed to fructose, which appears to be mostly involved in these functions. With a calculated contribution of 23-24%, the other types of investigated molecules have likewise shown a specific involvement in these various impacts.

Meena et al., (2022) conducted research on evaluation of phytochemicals, antioxidants property and effects of Cichorium intybus cultivated at foothill area of Uttarakhand on hyperglycemic rat found that the essential traditional medicinal herb Cichorium intybus is utilised in the Unani, Ayurvedic, and Siddha traditions of medicine to treat disorders of the skin, liver, stomach and kidneys. Additionally, it serves as a blood purifier, antipyretic, and antibiotic. Highly reactive oxygen or Free radicals' species are susceptible to causing oxidative damage to human cells and organs, which can lead to a variety of degenerative disorders. The purpose of the research was to identify the phytochemicals, assess the antioxidant effects, and investigate the effects of Cichorium intybus, a plant grown in the mountains of Uttarakhand, on diabetic mice. Furthermore, the Cichorium intybus' antioxidant constituents were identified. Although Chicory's leaves and roots both are high in phytochemicals and antioxidant compounds, there is a substantial (P 0.05) difference in the active ingredient potential, between the two parts of the plant. On hyperglycemic rats, the plant's leaf extract also produced effects that were significantly significant (P 0.05). Thus, the root and leaf of the chicory plant may both be used to prevent and cure hyperlipidemia, hyperglycemia, maintain normal blood biochemical parameters, and decreased levels of oxidative stress in humans.

Tian et al., (2022) conducted research on overall structural alteration of gut microbiota and relationship with risk factors in patients with metabolic syndrome treated with inulin alone and other agents, a pilot study with an open label indicated that the human gastrointestinal microbiome has not been fully studied in relation to the relevance of some prebiotic items, such as inulin, and some medications. In this study, the effectiveness of utilising inulin either alone or in combination with other therapies to alter the human gut microbiome populations in people with metabolic syndrome (MetS) was examined. The researchers analyzed whether alterations in the gastrointestinal milieu are associated with variability in a variety of clinical parameters in the aftermath of intervention. In this single-center, single-blinded, randomised community-based pilot trial, 60 patients with MetS were randomly assigned to receive either inulin plus metformin, inulin plus traditional Chinese medicine and simply inulin for six months. The patients were 46.3 years old on average, and 43% of them were men. Venous blood specimens were taken after an overnight fast of 8 hours were analysed for blood glucose, blood lipid profiles and uric acid levels at baseline and the completion of the follow-up phase. Through 16S RNA amplicon sequencing, the microbiota in stool samples were taxonomically analysed. At six months, data on the microbiome and responsiveness were incorporated into an integrative assessment. The 16S rRNA sequencing results showed that inulin resulted in a higher fraction of Bifidobacteria at the conclusion (p=0.024) compared to inulin + metformin, inulin + TCM. More streptococcus (p=0.001), Holdemanella (p= 0.011) and Romboutsia (p=0.043) were found in samples of inulin+TCM and inulin+metformin. They also discovered associations between the gut microbiota and lipids, UA, and glucose that affect MetS progression. Inulin either alone or in combined with metformin or TCM affected specific gut microbial taxa differently between the groups, but the overall diversity was unaffected. As a result, they investigated microbiota-related metabolites

that could reveal additional information regarding intrinsic differences. As just a conclusion, a reliable approach for treating metabolic syndrome might be established in the future.
Moradi, Javidan et al. (2013) study's goal was to see how probiotic cheese (PCh) and chicory root extract (CRE) intake affected lipid profiles in a wide group of people. The 7-week experiment included 180 individuals with high cholesterol levels. The study divided participants into three groups of 60 people using random sampling technique. G1 was given 30 g of PCh + CRE on a daily basis, whereas G2 received 30 g of PCh only. The third group, which served as the placebo group, received Control. The probiotic bacteria in the items were Lactobacillus acidophilus LA5 and Bifidobacterium lactis. The research revealed that both intervention groups experienced a significant improvement: G1 . G2 participants showed comparable advancements. All parameters, with the exception of TGL of G2 2, showed significant improvements when both groups' results were contrasted with those of the placebo group.
Jurgoński, Milala et al. (2011) determined the chemical composition and constituents of various chicory plant parts, particularly their inulin and phenolic components. Roots of the plant had high levels of inulin, with degrees of polymerization ranging from 3 to 10, While phenolics were detected in concentrations ranging from 0.5 - 1.7 g per 100 g of fresh bulk. Similar composition was also found to be present for the peel of the plant. Lead and seed in extracted forms had significantly lower inulin mass fractions while the phenolic fractions were significantly higher. Additionally, Wistar rats fed high fructose and saturated fat diets were used to study the biological properties of a non-inulin component from each extract. Each diet contained same amount of inulin (6%) but different phenolic fractions. After being treated for a period of 4 weeks, the caecum's microbial enzymatic activity changed when it was fed a diet comprising phenolic contents generated from peel and seed extracts as well as a diet containing leaf extract. In rats served the meal boosted with root extract, the content of acetate in the food drastically decreased. Peel and leaf extracts significantly increased the blood antioxidant potential of lipophilic substances when added to fructose diets.
The purpose of the research conducted by Lepczyński, Herosimczyk et al. (2021) was to determine supplementary effects of chicory root containing inulin on different parameters in a pig trial. 24 pigs divided into three, G1 (n = 8): fed a baseline diet also known as the Control group. Two other experimental groups (G2) consuming 2% inulin in addition to basal diet and G3 consumed 4% dried chicory root. The trial continued for 40 days before the final readings of the responses were collected. In neither the Control group nor the treatment group did the liver tissues exhibit any evident morphological alterations. Treatment group supplementation enhanced the equilibrium of oxidative species in blood plasma. Chicory diet increased Ca (P=0.001), K (P=0.05), and decreased cadmium (P=0.05) levels in the liver when compared to Control. Chicory root contains inulin, which increased the amounts of Se and salt while lowering the population's Zn content. Furthermore, pigs fed the CR diet had kidneys with a higher lead content (P=0.05).

III. MATERIALS AND METHODS

Study Site

The study was conducted in Lady Reading Hospital (OPD & IBP) Peshawar. Patients were enrolled after having their consent.

Ethical Approval

The ethical approval was received from the ethical committee Department of Human Nutrition, The University of Agriculture Peshawar.

