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Anti-dyslipidemic and anti-hypercholesteremic effects of concoction juice: A randomized, double-blind, placebo controlled trial

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PAPER

Abstract

Globally, dyslipidemia is an alarming condition, which may cause death. However, its country-wise ratio varies. In Pakistan, it is about 16–20% in both men and women. Dyslipidemia can be defined as the up level quantity of lipids in blood than the average value. The treatment of dyslipidemia can be done by dietary interventions with indigenous sources. The (Concoction) juice has the ability to reduce the low-density lipoprotein (LDL), total cholesterol (TC), triglycerides (TGs). and raise the high-density lipoprotein (HDL) level. For efficacy studies, dyslipidemic females (n = 1010) were approached in different clinics and hospitals of Sargodha. They were approached with biomarkers, that is, lipidemic profile, TC, HDL, urea, creatinine, and TGs. A total of 85 females were selected and they were divided into three groups (T_0, L_1 and M_1). T_0 is an experimental (control) group, T_1 group has dyslipidemic patients treated with lab-made juice, and M_1 has dyslipidemic patients treated with market products. After 120 days of treatment, the data were analyzed statistically to validate the results of the study. The anthropometric and dietary intake was assessed by dyslipidemic volunteers. A significant level of dyslipidemic biomarker was found in L_1. The down level was found in TC (216-184 mg/dL), TGs (215.54-138.46 mg/dL), and LDL (145.64-134.34 mg/dL), and raised level was found in HDL (44.15-54.43 mg/dL). Other parameters that showed a downward trend were urea (12.73-11.15 mg/dL), uric acid (6.12-5.38 mg/dL), creatinine (1.02-1.0 mg/dL), ALT (55-34 u/l), AST (47-27 u/l), ALP (91.63-83.76 IU/L), bilirubin (0.65 to 0.57 mg/dl), RBCs, WBCs, and Hb. Based on these results, it is concluded that lab-made concoction L_1 showed best results overall and is also appropriate and cost effective and further research has to be done on a large scale.

Keywords: anthropometry; dyslipidemia; garlic; ginger; honey; juice; total cholesterol; triglycerides

Introduction

Health can be defined as a state of psychological and social well-being and not just the absence of disease (WHO, 2012). Many effects that are interrelated at different points are collectively called the nutritional status of a person (Park, 2009). Plants are the natural sources for the treatment of diseases (Weidner *et al*., 2012). Nowadays extracts that are prepared from biomaterials are used as functional food and nutraceuticals (Müller and Kersten, 2003).

Liver produces cholesterol and performs good functions in the body. High cholesterol levels cause health complications like arteriosclerosis (plaque produced in arteries that causes myocardial infarction is termed as arteriosclerosis) (Kurian *et al*., 2013).

Garlic has a sulfur-containing compound known as Allicin ((R, S)-diallyldisulfid-S-oxide), which is prepared when alliinase enzymes act on alliin. This compound has lots of functions that are advantageous for the health of

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humans. Allicin possesses recirculatory, hypolipidemic, and anti-platelet actions (Leuter *et al*., 1996).

Atherosclerosis is one of the foremost origins of primary disability and death. The top recognized independent risk influence implicated in the pathology of atherosclerosis is hypercholesterolemia (Libby, 2005). Coronary events and atherosclerosis pose a risk to the cardiovascular system and have a robust connection with raised serum lipids (Gotto, 2011: Siri-Tarino *et al*., 2010). The prevalence and disease incidence report released in India in 2013 showed that >224 billion individuals in India have increased levels of cholesterol (Lachhiramka and Patil, 2016).

The rhizome/stem of ginger, in addition to containing such proximate constituents like ash, protein fiber, moisture, and carbohydrate, has a volatile oil in its stem that contributes to its pleasant aroma. In addition, ginger contains ascorbic acid, β-carotene, curcumin, gingerol, linalool, paradol, γ-terpinene, as well as terpinen-4-ol (Shahidi and Hossain, 2018). The swollen rhizome/stem of ginger has been associated with antimicrobial, anti-inflammatory, and anti-carcinogenic properties (Samaniego *et al*., 2011). It was shown by in vitro experiments that lipid peroxidation was decreased and levels of antioxidant enzymes among serum glutathione were increased by the administration of ginger. Hence, it has been proved that ginger has an equivalent antioxidant consequence to that of vitamin C (Ahmad *et al*., 2009). This study showed that the combined extract of *Zingiber officinalle* (ginger) and *Allium sativum* (garlic) retain anti-inflammatory, immune-modulatory, antioxidant, and anti-lipidemic effects and, therefore, can be useful in the management of inflammation-related diseases and useful as an immune booster and in the treatment of dyslipidemia. The combined extract restored the hematological indices and improved the serum lipid profile (Adegbola *et al*., 2021).

