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Effectiveness of Apple Cider Vinegar on serum LDL and HDL level.

Neha Sethi[1], lecturer Rahyat and Bahara University, Ms. Sonia Daniel[2], Tutor SCON.

Neha sethi: nehasawhney101@gmail.com 8146503744, Sonia: soniadaniel@scon.edu.in, 9588611069

Abstract

Obesity is one of the major health problems now days. It is not always necessary that if the person is not obese, the serum cholesterol level is normal. Various interventions are available now days including dietary supplements which claim to reduce serum cholesterol level. The focus of this study is to find out the effectiveness of one the dietary supplement that is Apple Cider vinegar.

An experimental study has done on 40 samples (20 experimental and 20 control) selected randomly in Pune city. The population consists of individual living normal life style, without having any strict fat reduction intervention. The sample were selected by using random sampling and divided by giving random allocation into control and experimental group. Apple cider vinegar (oral) therapy was given to experimental group for the duration of 4 months from January, 2017 to April, 2017 and control group had received no intervention. Confounding variables were controlled by selecting homogeneous sample of males and who were regularly going for morning walk daily (both experimental & control). Blood profiles (including, total cholesterol and LDL) of all 40 subjects were noted on monthly basis. Both the groups were undergone pre test and Effectiveness of apple cider vinegar therapy was determined by using T-Test (post test comparison) between experimental and control group. Chi-square test was used to determine the association between socio-demographical variables and observed data.

Results showed that, out of 40 subjects, 80% were non-vegetarian and 20% were vegetarian in experimental group and 72% were non-vegetarian and 28% were vegetarian in control group. In experimental & control group, majority of subjects (84%) were having body weight as more than there BMI. Majority of subjects (84%) were in age group of 30 to 35 and 6% were in age group of above 40 years. Independent T-Test results showed that there is significant difference between the experimental group and control group ($p < .005$). Results showed that regular intake of apple cider vinegar empty stomach in morning and before each meal helps to reduce total cholesterol level as well as LDL level. There were few samples (2%), which showed no changes in their blood cholesterol level. Chi-square shows significant association between age, BMI and the serum cholesterol level ($p=.002$).

Key words: Apple cider vinegar, Low Density lipoprotein and High Density Lipoprotein

Introduction

"An apple a day keeps doctor away" was truly said once.

Apples are the healthiest food that a person can eat. They are high in fiber rich in vitamin C, they are low in calories. They have only trace of sodium and no fats or cholesterol. Apples have a great property as antioxidants as it is high in polyphenols. It's not only about the functions it has shown great benefits like, it mitigates the effects of asthma and Alzheimer's diseases, while assisting with weight management, bone health, pulmonary functions and gastrointestinal protection.

Apple cider Vinegars is known for its best of vinegar as the main effect of it is to help to get rid of the fats around the liver. When it is consumed it has gentle effect on the digestive tract as compared to the other forms of the vinegar. It has also got the special ability to breakdown the fats over a period of time and that will help in easy and healthy functioning of the kidneys bladder and liver. The apple cider vinegar has acidic properties which will reduce the irritability and inflammation of the liver. Study reveals the importance if BMI as a nutrition assessment.

The excess of fats in liver can cause Fatty liver which is causes enlargement and swelling of live where the metabolism is poor and can lead to heart disease too it is possible for us to get rid of the fatty liver by having dietary modification adding plant- based diet, and whole grains. Adding on the plant based diet; exercise will help to control your cholesterols and triglycerides. Along with it consumption of the apple cider vinegar will definitely shows the results of reducing the risk for complications.

Review of literature

A high intake of food derived from plants such as fruits and vegetables can prevent cardiovascular diseases. Fruits are also rich in antioxidants which delays ageing and help in lowering cholesterol level[1].Because fruits and vegetables have a high water and fiber content, they're low in calories relative to their volume. Consuming them on a regular basis can result in a higher volume of food intake. Since humans consume a consistent volume of food, a high consumption of low calorie density

foods can help to control overall food intake and manage body weight. These natural plants are rich in polyphenols and fiber and are effective in preventing cardiovascular disorder. Apples are one of them rich in polyphenols and its vinegar helps to reduce cholesterol level[2]

Epidemiological studies revels that frequent apple consumption reduces the risk of chronic pathologies such as cardiovascular disease, specific cancers, and diabetes[3, 4].Studies also proved that apple intake may positively affect lipid metabolism, reduce body weight[4] patency of blood vessels and inflammation. It is said that an apple a day keeps doctor away is proving right as apples are rich in pectin which are rich soluble fibers which it has been demonstrated are effective in lowering cholesterol levels. Real value of apple lies in its organic compounds not only compounds but it is a good source of dietary fibers which provides about 12% of daily fiber requirements.

A mixture of apple cider vinegar and olive oil over the salad dressing used in the Mediterranean diet is proved to reduce the chances of diabetes, have glucose-lowering capacity and minimizes the chances of heart attack by lowering the cholesterol level[5]. Recent studies indicate that apple cider vinegar improves insulin sensitivity also[6]**.** Blood sugar control is essential for patient with diabetes, and the polyphenols in apples have been reducing the uptake of carbohydrates by the e body, this in turn reduces the fluctuation of blood sugar levels in bloodstream. The polyphenols also lower glucose absorption in our digestivetract, and they stimulateinsulin in pancreas. And finally polyphenols stimulate the insulin receptors on cells throughout body, which removes the sugar from bloodstream and gets it to cells, which needs it for metabolism and proper organ function.