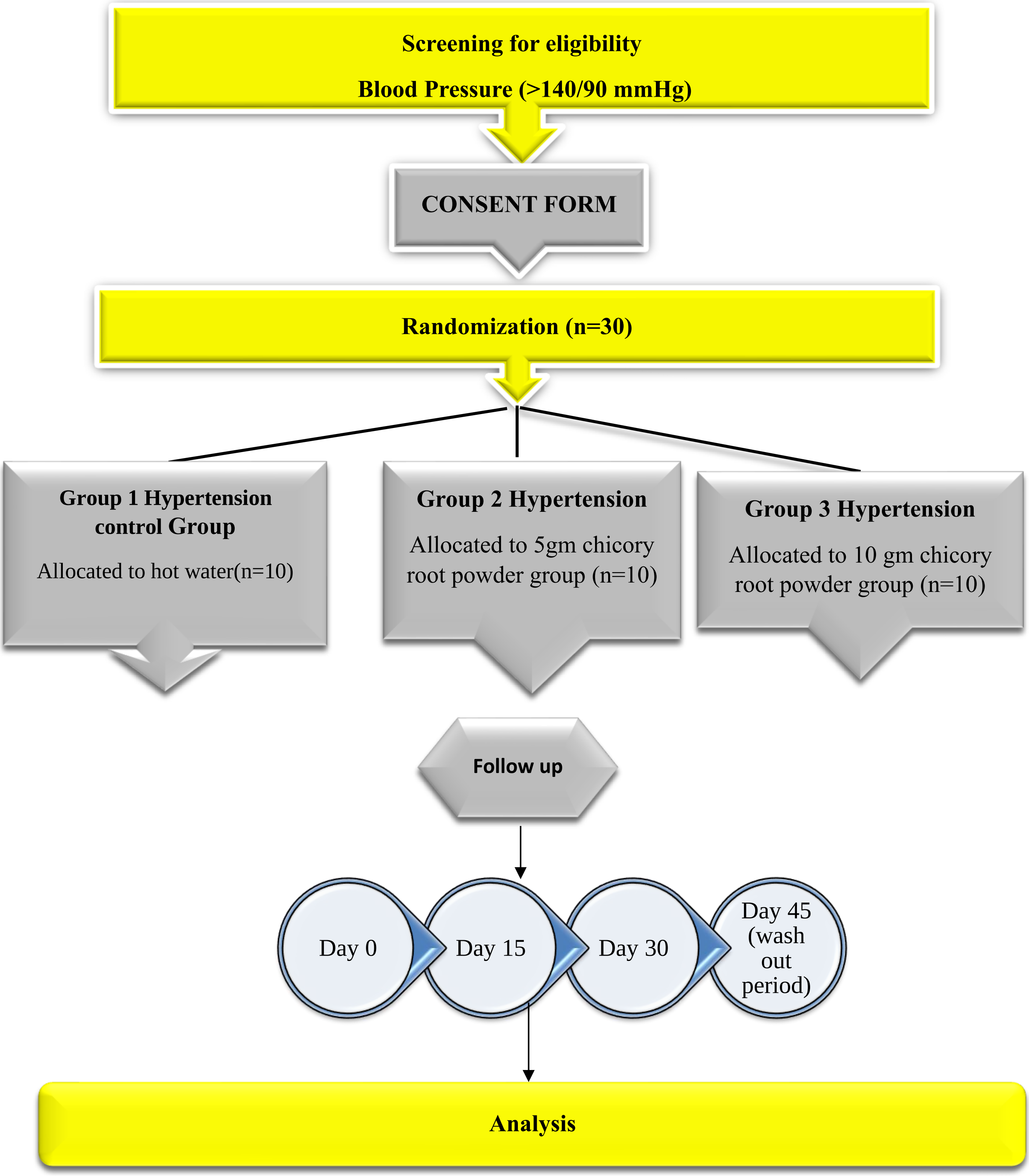
Inclusion Criteria

Patients who were already diagnosed for hypertension age ≥ 40 years and have elevated level of cholesterol, LDL and HDL, regardless of gender, and regularly visiting the study site for follow-up and checkup were enrolled.

Exclusion Criteria
This study excluded patients with diabetes, cardiovascular disease (CVD), chronic kidney disease (CKD), and other chronic medical conditions.

Study Design

Figure A



This study was a controlled randomized clinical trial with a single blind Control. A sample of total 30 hypertensive patients with elevated lipid profile were enrolled for this study. The participants were allocated into three groups randomly such as group-1, group-2 and group-3. Each group comprised 10patients. The group 1(Control group) received simply hot water, while group 2 received 5 g of chicory root powder and group received 10 g of chicory root powder. Chicory root powder was given for 30 days. The dosages were given to the groups in the following order.

1) Group 01: Control group participant was receiving simple hot water.
2) Group 02: Receive 05 gm. chicory root powder.
3) Group 03: Receive 10 gm. chicory root powder.

The participants were receiving various doses of chicory root powder in hot water. The cholesterol, LDL and HDL were measured on days 0, 15, and 30. For wash out period this assessment was done on day 45.

Data collection

Both objective and subjective data was obtained using pre-designed questionnaires (Annexure-I) and laboratory tests. The questionnaire contained the following parameters,

i. Blood Cholesterol
ii. Blood pressure
iii. Socio-demographic characteristics

Before and after the intervention, blood pressure data was recorded using a sphygmomanometer. Blood serum levels and anthropometric measurements, including as weight, height, waist circumference, and waist-to-hip ratio, were taken on Days 0, 15, 30, and 45. A pre-designed questionnaire (Annexure-I) was used to know about lifestyle and dietary recall. A weight machine was used to determine the weight. Cholesterol, LDL and HDL level was determined in the human nutrition lab of AUP using micro lab.

Metabolic indicators:

Total cholesterol:

Total blood cholesterol is comprised of LDL cholesterol, HDL cholesterol, and TGL.

Blood Sample Procedure

Patients' blood was transfused at random. Collection of the blood (5 ml) was performed in gel vials. Inspection of blood was carried out in antiseptic environment. After centrifuging the samples at an appropriate rpm for specified time, the serum was stored for further analysis. Spectra analysis was performed through spectrophotometer to study lipid profile.

Cholesterol Determination

To determine cholesterol, the enzymatic calorimetric technique specified in the release of the national cholesterol education application record in 1988 was employed. A spectrophotometer (S-200D) and a DiaTech kit (TV-001-CE-004) were employed. As a consequence, cholesterol was detected following enzymatic hydrolysis and oxidation.

Chemical Composition

1.**Mono reagent**

4-Aminoantipyrine	0.25 mmol/l
Phosphate buffer (pH 6.5)	30.0 mmol/l
Phenol	25.0 mmol/l
Cholesterolesterase	> 150.0 U/l
Peroxidase	> 5.0 KU/l
Cholesteroloxydase	> 100.0 U/l
Sodium azide	< 0.01 %
2.Standard	200mg/dl or 5.17 mmol/l

3.5.2 Procedure

The solutions were made, the spectrophotometer's wavelength was set to 500nm, and a 1cm mild cuvette was utilized 1000l of chemical cholesterol was piped into all check tubes, a 10l dose was injected into a standard tube, and a 10l sample was divided into several tubes and blended. In 37 emanzini bath water, all test tubes are simmered for 10 minutes. After incubation, the spectrophotometer's absorption was set, and sample and rate values were taken.

Determination of HDL

Cylomicrons. LDL (low desity lipoprotein) and VLDL (low density lipoprotein) are due to the inclusion of phosphotungstic acid and magnesium chloride. After incorporation, a portion of the clean supernatant fluid contained HDL, which was analysed for HDL (high density lipoproteins), cholesterol reagent was used for further HDL Cholesterol testing.

Reagent

Magnesium Chloride	25 mmol/l
Phosphotungstic acid	0.55 mmol/l

Preparation of Solution

1.The precipitant is ready to be used.
2.When stored at + 18 - 22°C, it was last until the expiration date.

Procedure

Procedure was performed in two steps

Step 1

Precipitation

Through pipette, 200 l samples and 500 l precipitant were placed into centrifuge tubes. These are mixed and left at ambient temperature for 10 minutes before centrifuged at 4000 rpm for 10 minutes. Within two hours of centrifugation, the supernatant was removed, and HDL cholesterol was determined using the Lopes-Virella method (1977)

Step 2

The wavelength of the spectrophotometer was set at 546 nm, and 1cm of light intensity was applied. A 100 l supernatant was pumped and mixed into test tubes. The absorption of the sample and the level towards the empty reagent was measured after incubation at 10 to 37 °C.

Powder Preparation

Fresh chicory root was obtained from Malakander farms. After that, the washing and cleaning process, followed by the drying phase. After that, the chicory root was chopped into slices. For hot air drying, the chopped chicory root was placed in an oven for 24 hours at a temperature of 50°C. Then, it was ground into a fine powder and was pour into an airtight jar. With the assistance of experts from the Human Nutrition Lab, the powder was packed into sachets in various amounts as specified for use on patients.

Blood Pressure

A subject was invited to sit and their arm was flexed. Ensure that the flexed elbow is level with the heart. An appropriately sized approximately blood pressure cuff was utilized to begin the blood pressure measurement. The lower edge of the cuff should be one inch above the antecubital fossa as it wraps around the upper arm. Blood pressure was measured with the use of a stethoscope. Observed the sphygmomanometer and listened with the help of stethoscope. The initial sound was systolic pressure, and when it stops, it was diastolic, such as (120/80).

Anthropometric status

Body measurements was taken by anthropometric status based on weight, height, waist circumference, and hip circumference.

A standardized weighing scale was used to determine weight. Heavy clothing and additional clothing were removed before stepping on the weighing scale. The person was standing straight and still with his or her legs firmly planted. The weighing scale calculated the weight to the closest 0.1 kg and produced an individual weight.

A stadiometer was used to measure height. First and foremost, the person was requested to remove their shoes and step on the scale. His or her feet was pressed together and firmly against the stadiometer. The head and back was in contact with the stadiometer and was remain straight. The head part was pulled closer to the head and gently rubbed against it. The height was measured to the closest 0.1 cm. The BMI (Body Mass Index) was computed using the formula kg/m, and categories was created based on the following values: normal is 18.5-24.9, overweight is 25-29.9, obese is 30 and severely obese is 40.