According to the Islamic point of view, honey is a, healthy food. The holy Quran intensely demonstrates the latent beneficial value of honey: "And thy Lord taught the bee to build its cells in hills, on trees, and in (men's) habitations; Then to eat of all the produce (of the earth), and find with skill the spacious paths of its Lord: there issues from within their bodies a drink of varying colors, wherein is healing for men: verily in this is a sign for those who give thought." The Muslim Prophet Mohammad (S. A. W. W.) suggested honey for the management of diarrhea (Molan, 1999). Almost 1000 years ago, Avicenna, the great Iranian scientist and physician, suggested honey as the best medication for tuberculosis (Asadi-Pooya *et al*., 2003).

Lemon contains citric acid, vitamin C (ascorbic acid), flavonoids, and minerals (Benavente *et al*., 1997). In citrus fruits, there is a naturally occurring compound known as Citric acid (2-hydroxy-1,2,3-propanetricarboxylic acid) that is weak tricarboxylic acid. Citric acid is used for many purposes like providing sour taste to beverages and food, and acidity to the food. Among all food acids, citric acid is present in lime and lemon (Villa-Ruano *et al*., 2019).

Influence of apple cider vinegar has been investigated from hundreds of years. Hippocrates (Father of modern medicine) prescribed a combination of apple cider vinegar and honey for the treatment of a number of diseases (Mindell and Mindell, 2002). Polyphenolic components of apple cider vinegar have important beneficial effects on health (Shahidi *et al*., 2008; Verzelloni *et al*., 2007). Antioxidant flavonoid components of apple cider vinegar lower the side-effects of a high cholesterol diet (Setorki *et al*., 2010). The main constituent of apple cider vinegar is acetic acid, which is consumed at a concentration of 3 to 9%. It is used as seasoning and also as a medicine (Fushimi *et al*., 2006).

The study of Naseem *et al*. (2016) revealed that dietary herbal extract has cardioprotective and anti-atherogenic effects devoid of any known side-effects in experimental animal models. In the present study, cardioprotective effects of some of these herbs (apple cider vinegar, honey, garlic, ginger, and lemon) were investigated in experimental animal models of hyperlipidemia.

The plasma levels of total cholesterol (TC), triglycerides (TG), high-density lipoprotein-C (HDL-C), low-density lipoprotein-C (LDL-C), and body weight in rabbits fed on normal chow diet (group I) remain stable throughout the experimental period. With hypercholesterolemic diet, body weight increases ($P > 0.05$), and there was a significant rise in TC, TG, VLDL, and AIP (P 0.05). Plasma glucose and ALT levels were increased and plasma GSH decreased in hyperlipidemic animals as compared to the control group.

Objectives

- To make a comparative study between lab-made and market concoctions.
- To explore the effects of selected juice treatments in dyslipidemic female adults.

Materials and Methods

Procurement of materials

Ingredients (ginger, apple cider vinegar, garlic, and lemon) were purchased from the bazar of Sargodha and honey was sourced from the forest. The raw materials were stored

at suitable temperature at the Nutrition Lab, Institute of Food Science and Nutrition, University of Sargodha.

Preparation of concoction

At the university lab, juice was extracted and mixed with honey and apple cider vinegar in equal amounts and then boiled at 60 ± 5°C. After cooling, it is packed in different packing materials and stored. At the time of using, one table spoon of juice was mixed in lukewarm water and provided to volunteers three times a day Naseem *et al.*, 2016. Treatment plan is mentioned in Table 1.

Up to 8 month selected treatment of concoction juice (L_1: concoction stored at refrigerated temperature (0–4°C) in glass bottle) which showed best physic-chemical, sensory, microbial and stability

Table 1. Treatment plan and composition.

Treatments	Ginger (%)	Garlic (%)	Lemon (%)	*ACV (%)	Honey (%)
T_0	0	0	5	5	0
L_1	20	10	15	15	40
M_1	–	–	–	–	–

*ACV, apple cider vinegar; T_0, Control group; L_1, Lab-made product; M_1, market product.

Study technique

Eighty-five adults, both men and women, were approached. For the study, different hospitals and institutes were selected. Two-stage sampling techniques, that is, convenience sampling and purposive sampling, were adopted for the selection of volunteers. The blood samples of selected volunteers were collected; blood was coded and placed in specified jars for tests in labs Muhammad (2000). The clinical controlled trial, randomized research method, was performed by taking samples of blood of all the volunteers in two steps. In the first step, the selected dyslipidemic volunteers were shifted for further research and in the second step, these tests were again performed in dyslipidemic volunteers after 120 days MacMahon and Trichopoulos, 1996; Kumar *et al.*, 2008. The study was performed for 120 days study with test (before and after). The data of Dietary Intakes Assessment and Biomarker (lipid profile, CBC, LFT and RFT, Urea, Creatinine, Cholesterol, LDL, HDL, TG) of selected volunteers were recorded for their nutritional status assessment (Figure 1).