A non-stretchable measuring tape was used to measure waist circumference, which were begun at the top of the hip bone. The measuring tape was wrapped completely around the body and levelled with the navel. Make sure the tape is in a straight position and is rounded, not too tight or loose. No one was urged to hold his or her breath. The measurements were in centimeters. A measuring tape was brought and wrapped around an individual's hips to determine hip circumference. The hips' widest point was chosen. The readings in cm were recorded and written down. Using the formula Waist in centimeters/Hip in cm, the waist to hip ratio was computed. Both male and female cutoff values for the W/H ratio was used. For female it is 20.85 cm while for male it is 20.90 cm 2011. Patients was classified as "central obesity" if their waist-to-hip ratio cutoff values was higher than the specified values. Statistics from the year 1990 (National Center for Health Statistics)

Statistical Analysis

Data was analyzed to know the effect of chicory root on systolic BP, diastolic BP, serum cholesterol, serum LDL and serum HDL while providing their different doses. Paired-t test was used for the comparison of Total cholesterol and blood pressure at day 0, 15, 30 and 45. One-way ANOVA was applied comparison of cholesterol, LDL, HDL of the three groups. The mean and standard deviation were calculated using a descriptive statistic. SPSS 21.0 and Microsoft Excel were used for analyzing the data.

IV. RESULTS AND DISCUSSION

Chicory root powder has long been used as a home treatment for several diseases. Research was intended to determine the blood pressure and total cholesterol lowering impact of chicory root powder in different doses, with the null hypothesis that chicory root powder had no combinatorial effect on lowering blood pressure and total cholesterol level. This study included 30 hypertension individuals in total. All subjects signed the consent form. The anthropometric data was gathered using a pre-designed questionnaire. They were all randomly allocated to one of three groups (Figure 1). At three distinct periods, all individuals were evaluated for cholesterol testing and anthropometry parameters. 0 days, 15 days, 30 days, and 45 days were followed by a blank interval. In terms of anthropometric indices, the entire therapies reduce waist circumference, waist to hip ratio, BMI, and love handlers considerably. The values were all displayed as means with standard deviations. SPSS software (Statistical social packages for social sciences version 21) and MS Excel 2021 were used to analyse the data. All essential tests, such as the paired t-test for analysis, were carried out. The outcome is provided and discussed in depth below:

Table 01: Overall characteristics of sociodemographic of respondents

Variable	Category	Mean ± SD/Frequency (Percentage)		
		Control	Treatment A	Treatment B
Age	-	50.20 ± 7.81	47.30 ± 8.62	52.90 ± 7.62
Gender	Male	06 (60%)	07 (70%)	05 (50%)
	Female	04 (40%)	03 (30%)	05 (50%)
Residence	Rural	03 (30%)	06 (60%)	04 (40%)
	Urban	07 (70%)	04 (40%)	06 (60%)
Family type	Joint	06 (60%)	05 (50%)	07 (70%)
	Nuclear	04 (40%)	05 (50%)	03 (30%)
Education	Literate	06 (60%)	08 (80%)	06 (60%)
	Illiterate	04 (40%)	02 (20%)	04 (40%)
Occupation	Employed	04 (40%)	06 (60%)	05 (50%)
	Unemployed	06 (60%)	04 (40%)	05 (50%)

Descriptive results are presented in the form of Mean ± SD or frequency (percentage)

Socio-demographic data is an important contributor in all sorts of researches as it gives us the information about the baseline of study participants and their day to day living. Data on the social demographic of this study is provided in table 01. Mean age of the study respondents was 50.20 ± 7.81, 47.30 ± 8.62 and 52.90 ± 7.62 for Control, Treatment A and Treatment B, respectively. Further, most of the study respondents were male (60%) with a mixed residence. Further, the trend of living in joint families was greater as 60% Control, 50% Treatment A and 70% Treatment B respondents reported to be living in joint families. In addition, literacy rate was greater among study participants (60% Control, 80% Treatment A and 60% Treatment B) while the status of employment was mixed (Table 01). According to researchers, sociodemographic variables may influence adherence through impacting an individual's capacity to gain knowledge, interact successfully with their health care providers, and get appropriate social support surrounding their illness (Emery, Woodhead et al. 2010). Liew, Lee et al. (2019) studied the association between sociodemographic factors and prevalence of hypertension among 10215 respondents and found close association of the involved sociodemographic in the prevalence of hypertension. Therefore, our study included sociodemographic factors of the study respondents to attain a basic idea of the background of the respondents in consideration.

Table 02: Lifestyle and medical history of respondents

Variable	Category	Mean ± SD/Frequency (Percentage)		
		Group 1	Group 2	Group 3
Hypertension	No	0 (0%)	0 (0%)	0 (0%)
	Yes	10 (100%)	10 (100%)	10 (100%)
Smoking	Non smoker	10 (100%)	05 (50%)	10 (100%)
	Past Smoker	0 (0%)	03 (30%)	0 (00%)
	Current	0 (0%)	02 (30%)	00 (00%)
Any other medical condition	Yes	0 (0%)	0 (0%)	0 (0%)
	No	10 (100%)	10 (100%)	10 (100%)
Anxiety/Depression	Yes	1(10%)	06(60%)	04(40%)
	No	09(90%)	04(40%)	06(60%)
Junk food	Yes	03 (30%)	04 (40%)	04 (40%)
	No	04 (40%)	03 (30%)	03 (30%)
	Both	03 (30%)	03 (30%)	03 (30%)
	Yes	0 (00%)	0 (00%)	0 (00%)

Any hyperlipidemic medicine intake	**No**	10 (100%)	10 (100%)	10 (100%)
Physical activity	**Sedentary**	8 (80%)	5 (50%)	9 (90%)
	Moderate	2 (20%)	3 (30%)	1 (10%)
	Active	0 (0%)	2 (20%)	0 (00%)
	Very active	0 (0%)	0 (0%)	0 (0%)

Descriptive results are presented in the form of Mean ± SD or frequency (percentage)

Data on the lifestyle and medical history of the respondents was also collected and through simple descriptive statistics, the analysis was made. Results for the lifestyle and medical history of the respondents is presented in table 02. All of the respondents of the study belonging to each group were hypertensive. Majority of the participants (83%) were non-smokers while all of them had no other medical condition associated with hypertension. The status of anxiety and depression was mixed with no anxiety among 90% Control, 40% Treatment A and 60% Treatment B respondents. Junk food consumption was also found to be mixed with the presence of at least some degree of consumption among participants of each group (Table 02). Before the start of study, the participants of the study were made to stop taking any hyperlipidemic drug and their whole dependency was on the chicory root powder treatment. A sedentary lifestyle was observed among 80% participants of Control group, 50% of treatment A group and 90% of treatment B group. Winnicki, Somers et al. (2006) found that individuals with a family history of hypertension reported more unpleasant lifestyles (P = 0.004) and higher clinic and ambulatory blood pressures (P = 0.03) than those without a family history of hypertension. Male gender (P = 0.003) and age (P = 0.02) were also predictors of lifestyle impairment. Adopting an unhealthy lifestyle was associated with an increased chance of acquiring chronic hypertension (P = 0.04). Similarly, Payab, Kelishadi et al. (2015) found a significant association between the consumption of Junk foods and the negative changes in the BP levels of individuals. These trends reported by literature support the medical history and lifestyle data collected and interpreted in our study.

Table 03: Anthropometric Characteristics of the Enrolled subjects

Characteristics	Mean ± SD Control	Mean ± SD Treatment A	Mean ± SD Treatment B	P- value
Weight of patient (Kgs)	74.90 ± 10.79	78.20 ± 13.38	66.40 ± 13.46	0.11
Height of patient (cm)	169.02 ± 8.32	172.38 ± 7.34	166.31 ± 10.83	0.33
Body mass index (BMI)	26.12 ± 2.33	26.26 ± 4.17	23.92 ± 3.90	0.27
Waist circumferences (cm)	89.80 ± 7.55	91.70 ± 8.85	87.70 ± 7.11	0.53
Hip circumferences (cm)	98.91 ± 2.33	100.11 ± 2.39	99.68 ± 3.94	0.66
Waist/hip ratio	0.90 ± 0.08	0.91 ± 0.08	0.88 ±0.085	0.67

Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder

Anthropometric data is an important aspect of nutritional sciences which indicates the baselines characters as well as the level of consumer fitness among a study population. Data on the anthropometry of the study respondents is presented in table 02. Weight of the respondents was recorded as 74.90 ± 10.79, 78.20 ± 13.38 and 66.40 ± 13.46 for Control, treatment group A, and treatment group B. Mean score for height (cm) of the patients were 169.02 ± 8.32 for Control, 172.38 ± 7.34 for treatment A and 166.31 ± 10.83 for treatment B. BMI, waist circumference, hip circumference and WHR (waist to hip ratio) also showed similar differences in the mean scores of the 3 treatment groups. 26.12 ± 2.33, 26.26 ± 4.17 and 23.92 ± 3.90 were the recorded scores for BMI; 89.80 ± 7.55, 91.70 ± 8.85 and 87.70 ± 7.11 were the recorded scores for waist to hip ratio; 98.91 ± 2.33, 100.11 ± 2.39 and 99.68 ± 3.94 were the recorded scores for hip circumference; 0.90 ± 0.08, 0.91 ± 0.08 and 0.88 ±0.085 were the recorded mean scores for WHR for Control, treatment A and treatment B, respectively. All of the mean scores presented in different parameters of the anthropometric data showed a non-significant (p>0.05) difference between the different study groups which confirmed the baseline homogeneity among the study groups.

Table 04: Comparison of Systolic Pressure of 05 gm Chicory root powder at different interval

Period in days	**Mean systolic Pressure of Control Group**				Period in days	**Mean systolic Pressure of Treatment A Group**			
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	158.00 ± 14.75	5	1.04	3.16	00	173.00 ± 20.02	-23	3.53	-13.2
45	163.00 ± 15.67				45	150.00 ± 14.14			
00	158.00 ± 14.75	-1	0.17	0.63	00	173.00 ± 20.02	-36	5.51	-20.8
30	157.00 ± 16.36				30	137.00 ± 14.18			
00	158.00 ± 14.75	1	0.17	0.63	00	173.00 ± 20.02	-14	1.80	-8.09
15	159.00 ± 20.24				15	159.00 ± 20.24			

Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of ***Systolic Blood Pressure*** *over the different time period.*

The effects of Control and different treatment groups were studied on the blood pressure of the study respondents. The effects on the systolic blood pressure are presented in table 04, 05 and figure 01. Data presented in table 04 revealed that Control group did not have any significant change in their systolic blood pressure in a span of 30 days as well as in the washout period (45th day). T-value scores of the tested time interval for Control are lower than 1.96 which is the threshold of significance at a 95% CI. Mean score recorded at 0 day was 158.00 ± 14.757 which reduced to 157.00 ± 16.364 at the final day of treatment and was recorded as 163.00 ± 15.670 after a 15-day washout period (at 45th day). On the other hand, Treatment group A showed a slight change in the mean score from day 0 (173.00 ± 20.02) to day 15 (159.00 ± 20.24) which was statistically non-significant. Onwards from there, the change recorded on 30th day was 137.00 ± 14.18 which was statistically different from the baseline. Further, at the end of washout period (45th day) the mean value score for systolic blood pressure was 150.00 ± 14.14 which was significantly different from baseline however, it revealed a rise in the systolic blood pressure after stopping the treatment in group A (Table 04).

Table 05: Comparison of Systolic Pressure of 10 gm Chicory root powder at different interval

Period in days	**Mean Systolic Blood Pressure of Control Group**				Period in days	**Mean Systolic Blood Pressure of Treatment B Group**			
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	158.00 ± 14.75	5	-1.04	3.16	00	171.00 ± 17.28	-26	7.00	-15.2
45	163.00 ± 15.67				45	145.00 ± 17.15			
00	158.00 ± 14.75	-1	0.17	-0.63	00	171.00 ± 17.28	-41	8.94	-23.9
30	157.00 ± 16.36				30	130.00 ± 13.33			
00	158.00 ± 14.75	1	0.17	0.63	00	171.00 ± 17.28	-16	7.23	-9.35
15	159.00 ± 20.24				15	155.00 ± 15.81			

*Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of **Systolic Blood Pressure** over the different time period.*

Table 05 presented data on the systolic blood pressure compared between Control and treatment B group. Results for Control are the same as interpreted in the previous section. Treatment B group in which the participant received 10gm of chicory root for 30 days showed that the baseline mean score for treatment B group was 171.00 ± 17.28 which reduced to 155.00 ± 15.81 within a span of 15 days of treatment. Further, with a treatment of 30 days the mean score of systolic blood pressure reduced to 130.00 ± 13.33 in treatment B group. The effects were significant as the observed t-values for both time intervals were above 1.96. After stopping the treatment in group B, the mean score for systolic blood pressure was found to be raised again to 145.00 ± 17.15. This value was also significantly different between the baseline and the end of washout period. Sedighi, Cheraghi et al. (2021) separated 32 male Wistar rats were into four groups of eight in an investigation. For two weeks, animals in the control group were given normal saline while animals in the Chicory treatment groups were given extract at 25, 50, and 100 mg/kg. Systolic blood pressure was considerably lower in the 50 mg/kg extract-treated group as compared to the control and 200 mg/kg extract-treated groups. Nishimura, Ohkawara et al. (2015) reported that participants with the ADR2 SNP16A/G allele who drank the chicory root extract drink for four weeks had a substantial drop in systolic blood pressure (SBP) compared to the Control group (p = 0.018). These effects of chicory root powder can be attributed to inulin which is one of the major ingredient in the chicory plant. Becerril-Alarcón, Campos-Gómez et al. (2019) conducted a study on the effects on inulin supplementation in women with breast cancer. At baseline, there were 6 women with SBP >130 mmHg in the Control group and 13 in the inulin group. After 21 days of supplementation, the number of subjects with SBP >130.1 mmHg fell from 13 to 10 in inulin supplementary group, but rose from 6 to 8 in the Control group. These effects either with the direct consumption of chicory root powder or with the consumption of inulin contributes significantly to the findings of our study.

Table 06: Comparison of Diastolic Pressure of 05 gm Chicory root powder at different interval

Period in days	**Mean Diastolic Pressure of Control group**				Period in days	**Mean Diastolic Pressure of Treatment A Group**			
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	95.00 ± 10.80	1	0.24	1.05	00	103.00 ±8.23	-2	0.39	-1.94
45	96.00 ± 6.99				45	101.00 ±11.00			
00	95.00 ± 10.80	2	1	2.10	00	103.00 ± 8.23	-27	10.37	-26.21
30	97.00 ± 8.23				30	76.00 ± 6.99			
00	95.00 ± 10.80	4	1.30	4.21	00	103.00 ± 8.23	-16	7.23	-15.53
15	99.00 ± 9.94				15	87.00 ± 6.74			

*Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of **Diastolic Pressure** over the different time period.*

Diastolic BP of the respondents was also measured in response to different type of treatments provided to the groups. Data presented in table 06 showed that Control group had a mean diastolic BP of 95.00 ± 10.80 at baseline. At 15th day of treatment, the Control group showed a mean score of 99.00 ± 9.94 which indicate a slight increase in the diastolic BP. With progression of treatment the recorded mean score at 30th day was 97.00 ± 8.23 for the Control group. Further, at the end of washout period, the mean score for Control was 96.00 ± 6.99. Control had an overall non-significant effect on the diastolic BP of the patients. Treatment group A showed a mean score of 103.00 ± 8.23 for diastolic BP at the baseline. At 15th day of treatment 87.00 ± 6.74 was the recorded mean score which showed a significant change on the 15th day of treatment by group A. At 30th day of treatment, the diastolic BP reduced further and showed a mean score of 76.00 ± 6.99 which was significantly different from the baseline mean score. After that, the 15 day wash out period (till 45th day) a rise was recorded in the diastolic BP which was so close to the baseline that a non-significant difference was observed between the mean score at 45th day (101.00 ±11.00) and at baseline.