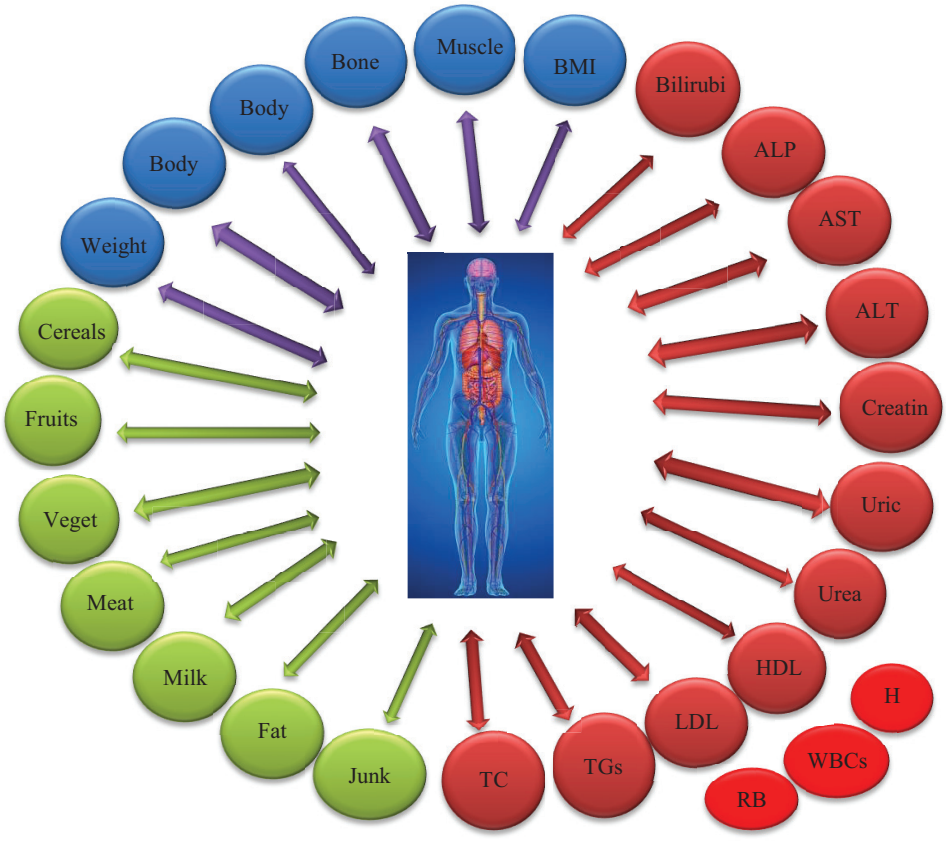

Figure 1. Graphical. TC, (total cholesterol); TG, (triglycerides); LDL, (low-density lipoprotein); HDL, (high-density lipoprotein)

Statistical analyses

With the help of blood samples and sensory evaluation, statistical analyses were performed. Significant values were tested by parametric and nonparametric tests. $P \leq 0.05–0.01$ is of statistical significance. Tables, graphs, and charts were used to present the data. Data were checked by descriptive statistics and analyzed by using Minitab 16 statistical software to validate the outcomes of the study (Steel *et al*., 1997).

Results

The test parameters of results are mentioned in the graph: anthropometric (blue color), food intake dairy (green color), and blood sample (reddish and red color) parameters are mentioned in this figure, while their complete details are mentioned in the results section.

Dietary intakes assessment

After getting a health assessment of dyslipidemic volunteers, we found nonsignificant values found in days of dietary intake (Table 2). Per USDA recommendation, cholesterol can be decreased by eating fruits and vegetables. With respect to mean values, dyslipidemic volunteers consumed more of meat and meat products. Significantly lessened values of fat and oil were consumed on days (3.67 ± 0.17 to 2.67 ± 0.13). Also, the same trend is found with regard to junk food and snacks (4.05 ± 0.18 to 3.05 ± 0.13). Cholesterol levels might be increased with fried or junk food due to the existence of trans fat in them. Regular ingesting of such food ultimately results in many diseases like dyslipidemia.

Anthropometric assessments

With respect to days, only significant values were found in weight (66.55 ± 2.37 to 64.48 ± 2.28) and Body Mass Index (BMI) (27.45 ± 0.94 to 26.56 ± 0.9), which were reduced after 120 days. It means that the combined juice may affect weight reduction but no changes were found in the mean values (days) of body muscle mass (BMM) and body water (BW) and body bones mass (BM) (Table 3).