Table 07: Comparison of Diastolic Pressure of 10 gm Chicory root powder at different interval

Period in days	**Mean Diastolic Pressure of Control group**				Period in days	**Mean diastolic Pressure of Treatment B Group**			
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	95.00 ± 10.80	1	0.24	1.05	00	98.50 ± 14.15	-0.5	-0.11	0.50
45	96.00 ± 6.99				45	99.00 ± 8.75			
00	95.00 ± 10.80	2	1	2.10	00	98.50 ± 14.15	-23	5.35	-23.3
30	97.00 ± 8.23				30	75.50 ± 5.98			
00	95.00 ± 10.80	4	1.30	4.21	00	98.50 ±14.15	-14.5	3.31	-14.7
15	99.00 ± 9.94				15	84.00 ± 6.99			

Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of ***Diastolic Blood Pressure*** *over the different time period.*

Table 07 presented the results of group comparison between Control and Treatment B on the diastolic BP of the respondents. The mean score and trends presented by Control are already explained in the earlier section. Treatment group B showed a mean score 98.50 ±14.15 at the baseline. With treatment of 10g chicory root powder the diastolic BP was found to be reduced at 15th and 30th day of treatment. Mean scores recorded at 15th and 30th day were 84.00 ± 6.99 and 75.50 ± 5.98, respectively. It was eminent from these results that Treatment group B had a significant effect on the diastolic BP of the respondents which was time dependent. T-value of 3.31 at 15th day and 5.35 at 30th day of treatment confirmed the significance of these results. Moreover, it was also found that after stopping the treatment and continuing the diastolic BP recorded at 45th day (washout period) caused a rise in the diastolic BP of the study respondents with a mean score of 99.00 ± 8.75 which was even a greater score as compared to the one recorded at baseline. In his study, Becerril-Alarcón, Campos-Gómez et al. (2019) found that the core ingredient in chicory root powder (inulin) was involved in mitigating the DBP among women with breast cancer. The number of patients with DBP more than 90 mmHg rose (n=4) in the Control group; whereas, in the inulin group, the majority stayed below 90 mmHg (n=18). While studying the effects of chicory root powder on the hypertension of individuals, Sedighi, Cheraghi et al. (2021) also reported a decrease in the DBP levels in the 50 mg/kg extract-treated group as compared to the control and 200 mg/kg extract-treated groups with a treatment time of 14 days. However, Nishimura, Ohkawara et al. (2015) found no significant differences in the mean DBP either among the Control group or the chicory treatment group for a period of 4 weeks. Mean scores for DBP among Control were 75.3 ± 2.23 and 75.35 ± 2.44 at the beginning and end of treatment while 74.61 ± 2.21 and 74.88 ± 2.09 were the recorded mean scores for the chicory treatment group consuming 300ml chicory root extract per day. Although, available literature did not find sufficient evidence on the decrease in the DBP with the consumption of chicory root powder, the amount consumed in these studies is relatively low as compared to the once consumed in our study which can be the possible reason for the significant effects of chicory root powder on the DBP in our studies.

Table 08: Comparison of serum cholesterol of 05 gm Chicory root powder at different interval

Period in days	**Mean serum cholesterol of Control Group**				Period in days	**Mean serum cholesterol of Treatment A Group**			
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	253.90 ± 36.83	2.59	5.46	2.21	00	287.70 ± 42.35	-20.70	8.54	-7.86
45	256.50 ± 36.58				45	269.80 ± 41.77			
00	253.90 ± 36.83	8.40	4.31	3.20	00	287.70 ± 42.35	-24.60	10.62	-9.35
30	262.30 ± 37.53				30	263.10 ± 43.03			
00	253.90 ± 36.83	3.70	3.85	1.45	00	287.70 ± 42.35	-12.30	8.79	-4.67
15	257.60 ± 36.62				15	275.40 ± 42.64			

Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of ***Serum Cholesterol*** *over the different time period.*

Analysis of lipid profile was also made in response to the provided treatment to the study respondents. Serum cholesterol, HDL and LDL were the studied parameters. Table 08 presents data on the serum cholesterol of the respondents in response to Control and 5g chicory root powder for the time of 30 days. Control group showed significant changes in the serum cholesterol of the respondents with a mixed pattern of increase and decrease throughout the span of study. 253.90 ± 36.83 was the mean cholesterol score recorded for Control group at the baseline (Day 0). Treatment with Control for 15 days caused a slight increase in the serum cholesterol with a mean score of 257.60 ± 36.62. At 30th day of treatment, Control group revealed a mean score of 262.30 ± 37.53 which again revealed the trend of increase in mean cholesterol. After the end of treatment, the washout period score recorded at 45th day was 256.50 ± 36.58 which was lower than the mean score recorded at 30th day of treatment but greater than the baseline score. Treatment A group which consumed 5g of chicory root powder for its therapeutic effect showed a mean score of 287.70 ± 42.35 for serum cholesterol at the baseline. Mean score recorded at 15th day of treatment for Treatment A group was 275.40 ± 42.64 and at 30th day of treatment was 263.10 ± 43.03 which indicated a time dependent therapeutic effect of chicory root powder against serum cholesterol levels of study respondents. These effects were significant based on the t-value scores (>1.96) and were increasing with an increase in days of treatment. With the stoppage of treatment at 30th day and the recording of serum cholesterol at 45th day (washout period) it was noted that the serum cholesterol showed a slight rise in the mean score (269.80 ± 41.77) as compared to the score recorded at 30th day of treatment.

Table 09: Comparison of serum cholesterol of 10 gm Chicory root powder at different interval

Period in days	**Mean serum cholesterol of Control Group**				Period in days		**Mean serum cholesterol level of Treatment Group B**		
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	253.90 ± 36.83	2.59	5.46	2.21	00	297.70 ± 40.28	-37.4	35.06	-14.63
45	256.50 ± 36.58				45	260.00 ± 38.67			

00	253.90 ± 36.83	8.40	4.31	3.20	00	297.70 ± 40.28	-42.1	45.54	-16.47
30	262.30 ± 37.53				30	255.60 ± 38.70			
00	253.90 ± 36.83	3.70	3.85	1.45	00	297.70 ± 40.28	-21.6	29.45	-8.45
15	257.60 ± 36.62				15	277.20 ± 39.63			

Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of ***Serum Cholesterol*** *over the different time period.*

Table 09 contain data on the effects of Control and 10g chicory root powder on the serum cholesterol levels of study respondents. The effects of Control are the same as the one provided in table 08 which are explained in the earlier section. Treatment group B which consumed 10g chicory root powder for its therapeutic effect on the serum cholesterol level revealed a mean score of 297.70 ± 40.28 at day 0. With a treatment of 15 days, the mean score showed a decline and the recorded value was 277.20 ± 39.63. Further, at 30th and final day of treatment, the recorded mean score was 255.60 ± 38.70 which revealed a greater decline than the one recorded at 15th day of treatment in comparison to the baseline mean score. From this, it is made clear that 10g chicory root powder had a significant effect on the serum cholesterol level of the respondents. T-values recorded at 15th and 30th day were 29.45 and 45.54, respectively. After stopping the treatment with chicory root powder a recording of the mean score was made on 45th day with the purpose to find the effects of the 15 day washout period. The mean score recorded was 260.00 ± 38.67 which was found to be greater than the one recorded at the final day of treatment. Babaei, Forouzandeh et al. (2018) evaluated the effects of chicory extracts on the oxidative stress and lipid profile of patients with chronic periodontitis in an 8 week RCT (Double Blind). Participants of the study consumed 1g chicory leaf extract twice a day. There were no significant changes in total cholesterol (TC) between the two groups at baseline ($p<0.094$), however there were substantial decreases in TC in the intervention group post intervention (168.00 ± 48.59 vs. 201.65 ± 58.22 mg/dL) compared to their baseline values. Another study conducted by Ghaffari, Rafraf et al. (2019) considered 92 respondents in a double blind clinical trial to compare the effects of different strategies against fatty liver diseases (Non-alcoholic). Among the study participants, one group was supplemented with chicory seed (9g/day) for an intervention period of 12 weeks. Chicory seed group revealed a significant reduction in the serum cholesterol levels as compared to the Control or control group. However, Nishimura, Ohkawara et al. (2015) reported a non-significant decline (At baseline: 222.29 ± 6.63; At 4th week: 222.87 ± 5.98) in the serum cholesterol levels while feeding chicory root extract (300ml/day). Findings of these researches made it clear that consumption of chicory extract is beneficial in mitigating the total cholesterol levels but the dosage is an important factor. As shown in our study, the greater dose was more effective against total serum cholesterol which is supported by the available literature.

Table 10: Comparison of Low-density lipoprotein level of 05 gm Chicory root powder at different interval

Period in days	**Mean low density lipoprotein of Control Group**				Period in days		**Mean Low density lipoprotein level of Treatment Group A**		
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	156.10 ± 21.39	-2.4	3.207	-1.53	00	158.00 ± 24.40	-11.8	15.5	-7.46
45	153.70 ± 22.05				45	146.20 ± 23.28			
00	156.10 ± 21.39	-5.3	10.69	-3.39	00	158.00 ± 24.40	-14.4	18.1	-9.11
30	150.80 ± 21.72				30	143.60 ± 23.47			
00	156.10 ± 21.39	-2.6	6.5	-1.66	00	158.00 ± 24.40	-6.6	16.5	-4.17
15	153.50 ± 21.12				15	151.40 ± 23.47			

*Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of **Low-Density Lipoprotein Level** over the different time period.*

Another important parameter among the lipid profile was the LDL which contributes to the health of an individual. Table 10 compared the results obtained from the efficacy of Control and Treatment A group which consumed 5g chicory root powder. Recorded mean score for Control group was 156.10 ± 21.39 at 0 day of treatment. This score was found to be affected significantly throughout the treatment with the span of time. A slight decrease was noticed at 15th day of treatment (153.50 ± 21.12) among participants of Control group which declined a little further at 30th day of treatment (150.80 ± 21.72). These effects were significantly different ($t>1.96$) from the baseline mean score. More, a slight incline was noticed at the 45th day which marked 15 days of the washout period. In comparison, the treatment group A which consumed 5g of chicory root powder showed a baseline mean score 158.00 ± 24.40 for LDL. Treatment with 5g chicory root powder for 15 days showed a significant decline in the mean score of LDL among participants of Treatment group A resulting in a mean score of 151.40 ± 23.47. Continual of this treatment up until 30th day of treatment resulted in further decline in the LDL score (143.60 ± 23.47) which indicated that 5g chicory root powder consumption can have a positive effect on the health of individuals with its LDL lowering effect. The final recorded value at 45th day which marked 15-day washout period showed a little incline in the LDL value as compared to the one recorded at 30th day of treatment. Mean LDL score recorded at 45th day was 146.20 ± 23.28 among the participants of Treatment group A.

Table 11: Comparison of Low-density lipoprotein level of 10 gm Chicory root powder at different interval

Period in days	Mean Low Density lipoprotein of Control Group				Period in days	Mean Low Density lipoprotein of Treatment Group B			
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	156.10 ± 21.39	-2.4	3.20	-1.53	00	158.30 ± 27.52	-27.5	26.0	-17.37
45	153.70 ± 22.05				45	130.80 ± 26.78			
00	156.10 ± 21.39	-5.3	10.69	-3.39	00	158.30 ± 27.52	-30.1	28.4	-19.01
30	150.80 ± 21.72				30	128.20 ± 27.03			
00	156.10 ± 21.39	-2.6	6.5	-1.66	00	158.30 ± 27.52	-15.6	13.2	-9.85
15	153.50 ± 21.12				15	142.70 ± 27.35			

*Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of **Low-Density Lipoprotein Level** over the different time period.*

Table 11 provides the comparison between Control and Treatment group B who consumed 10g chicory root powder for 30 days. The effects of Control are the same as the one discussed in the previous section.

However, it was eminent that with the consumption of 10g of chicory root powder serum LDL levels decreased up to a greater extent. Mean LDL score for Treatment group B at the baseline was 158.30 ± 27.52 which reduced to 142.70 ± 27.35 after 15 days of treatment and 128.20 ± 27.03 after 30 days of treatment. This shows that chicory root powder has the potential to decrease serum LDL concentrations if consumed 10g/day. However, the effects were found to be slightly reversed after the treatment was stopped at 30th day.

With a washout period of 15 days, the final reading was recorded at 45th day which was considered as the washout reading. The mean LDL score at 45th day was 130.80 ± 26.78 which revealed a little rise in the LDL levels as compared to the LDL levels at 30th day. Mean scores recorded at different intervals were significantly different from the baseline mean score for Treatment group B at each of the three time intervals. Ghaffari, Rafraf et al. (2019) found a significant reduction in the serum LDL levels of study participants with a consumption of chicory extract 9g/day for 12 weeks ($p<0.05$). Further, Babaei, Forouzandeh et al.

(2018) reported a significant decline in the serum LDL (155.65 ± 61.81 vs. 207.51 ± 67.92 mg/dL) concentrations post intervention, as compared to baseline values in the intervention group However, in the control group, serum LDL ($p<0.33$) values were considerably higher. This study was a double blind RCT and gave 1g chicory root extract twice a day for a period of 8 weeks.

Wu, Zhou et al. (2018) also reported a significant decline in the serum LDL concentrations with the consumption of chicory polysaccharides ($p<0.05$). These results from previous literature confirmed that the findings of our study are supported by the literature and the effects are greater in greater doses.

Table 12: Comparison of High-density Lipoprotein level of 05 gm Chicory root powder at different interval

Period in days	Mean high density lipoprotein level of Control Group				Period in days	Mean High density lipoprotein level of Treatment Group A			
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	48.50 ± 16.11	-2.9	4.79	-5.97	00	51.60 ±14.19	17.4	12.9	33.7
45	45.60 ± 16.00				45	61.60 ± 13.49			
00	48.50 ± 16.11	-5.4	11.9	-11.13	00	51.60 ± 14.19	14.2	7.6	27.49
30	43.10 ± 16.16				30	65.80 ± 13.11			
00	48.50 ± 16.11	-2.7	7.36	-5.56	00	51.60 ± 14.19	5.4	7.07	10.4
15	45.80 ± 16.47				15	57.00 ± 14.20			

Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of ***High-Density Lipoprotein Level*** *over the different time period.*

Table 12 presented data on the comparison between the effects of Control and Treatment group A on the HDL of study respondents belonging to each study group, with the span of time. It had been found that that mean HDL score at the baseline for treatment group A was 51.60 ± 14.19. This mean score was found to be effected with the providence of 10g of chicory root powder which was eminent at different time intervals. At 15th day of treatment, the recorded mean score was 57.00 ± 14.20 with a rise of 10.4% as compared to the baseline mean score. Further, the mean score at 30th day was 65.80 ± 13.11 with a recorded rise of 27.49% as compared to the value at the baseline. These rise in the mean HDL scores were significant based on the T-value scores (T>1.96). The period of 30 days marked the stoppage of all sorts of treatments, onwards from there up until 45th day, a 15 days washout period was observed. Mean score collected at 45th day for Treatment group A was 61.60 ± 13.49 which shown a decline in the mean HDL concentration with the stoppage of treatment. While studying the effects of chicory extract and psyllium husk on diabetes, Abdel-Rahim, Rashed et al. (2016) conducted a lipid profile analysis for assessing the effects of selected treatments. The therapy was carried out for a month after the Albino rats were instilled with diabetes and obesity. At the conclusion of the animal research, many analyses were performed, including lipid profile. A balanced meal including 20% chicory leaves or psyllium seeds resulted in a considerable rise in the serum HDL levels. Further, the consumption of 2g chicory extract for 8 weeks of study was found to be associated with the lipid profile levels of the study respondents (Babaei, Forouzandeh et al. 2018). The intervention group's HDL-C levels increased relative to their baseline levels, as did the control group (42.25 ± 8.47 vs. 32.15 ± 6.41 mg/dL; p < 0.001). Observational studies conducted around the world have consistently shown that high serum levels of HDL are associated with a lower risk of CHD development and related complications, whereas low serum levels of this lipoprotein are associated with an increased risk of cardiovascular morbidity and mortality in both men and women (Nagao, Nakajima et al. 2018). These results from the literature not only proves the effects of chicory on the increase of serum HDL levels but also the protective role these risen levels have in the health of an individual. Thus, the findings of our study are supported which provide strong basis for the results of our study.