Biomarker of blood samples (dyslipidemia)

TC level (mg/dL)

The combined juice showed positive outcomes with regard to TC (Table 4). In T_0 (219 ± 1.18 to 225.43 ± 2.75), the cholesterol levels were increased. Cholesterol levels decreased significantly with Treatment L_1 (216 ± 1.15 to 184 ± 1.69) over the course of 120 days. Treatment M_1 also decreased TC (217.44 ± 1.77 to 193.25 ± 1.4) with a dose of 1 tablespoon three times a day.

Table 2. Dietary intake of dyslipidemic volunteers before and after.

	Cereals		Fruits		Vegetables		Meat and meat products		Milk and milk products		Fats and oil		Junk and snacks	
PS	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days
Dyslipidemic	6.43 ± 0.23	6.58 ± 0.23	0.89 ± 0.1	1 ± 0.1	1.73 ± 0.1	1.76 ± 0.07	4.25 ± 0.2	4.2 ± 0.16	4.27 ± 0.2	4.28 ± 0.16	3.67 ± 0.17	2.67 ± 0.13^{B}	4.05 ± 0.18^{A}	3.05 ± 0.13^{B}

PS, Physiological status.

Table 3. Anthropometric measurements of volunteers before and after.

		Weight (Kg)		Body fat (%)		Body water (%)		Bone mass (%)		Muscle mass (%)		BMI	
PS	Age	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days
Dyslipidemic	30–50 ± 7	66.55 ± 2.37	64.48 ± 2.28	37.07 ± 0.57	37.07 ± 0.57	36.76 ± 0.63	36.8 ± 0.63	7.08 ± 0.23	7.08 ± 0.23	25.86 ± 0.26	25.86 ± 0.26	27.45 ± 0.94	26.56 ± 0.9

PS, physiological status.

TGs (mg/dL)

The good ingredients combination of concoction juice showed significant results in treatments and days of TGs (Table 4). TG levels of respondents were increased in Treatment T_0 (206.21 ± 3.7 to 241.64 ± 3.14) while they were significantly decreased in Treatment M_1 (200.25 ± 3.52 to 161.13 ± 4.67) and significantly decreased in Treatment L_1 (215.51 ± 3.43 to 138.463 ± 5.31).

Niacin plays a role in preventing the deposition of TGs in adipose tissue by controlling or holding the diacylglycerol acyltransferase enzyme in the liver.

In the production of cholesterol, this enzyme is active in the 3-hydroxy-3-methyl-glutaryl-coenzyme a reductase (HMG-CoA reductase) pathway (Alagwu *et al.*, 2011; Mushtaq *et al.*, 2011). According to Yaghoobi and Salomé (2008), daily consumption of honey (70 g) in lukewarm water will reduce the TGs and other hyperlipidemic parameters.yaghoobi

LDL (mg/dL)

Means squares for the effect of juice (Table 6) on LDL have shown highly significant results. In the control group (T_0), means for efficacy study indicated that LDL value increased significantly (154.15 ± 1.48 to 167.21 ± 1.72) while in other treatments, namely, L_1 and M_1, values significantly decreased. High values decreased in L_1 (145.64 ± 0.49 to 134.34 ± 0.48). This indicates that Treatment L_1 reduces the LDL level than the other treatments.

Garlic facilitates high production of HDL and reduced level of LDL (Hongbao and Kuan-Jiunn, 2006).

HDL (mg/dL)

The levels of HDL were decreased in the respondents following Treatment T_0 (45.74 ± 0.53 to 34.59 ± 0.88), while the HDL levels moved upward significantly in Treatment M_1 and was move more upwards significantly in Treatment L_1 (44.15 ± 0.43 to 54.43 ± 0.67) (Table 7).

Urea (mg/dL)

Means squares for effect of juice (Table 8) on urea have shown highly changed outcomes. In the control group (T_0), means for efficacy study indicated that urea value increased significantly (12.33 ± 0.27 to 14.27 ± 0.43) while

Table 4. Comparison test of TC (mg/dL) of volunteers before and after.

Treatment	Day 0	Day 120	Mean
T_0	219 ± 1.18	225.43 ± 2.75	222 ±1.965
L_1	216 ± 1.15	184 ± 1.69	200 ±1.42
M_1	217.44 ± 1.77	193.25 ± 1.4	205.345 ± 1.585
Mean	217.48 ± 1.36	200.89 ± 1.94	–

TC, total cholesterol; T_0, Control group; L_1, Lab-made product; M_1, Market product.

Table 5. Comparison test of TGs (mg/dL) before and after.