Table 13: Comparison of High-density Lipoprotein level of 10 gm Chicory root powder at different interval

Period in days	Mean High density lipoprotein level of Control Group				Period in days	Mean High density lipoprotein level of Treatment Group B			
	Mean ± SD	Mean difference	t value	% (+/-)		Mean ± SD	Mean difference	t value	% (+/-)
00	48.50 ± 16.11	-2.9	4.79	-5.97	00	48.30 ± 15.37	14.2	15.92	29.39
45	45.60 ± 16.00				45	62.50 ± 14.96			
00	48.50 ± 16.11	-5.4	11.94	-11.1	00	48.30 ± 15.37	16.6	23.63	34.36
30	43.10 ± 16.16				30	64.90 ± 14.79			
00	48.50 ± 16.11	-2.7	7.36	-5.5	00	48.30 ± 15.37	7.8	14.08	16.14
15	45.80 ± 16.47				15	56.10 ± 15.25			

*Control = only warm water, Treatment group A = treatment with 5gms chicory root powder, Treatment group B = treatment with 10gms chicory root powder. % (+/-) = + indicating increase or – indicating decrease in the percentage of **High-Density Lipoprotein Level** over the different time period.*

High density lipoprotein (HDL) is another important component of lipid profile. Table 13 presented data on the comparison of HDL levels between Control and Treatment Group B at different time intervals. The effects of Control are already explained in the earlier section and table 12 contains the same results with no exception. Therefore, the explanation of Treatment group B is made in this section. It is found that the mean score at baseline for Control was 48.50 ± 16.11 which decreased with the time interval. At 15th day, the mean score for HDL was 45.80 ± 16.47 while at 30th day, the recorded mean score was 43.10 ± 16.16. This showed that Control reduced HDL in the span of 30 days. After a washout period of 15 days 45.60 ± 16.00 was the recorded mean score for Control group. This showed that the Control group reduced HDL with the span of time during treatment but HDL increased in the washout period. Recorded mean score for treatment group A at the baseline was 48.30 ± 15.37 which was found to be increased at the 15th and 30th day of treatment. With an increase, the recorded mean score at 15th day of treatment was 56.10 ± 15.25 which increased even further with the progression of treatment and reached 64.90 ± 14.79 at 30th or final day of treatment. This increase was found to be significantly different in comparison with the mean score recorded at baseline with T-value 14.08 at 15th day and 23.63 at 30th day of treatment. After this, the washout period had shown to be causing a negative impact on the levels of HDL cholesterol and it started to fall again. At 45th day, recorded mean score was 62.50 ± 14.96 which indicated the decline in mean score during the washout period.

Table 14: Between the group comparison of Systolic Pressure of various doses of Chicory root powder at different interval

Period in days	Control	Treatment A	Treatment B
Day 0	158 ± 14.75 ^{b}	173 ± 20.02 ^{a}	171 ± 17.28 ^{a}
Day 15	159 ± 20.24 ^{a}	159 ± 20.24 ^{a}	155 ± 15.81 ^{b}
Day 30	157 ± 16.36 ^{a}	137 ± 14.18 ^{b}	130 ± 13.33 ^{b}
Day 45	163 ± 15.67 ^{a}	150 ± 14.14 ^{b}	145 ± 17.15 ^{c}

Values are presented in the form of Mean ± SD, Row-wise alphabetic order is used to identify the difference between mean scores

Table 14 presented data on the mean score comparison for systolic BP between groups for each of the three groups namely Control, Treatment A and Treatment B. It is eminent from the data that at day 0, the mean score for Control was less 158 ± 14.75 while the mean scores for the rest of the two groups were greater and close to each other which can be explained by the alphabetic order of the mean scores. Further, on 15th day of the treatment, the mean scores for systolic BP showed a rise in the Control group while it showed a decline for the two treatment groups. Treatment group B showed the greatest decline with the recorded mean score as 155 ± 15.81. With further progression in the treatment, the mean scores for two treatment groups A and B showed a decline while the Control almost remained at a similar point. Treatment group B which consumed 10g chicory root powder showed the greatest decline in the mean systolic BP which is evident from the mean score recorded at final day of treatment (130 ± 13.33). The mean score recorded for treatment A was 137 ± 14.18. Washout effects observed at day 45th revealed an increase in the systolic BP of all groups with the mean scores 163 ± 15.67, 150 ± 14.14 and 145 ± 17.15 for Control, Treatment group A and Treatment group B. Research have found that fresh chicory roots contain 68% inulin (a polysaccharide related to starch), 14% sucrose, 5% cellulose, 6% protein, 4% ash, and 3% miscellaneous chemicals by dry weight (Wilson, Smith et al. 2004). The therapeutic effects of chicory can be attributed to these ingredients especially inulin which contributes significantly in the reduction of blood pressure. The study of Becerril-Alarcón, Campos-Gómez et al. (2019) is a good example of this case where inulin is found to be associated with the systolic BP of study respondents. More, findings from the study of Sedighi, Cheraghi et al. (2021) and Nishimura, Ohkawara et al. (2015) also found a significant association between consumption of chicory root extract and reduction in systolic BP of the respondents. Control showed no effect in any of these studies on the SBP of the subjects. These results prove that chicory root powder mitigate SBP which is also found in our study.

Table 15: Between the group comparison of Diastolic Pressure of various doses of Chicory root powder at different interval

Period in days	Control	Treatment A	Treatment B
Day 0	95 ± 10.80 ^{c}	103 ±8.23 ^{a}	98.5 ± 14.15^{b}
Day 15	99 ± 9.94 ^{a}	87 ± 6.74 ^{b}	84 ± 6.99^{b}
Day 30	97 ± 8.23 ^{a}	76 ± 6.99 ^{b}	75.5 ± 5.98^{b}
Day 45	96 ± 6.99 ^{a}	101 ±11.00 ^{b}	99 ± 8.75^{c}

Values are presented in the form of Mean ± SD, Row-wise alphabetic order is used to identify the difference between mean scores.

Table 15 presented data on the diastolic BP in response to different type of treatments posed by Control, Treatment A (5g chicory root powder) and Treatment B (10g chicory root powder). Baseline mean scores were 95 ± 10.80, 103 ±8.23 and 98.5 ± 14.15 for Control, Treatment A and Treatment B, respectively. This showed that Treatment A had the highest score for diastolic BP at the baseline. With progression in treatment, Control showed no significant change at any of the time intervals with mean scores of 99 ± 9.94 at 15th day and 97 ± 8.23 at 30th day. Treatment group A marked significant reduction in the mean diastolic BP of the respondents with the mean score 87 ± 6.74 at 15th day and 76 ± 6.99 at 30th day of treatment. Treatment group B also caused significant reduction in the mean diastolic BP with recorded mean score 84 ± 6.99 at 15th day and 75.5 ± 5.98 at 30th day of treatment. A constant decline in both treatment groups with no massive difference in the mean scores showed that the chicory root powder consumed in different concentrations can have a significant effect on diastolic BP regardless of the dosage. However, at the end of washout period, the mean score for Control was almost similar to the previous scores but the Treatment A and B groups showed a great incline in the mean diastolic BP with mean scores of 101 ±11.00 for treatment A and 99 ± 8.75 for treatment B. Inulin content and other ingredients found in the chicory root powder are the major contributors for its beneficial effects on humans (Wilson, Smith et al. 2004). Becerril-Alarcón, Campos-Gómez et al. (2019) found that the core ingredient in chicory root powder (inulin) was involved in mitigating the DBP among women with breast cancer. A constant rise in the SBP was observed in the Control group yet in the inulin group, the majority stayed below 90 mmHg (n=18). Sedighi, Cheraghi et al. (2021) also reported a decrease in the DBP levels in the 50 mg/kg extract-treated group as compared to the control and 200 mg/kg extract-treated groups with a treatment time of 14 days. On the other hand, Nishimura, Ohkawara et al. (2015) found a non-significant effect of the chicory root extract on DBP which might be explained by the lower dosage (300mg/day) as compared to the amount used in our study.

Table 16: Between the group comparison of Cholesterol of various doses of Chicory root powder at different interval

Period in days	Control	Treatment A	Treatment B
Day 0	253.90 ± 36.83[c]	287.70 ± 42.35 [b]	297.7 ± 40.28 [a]
Day 15	257.60 ± 36.62[a]	275.40 ± 42.64 [b]	277.2 ± 39.63 [b]
Day 30	262.30 ± 37.53[a]	263.10 ± 43.03 [a]	255.6 ± 38.70 [b]
Day 45	256.50 ± 36.58[a]	269.80 ± 41.77 [b]	260 ± 38.67 [c]

Values are presented in the form of Mean ± SD, Row-wise alphabetic order is used to identify the difference between mean scores.