Treatment	Day 0	Day 120	Means
T_0	206.21 ± 3.7	241.64 ± 3.14	223.925 ± 3.42
L_1	215.51 ± 3.43	138.463 ± 5.31	176.98 ± 4.37
M_1	200.25 ± 3.52	161.13 ± 4.67	180.69 ± 4.095
Mean	207.32 ± 3.55	180.411 ± 4.37	–

TG, triglycerides; T_0, Control group; L_1, Lab-made product; M_1, Market product.

Table 6. Comparison test of LDL (mg/dL) before and after.

Treatment	Day 0	Day 120	Means
T_0	154.15 ± 1.48	167.21 ± 1.72	160.68 ± 1.6
L_1	145.64 ± 0.49	134.34 ± 0.48	139.99 ± 0.485
M_1	141.21 ± 1.16	138.31 ± 1.25	155.105 ± 1.205
Mean	147 ± 1.043	146.62 ± 1.15	–

LDL, low-density lipoprotein; T_0, Control group; L_1, Lab-made product; M_1, Market product.

Table 7. Comparison test of HDL (mg/dL) before and after.

Treatment	Day 0	Day 120	Means
T_0	45.74 ± 0.53	34.59 ± 0.88	40.165 ± 0.71
L_1	44.15 ± 0.43	54.43 ± 0.67	49.29 ± 0.55
M_1	42.44 ± 0.57	46.74 ± 0.43	44.59 ± 0.5
Mean	44.11 ± 0.51	45.25 ± 0.66	–

HDL, high-density lipoprotein; T_0, Control group; L_1, Lab-made product; M_1, Market product.

Table 8. Comparison test of urea (mg/dL) before and after.

Treatment	Day 0	Day 120	Means
T_0	12.33 ± 0.27	14.27 ± 0.43	13.3 ± 0.35
L_1	12.73 ± 0.43	11.15 ± 0.12	11.94 ± 00.275
M_1	12.31 ± 0.14	12.41 ± 0.38	12.36 ± 0.26
Mean	12.45 ± 0.28	12.61 ± 0.31	–

T_0, Control group; L1, Lab made product; M_1, Market product.

in other treatments, namely, L_1 and M_1, values significantly decreased. High values decreased in L_1 (12.73 ± 0.43 to 11.15 ± 0.12). This indicates that L_1 has a greater effect on reducing the urea level than other treatments.

Uric acid (mg/dL)

Significant results were found in T_0, L_1, and M_1. Uric acid levels were increased a little in T_0 respondents (6.53 ± 0.03 to 7.09 ± 0.02), no changes were found in M_1, and it was decreased a little in Treatment L_1 (Table 9).

Ginger positively lowers the uric acid quantity (Shokr and Mohamed, 2019).

Creatinine (mg/dL)

The levels of creatinine were slightly increased in Treatment T_0 (1.03 ± 0.01 to 1.09 ± 0.03) while the levels of creatinine showed a downward trend in treatments M_1 and L_1 with 0.01 and 0.02 difference, respectively (Table 10).

ALT (SGPT) (U/L)

Means squares for effect of juice (Table 11) on ALT have shown highly changed outcomes. In the control group (T_0), means for efficacy study indicated that ALT value increased significantly (60 ± 2.45 to 75 ± 2.74) while in other treatments, namely, L_1 and M_1, values significantly decreased. High values decreased in L_1 (55 ± 3.15 to 34 ± 3.45). This means that L_1 has a greater effect on reducing the ALT level than M_1 (53 ± 4.38 to 39 ± 4.22).

Table 9. Comparison test of uric acid before and after.

Treatment	Day 0	Day 120	Means
T_0	6.53 ± 0.03	7.09 ± 0.02	6.81 ± 0.025
L_1	6.12 ± 0.07	5.38 ± 0.04	5.75 ± 0.05
M_1	6.05 ± 0.07	6.02 ± 0.04	6.035 ± 0.055
Mean	6.23 ± 0.056	6.16 ± 0.03	–

T_0, Control group; L_1, Lab-made product; M_1, Market product.

Table 10. Comparison test of creatinine (mg/dL) before and after.

Treatment	Day 0	Day 120	Means
T_0	1.03 ± 0.01	1.09 ± 0.03	1.06 ± 0.02
L_1	1.02 ± 0.01	1 ± 0.01	1.025 ± 0.01
M_1	1.02 ± 0.01	1.03 ± 0.01	1.025 ± 0.01
Mean	1.023 ± 0.01	1.04 ± 0.02	–

T_0, Control group; L_1, Lab-made product; M_1, Market product.

Table 11. Comparison test of ALT (SGPT) before and after.

Treatment	Day 0	Day 120	Means
T_0	60 ± 2.45	75 ± 2.74	67.5 ± 2.59
L_1	55 ± 3.15	34 ± 3.45	44.5 ± 3.3
M_1	53 ± 4.38	39 ± 4.22	46 ± 4.3
Mean	56 ± 3.32	49.33 ± 3.47	–

T_0, Control group; L_1, Lab-made product; M_1, Market product.

Table 12. Comparison test of AST (SGOT) before and after.

Treatment	Day 0	Day 120	Means
T_0	50 ± 3.45	63 ± 3.14	56.5 ± 3.29
L_1	47 ± 2.45	27 ± 2.75	37 ± 2.6
M_1	51 ± 3.18	36 ± 3.22	43.5 ± 3.2
Mean	49.33 ± 3.02	49.33 ± 3.03	–

T_0, Control group; L_1, Lab-made product; M_1, Market product.

Table 13. Comparison test of ALP (IU/L) before and after.

Treatment	Day 0	Day 120	Means
T_0	98.74 ± 4.18	114.68 ± 3.71	106.71 ± 3.94
L_1	91.63 ± 6.32	83.76 ± 4.36	87 ± 5.34
M_1	100.43 ± 4.72	85.94 ± 4.2	93.18 ± 4.46
Mean	96.93 ± 5.07	94.79 ± 4.09	–

T_0, Control group; L_1, Lab-made product; M_1, Market product.

AST (SGOT) (U/L)

The levels of AST were increased in the respondents following Treatment T_0 (50 ± 3.45 to 63 ± 3.14) while the AST levels were reduced significantly in Treatment M_1 (51 ± 3.18 to 36 ± 3.22) and were reduced highly significantly in Treatment L_1 (47 ± 2.45 to 27 ± 2.75) (Table 12).

ALP (IU/L)

ALP levels were improved in T_0, while the ALP (IU/L) levels were reduced significantly in M_1 and were reduced highly significantly in Treatment L_1 (Table 13).

Bilirubin (mg/dL)

Bilirubin scores were increased slightly in Treatment T_0 (0.59 ± 0.02 to 0.63 ± 0.04), while they were decreased slightly in Treatment M_1 (0.61 ± 0.02 to 0.59 ± 0.02) and Treatment L_1 (0.65 ± 0.02 to 0.57 ± 0.01) (Table 14.).

Table 14. Comparison test of bilirubin before and after.

Treatment	Day 0	Day 120	Means
T_0	0.59 ± 0.02	0.63 ± 0.04	0.61 ± 0.03
L_1	0.65 ± 0.02	0.57 ± 0.01	0.61 ± 0.015
M_1	0.61 ± 0.02	0.59 ± 0.02	0.6 ± 0.02
Mean	0.61 ± 0.02	0.59 ± 0.02	–

T_0, Control group; L_1, Lab-made product; M_1, Market product.

RBCs (mcells/mcL)

Non-significant results were obtained among treatments (Table 15). RBC levels were reduced slightly in Treatment T_0, while they increased slightly in Treatment M_1 and were better slightly in Treatment L_1 (Table 15).

WBCs (cells/mcL)

The WBC levels were reduced slightly in Treatment T_0, while the WBC levels improved slightly in Treatment M_1 and were better slightly in Treatment L_1.

Hb (g/dL)

Hb levels were reduced slightly in Treatment T_0, while the Hb levels improved in Treatment M_1 and were better in Treatment L_1 (Table 15).

The comparison test of TC, TGs, LDL, and HDL. Three treatments, namely, T_0, L_1, and M_1 are mentioned for each disease with their values before and after.

Discussions

Sobenin and colleagues have reported that they gave garlic powder (150 mg per day) for a period of 1 year to hyperlipidemic patients and found significant results in the case of LDL, TC, and TGs. Sulfur-containing amino acids like ajoene, S-allylcysteine, S-methylcysteine, allicin, sulfoxides, and diallyl disulfide are present in garlic. They showed good results in the conversion of hyperlipidemic to hypolipidemic (Sobenin *et al*., 2010). It is revealed by Alizadeh-Navaei (2008) that he used ginger capsules (3 g per day) in humans and found that ginger powder decreases endogenous production of cholesterol by increasing the LDL receptors for removing the LDL-C from plasma. The level of pancreatic amylase and lipase increases and lipid hydrolysis decreases by the action of ginger (Alizadeh-Navaei *et al*., 2008).

Our TGs study was also supported by Shishehbor *et al*. (2008) who explained that hyperlipidemia is also reduced by apple cider vinegar due to the presence of acetic acid, which plays a role in inhibiting hepatic lipogenesis by raising the beta oxidation of fatty acids in rats. Sterol regulatory elements binding protein-1 (SREBP-1) gene is blocked by acetic acid in diets that reduce the level and function of ATP citrate lyase (ATP-CL) and mRNA, respectively, which try to decrease the distribution of acetyl CoA (Fushimi *et al*., 2006).