Table 16 presents data on the effects of Control, Treatment A and B on the cholesterol levels of the respondents. A between group comparison showed that the mean scores at the baseline for the three groups were 253.90 ± 36.83, 287.70 ± 42.35 and 297.7 ± 40.28 which clearly indicated a lower baseline score for the Control as compared to the mean cholesterol of Treatment group A and Treatment group B. As the treatment progressed, the Control group showed an increase in serum cholesterol concentration with a mean score of 257.60 ± 36.62 at 15th day and 262.30 ± 37.53 at 30th day of treatment. A clear indication was observed from this that Control did not had any significant positive effect on the control of cholesterol levels. On the other hand, the two treatment groups A and B showed a reduction in the mean cholesterol levels of the study respondents. A mean score of 275.40 ± 42.64 at 15th day and 263.10 ± 43.03 at 30th day was observed in Treatment group A while a mean score of 277.2 ± 39.63 at 15th day and 255.6 ± 38.70 at 30th day was observed in treatment group B. Findings suggest a clear-cut indication of significant reduction in the mean serum cholesterol levels of the respondents belonging to each group. However, the group B which consumed 10g chicory root powder showed a greater reduction which made it clear that a higher dose of chicory root powder is more effective against cholesterol as compared to a lower dose as in Treatment group A (5g chicory root powder). Moreover, the washout period suggested a meagre decline in the mean cholesterol levels of Control group while the Treatment group A and B showed a rise in the mean cholesterol levels with mean scores of 269.80 ± 41.77 and 260 ± 38.67 for Treatment group A and Treatment group B, respectively. Abdel-Rahim, Rashed et al. (2016) reported that feeding diabetic rats a balanced meal alone did not improve their lipid profile, however feeding diabetic rats a balanced diet adding 20% chicory leaves or psyllium seeds resulted in a substantial drop in total cholesterol and the cholesterol/HDL-C ratio. Wu, Zhou et al. (2018) also reported similar findings where the chicory polysaccharide showed a significant reduction in the serum cholesterol levels. Moreover, Babaei, Forouzandeh et al. (2018) discovered that using chicory leaf extract for 8 weeks can lower blood cholesterol levels if consumed 2g a day. These results showed that chicory extracts are significantly associated with a reduction in total serum cholesterol levels. This association is directly associated with a dose dependent manner as found in our study.

Table 17: Between the group comparison of Low-Density Lipoprotein Pressure of various doses of Chicory root powder at different interval

Period in days	Control	Treatment A	Treatment B
Day 0	156.1 ± 21.39 [a]	158 ± 24.40 [a]	158.3 ± 27.52 [a]
Day 15	153.5 ± 21.12 [a]	151.4 ± 23.47 [a]	142.7 ± 27.35 [b]
Day 30	150.8 ± 21.72 [a]	143.6 ± 23.47 [b]	128.2 ± 27.03 [c]
Day 45	153.7 ± 22.05 [a]	146.2 ± 23.28 [b]	130.8 ± 26.78 [c]

Values are presented in the form of Mean ± SD, Row-wise alphabetic order is used to identify the difference between mean scores.

Table 17 presents data on the LDL compared between different groups including Control, Treatment group A and B. Data suggests that the mean scores for serum LDL concentrations were similar for each of the three groups at day 0. A decline was observed in all of the three groups which was non-significant in case of Control, while it was significant in case of Treatment A and B. Mean score differences for Control were 156.1 ± 21.39 at day 0, 153.5 ± 21.12 at day 15 and 150.8 ± 21.72 at day 30 which revealed a very little change in the serum LDL concentrations. In comparison, Treatment A showed the mean scores of 158 ± 24.40 at day 0, 151.4 ± 23.47 at day 15 and 143.6 ± 23.47 at day 30 which found a significant change in the mean LDL concentrations of the respondents with the providence of 5g chicory root powder. Further, Treatment group B revealed an even better control of serum LDL concentrations with the mean score of 158.3 ± 27.52 at day 0, 142.7 ± 27.35 at day 15 and 128.2 ± 27.03 at day 30. From this, it was revealed that the concentration of chicory root powder as well as the span of treatment had a significant contribution to the control of serum LDL. Data collected at day 45 which marked a washout period of 15 days showed a rise in serum LDL concentrations in Control, Treatment A and Treatment B. Chicory root polysaccharides were associated with a reduction in the serum LDL concentrations in NAFLD induced rats (Wu, Zhou et al. 2018). Similarly, consumption of 1g chicory leaf extract twice a day for 8 weeks reduced LDL-C (155.65 ± 61.81 vs. 207.51 ± 67.92 mg/dL) concentrations which confirmed the beneficial effects of chicory against serum LDL levels. While Nishimura, Ohkawara et al. (2015) found no significant difference in the mean scores (At baseline: 139.54 ± 5.70, At 4th week of treatment: 142.00 ± 5.5) of LDL from baseline to the end of 4 weeks treatment. No difference was reported in the Control group as well. This explains that the effects of chicory root extract in lower doses does not have a significant effect on the serum LDL concentrations. Our study tested chicory root extract in higher doses (5g and 10g) which caused a significant decline in the serum LDL levels as compared to Control. Hence, the effects found in our study are supported by the available literature.

Table 18: Between the group comparison of High-density Lipoprotein of various doses of Chicory root powder at different interval

Period in days	Control	Treatment A	Treatment B
Day 0	48.5 ± 16.11 [a]	51.60 ±14.19 [a]	48.3 ± 15.370 [a]
Day 15	45.8 ± 16.47 [a]	57.00 ± 14.20 [b]	56.1 ± 15.25 [b]
Day 30	43.1 ± 16.16 [a]	65.80 ± 13.11 [b]	64.9 ± 14.79 [c]
Day 45	45.6 ± 16.00 [a]	61.60 ± 13.49 [b]	62.5 ± 14.96 [b]

Values are presented in the form of Mean ± SD, Row-wise alphabetic order is used to identify the difference between mean scores

Table 18 contains results on the effects of Control, Treatment A and Treatment B on the levels of serum HDL concentrations. The baseline means scores where quite similar to one another (48.5 ± 16.11 for Control, 51.60 ±14.19 for Treatment A and 48.3 ± 15.370 for Treatment A) which led to a similar mean alphabetic character for each of the 3 means. Control group showed a decline in the mean score at day 15th (45.8 ± 16.47) while, Treatment A (57.00 ± 14.20) and Treatment B (56.1 ±

15.25) showed an increase in the mean HDL concentrations. This trend continued with span of time and led to an even lower score of HDL concentration for Control group (43.1 ± 16.16) while a greater HDL concentration was found for A (65.80 ± 13.11) and Treatment B (64.9 ± 14.79) at 30th day of treatment. Treatment group B which used a greater concentration of chicory root powder showed the greatest score among the study groups with an indication that the effect of chicory root powder is not only time based but also concentration based. At day 45th, the mean score for Control was 45.6 ± 16.00, Treatment A was 61.60 ± 13.49 and Treatment A was 62.5 ± 14.96. Control showed an increase in HDL score in washout period while Treatment A and B showed a decrease in HDL scores. Nasiri, Ziamajidi et al. (2014) studied the effects of aqueous extract of chicory root powder on lipid profile and found that the consumption of 1g/kg/day in rat model was non-significantly associated with the serum HDL concentrations. Control/Control also remained non-significantly changed during the treatment duration (14 days). However, Abdel-Rahim, Rashed et al. (2016) found that the consumption of 2g chicory extract per day in albino rats model was associated with an increase in serum HDL concentrations. Moreover, Babaei, Forouzandeh et al. (2018) reported that 2g chicory extract per day for 8 weeks in human participants was associated with an increase in the mean HDL concentrations as compared to the baseline as well as Control group. This proves that chicory extracts from different parts of the plant are associated with an increase in the mean HDL concentrations among animal and humans for a few exceptions.

VI. CONCLUSION AND RECOMMENDATION

It was concluded that

- Systolic and diastolic pressure was significantly reduced in supplement group.
- The concentration of cholesterol in supplement group was significantly reduced at day 30 as compared to day 0
- The concentration of LDL in supplement group was significantly reduced at day 15 and 30.
- HDL in supplement group was significantly increased at day 30.
- The lasting effect of chicory root powder 10 gm was little higher than 5gm
- Both doses of 5g and 10 gm were effective as well as long lasting

RECOMMENDATIONS

- The chicory root powder supplement can be recommended for the lowering lipid profile and blood pressure after conducting further detail studies
- Further studies are recommended for the Isolation of the active compounded from chicory root.
- Based on the results of the current study, 10g per day is recommended for reducing blood Pressure and total cholesterol level of hypertensive patient.

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