The level of pancreatic lipase moves upward with the bioactive component gingerol of ginger (Platel and Srinivasan, 2000; Ramakrishna *et al*., 2003). Gingerol plays an important role in increasing the working activity of hepatic cholesterol-7-hydroxylase, which converts the cholesterol into bile acid and finally eliminates it from the body (Srinivasan and Sambaiah, 1991).

Djousse *et al*. (2004) showed the outcomes of their research: 6–7% LDL was reduced in those volunteers by taking fruits and vegetables as paralleled to those who were not taking enough fruits. This may be because of dietary fibers in fruits that help in the absorption and removal of cholesterol from the blood (Ballesteros *et al*., 2001; Sprecher and Pearce, 2002).

Few phytochemicals present in the juice of *Citrus limon* like flavonoids, polyphenols, and terpenes assist in the reduction of serum bilirubin (Al-Snafi, 2016; Muhammad *et al*., 2013). This outcome is also confirmed by Shefalee (Bhavsar *et al*., 2007). It also comprises ascorbic acid (Vit C), which acts as an antioxidant that helps in lowering the level of bilirubin (Tounsi *et al*., 2011).

Table 15. Comparison test of RBCs (mcells/mcL), WBCs (cells/mcL) and Hb (g/dL) before and after.

	RBCs		WBCs		Hb	
Treatments	0 Days	120 Days	0 Days	120 Days	0 Days	120 Days
T_0	5.55 ± 0.18	4.8 ± 0.14	6435.25 ± 217	5420.25 ± 225	36.76 ± 0.63	36.8 ± 0.63
L_1	4.87 ± 0.1	5.42 ± 0.14	5963.25 ± 105	6234.5 ± 97.1	11.54 ± 0.13	11.48 ± 0.12
M_1	4.9 ± 0.15	5.12 ± 0.13	5829.08 ± 113	6071.7 ± 78.4	11.77 ± 0.09	12.22 ± 0.08

T_0, Control group; L_1, Lab-made product; M_1, Market product.

Sharma *et al*. (2010) demonstrated the outcome of garlic extract against the poisonousness of lead nitrate in male mice because it might augment the level of ALP. The results showed a substantial reduction in the level of ALP in those mice that were treated with ethanolic garlic extract. Similarly, the same effect of garlic was tested by D'Argenio *et al*. (2010) as it takes the ALP level to a standard value. The same pattern was found by Dkhil *et al*. (2011). D'Argenio *et al*. (2012) recently reported a non-significant decrease in the amount of ALP with the use of garlic. With ginger intake, the level of ALP decreases dramatically (Shokr and Mohamed, 2019).

Soleimani *et al*. (2020) found that after intake of garlic powder, the hepatic steatosis improved significantly and there was a reduction of serum ALT (57.8 ± 13.9 to 47.2 ± 16.1) and AST (48.3 ± 11.6 to 42.2 ± 11.2) concentration. Alliin, allinase, and other minerals are present in garlic. Alliin has properties of organosulfur compounds, which convert allicin to allinase enzyme, which has good anti-inflammatory and anti-oxidant properties.

Our study of ALT supported by Rahimlou *et al*. (2016) showed that serum ALT level was reduced by the ginger group (36.59 to 30.5 U/L) significantly as compared to the placebo group (34.53 to 30.82 U/L). Eidi *et al*. (2006) investigated the effect of garlic in diabetic rats at the ALT stage, which was suggestively decreased due to the use of garlic extract. D'Argenio *et al*. (2010) also evaluated liver functioning in rats. He gave garlic treatment, which showed a significant decrease in ALT level in rats. This study confirmed the capability of garlic extract to alleviate the damage of liver and reinforce the therapeutic potential of the diallyl disulfide. Dkhil *et al*. (2011) highlighted the positive effect of garlic against liver dysfunction because it reduces the elevated ALT level to its normal level.

Our result similar to that of Faran *et al*. (2019) observed significant difference in AST values when given garlic and ginger juice. The group E and D showed significant decreased values except group B in AST

Jabbari *et al*. (2005) noticed in their study that the creatinine level was reduced due to the defensive action of garlic against nephrotoxicity. In the research of El-Shenawy and Hassan (2008), serum creatinine level becomes normal due to the effect of garlic. Consumption of ginger regulates gluconeogenesis through proteolysis, which ultimately decreases the level of serum urea and creatinine (Abd Elwahab and Ali, 2015).

The HMG-CoA reductase has the role in cholesterol formation can be decreased by garlic (Kim and Kim, 2011). The high quantity of vitamin C present in Lemon (*Citrus Aurantifolia* L.) stimulates a-hydroxylase enzyme 7, which in turn converts blood cholesterol into bile acid, resulting in a decrease in blood cholesterol levels. Regular intake of vitamin C (1 mL/kg/day) reduces cholesterol and LDL blood TGs and promotes concentration of HDL in blood (Yasmin *et al*., 2010). El-Shenawy and Hassan (2008) stated that consumption of garlic prevents the increase in serum urea while producing a prominent reduction in the level of serum urea. Gluconeogenesis decreases with consumption of ginger through proteolysis, which ultimately reduces the level of serum urea and creatinine (Abd Elwahab and Ali, 2015).

Al-Jowari (2014) demonstrated that garlic has a tendency of augmenting the level of Hb, platelet count, WBCs, and RBCs. It might be possible due to the end product of garlic metabolism in the body, which accelerates the production and secretion of more erythropoietin in the kidney which are powerful stimulators of bone marrow. Besides this, garlic possesses few components that are considered active oxygen scavengers that compete with Hb in RBCs for O_2 causing hypoxia, which ultimately increases the production of RBCs and Hb (Iranloye, 2002).

Increase in WBCs is due to the immune stimulant activities of garlic. Immune stimulants are fixed precisely to the receptors on the surface of cells of lymphocytes and phagocytes that activate the cell to produce some enzymes that can kill pathogens (Fazlolahzadeh *et al*., 2011). Results are summarized in Figure 2.

Novelty

Nowadays, most dyslipidemic patients are treated with medicines, which may have some side-effects and high cost. But, this product is prepared with a combination of natural food and herbs (concoction) and has very good shelf life, sensory quality, and is very cost-effective. The recovery time period from disease is short.

Conclusion

Dyslipidemia is a very serious condition with a high prevalence rate in both men and women in Pakistan. Sedentary lifestyle coupled with regular intake of high calories, that is, high fat and carbohydrates, is a key factor. The combined juice contains garlic, ginger, honey, lemon extract, and apple cider. All of these have active ingredients to reduce the level of TC, TGs, LDL, and increase the level of HDL to prevent cardiovascular diseases. They also improve other biomarkers like decreasing urea, uric acid, creatinine, bilirubin, ALT, AST, and ALP. The combined juice (L_1) provides better results as compared to the market product (M_1) as it is cost effective, pure, and more reliant. The treatment of dyslipidemia with natural herbs or food

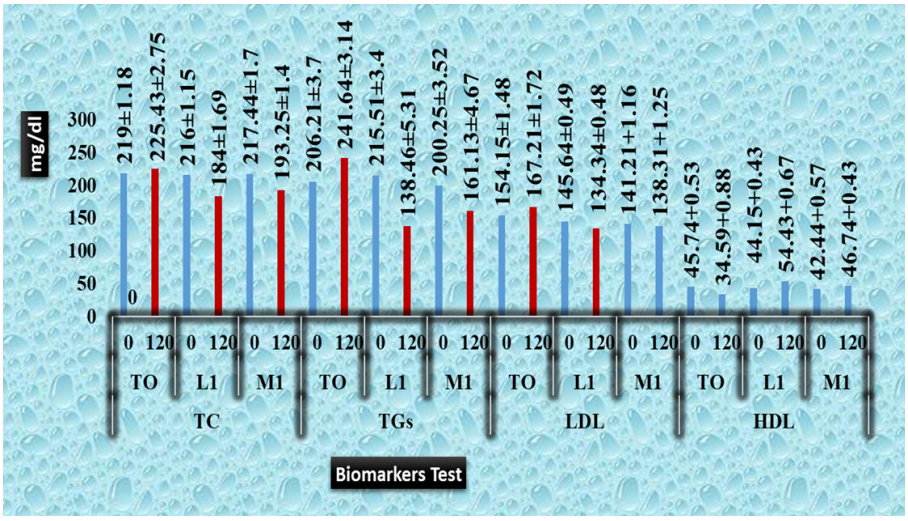

Figure 2. The effect of juice on TC, TGs, LDL, and HDL. TC, total cholesterol; TG, triglycerides; LDL, low-density lipoprotein; HDL, high-density lipoprotein.

is more important than by medicine. Further studies have to be done to address the issue of dyslipidemia at an initial stage in order to avoid the high risk of hospitalization.

Future Recommendations

During the research, we found this product offers high efficiency and high recovery rate with low cost. However, it was performed as a small pilot project. It should be expanded to a large scale so that more patients will be benefitted. In this way, we can reduce the number of dyslipidemic and hypercholesteremic patients and also create more job opportunities.

Ethics Approval

Not applicable.

Availability of Data and Materials

Collective data are available for publishing but cannot be provided by individual authors.

Conflict of Interest

The authors declare no conflict of interest and give their consent for publishing the material.

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