Apple cider vinegar has anti-glycemic effect and help to block the digestion of some starch; it also helps to keep the blood sugar levels on an even keel. Making sure that the sugar is balanced which incredibly influences the good health. The mechanisms by which apple cider vinegar reduces glucose levels are still unclear. Apple cider vinegar delay gastric emptying in healthy individuals[6] and in diabetes clients[4]. Apple cider vinegar suppresses the absorption of disaccharides in the small intestine and suppress the enteral carbohydrate absorption [6]. Also apple cider vinegar ingestion before sleep shown to decrease fasting glucose levels in diabetes client[7]. Apple cider vinegar reduces glycolysis and promotes glycogen synthesis by reducing xylose 5-phosphate accumulation in the liver and phosphofructokinase-1 activity in muscle[8]

In general people with fatty liver disease have no symptoms, especially in the beginning; however, some people may experience abdominal discomfort, fatigue and loss of appetite. These people may show symptoms like general feeling of being unwell and vague discomfort. This is why the proper diagnosis is important. Studies also showed that apple cider vinegar also decreases circulating lipid profile[8] and prevent fatty liver by reducing the chances of lipid accumulation in liver and skeletal muscle. The apples are rich in polyphenol which is an oligomers and polymers of flavanols and composed of epicatechin units[9]. Small peel of apple contains high levels of phenolics and flavonols[10]. Compound. Polyphenols have oxidative properties which helps to reduces the bad cholesterols[11]. Cloudy apple juice on the other hand may maintain an important polyphenol amount due to anaerobic conditions and the lack of the clarification step[12].

Apple cider vinegar have incredible benefits skin needs it, heart needs it, and even colon needs it. One of the widely known benefits is its ability to regulate cholesterols. Apple cider vinegar is a full source of vitamin C and it has phosphorus and copper. It also acts as an anti-oxidant. It lowers the bad cholesterol and monounsaturated fatty acid will elevate the good cholesterol. Apple cider vinegar along with Almonds is nutritionally rich in omega 3. [13]. According to Department of Agriculture, USA, 100 g of raw, unroasted almonds provides 579 kcal, 50 g of fat, 13 g of insoluble dietary fibre and 21 g of protein 14 and 9 g of PUFA, 36 g of MUFA and 5 g of SFA. [14]. A study shows effects of almond oil on fasting blood lipids among 27 strata. Study shows that almond regular intake of 2 to 5 gm of almond oil helps in reducing the cholesterol level by 60%[15].

Apple cider vinegar help in reducing the cardio vascular risk factors, including fasting and postprandial glucose, insulin resistance[16] and insulin secretion [17]. Daily intake of apple cider vinegar reduces the WC within the context of a weight-loss intervention and with a 9% decrease with an isocaloric, complex carbohydrate control diet[18]. Apple cider vinegar along with food as a daily snacks affects the cardiac markers, such as lipoprotein metabolism and body composition and improves heart health. It is also said to consume the overnight apple cider vinegar for the better health effect. The apple cider vinegar not only give use the better cholesterol level but also it reduces the risk for heart disease. It is shown in many researches that consumption of apple cider vinegar gives favorable plasma proteins and reduces the risk for heart disease.

Dietary pattern of each individual is different in each individual; it is affected by life style changes, diet. This is also has to do with the high unsaturated high fatty acids and vitamin C apple cider vinegar

helps the oxygen and nutrient to flow freely in blood. Adding apple cider vinegar in your diet will definitely give good health effect such as body weight reduction and anti-inflammatory properties. Study conducted by Estruch[19], Experimental group receives 1.5oz of apple cider vinegar per day and control group received same diet with a single, calorie-matched food. Results revealed that experimental group showed improvement in lipids, lipoproteins, and apolipoproteins levels and decrease abdominal adiposity in adults with elevated LDL-C. The LDL-C-lowering effect of apple cider vinegar has been reported in previous trials in hypercholesterolemic and normocholesterolemic individuals[20].

Vitamin D has vital role in for the cause of cardiovascular disease, low vitamin D cause risk for cardiovascular disease. Fat soluble vitamin D has found in very few foods; it can be added to the supplementary dietary products. Instead of which the apple cider vinegar which provides vitamin C, Magnesium and copper reduces the risk for heart disease will definitely prove great change. Apple cider vinegar has unique fat reducing property by accelerating lipolysis makes almond a cardio protective agent. Griel et al[21]reported that lipid-lowering effects of apple cider vinegar extend beyond the fatty acid profiles.

Objectives

1. To assess the effectiveness of apple cider vinegar on serum cholesterol level.
2. To compare the serum cholesterol level and LDL after apple cider vinegar therapy.
3. To determine the association between socio demographical data with observed serum cholesterol level.

Hypothesis

H_0: There is no significant difference between the serum cholesterol level of experimental and control group.

Methodology

The research approach used for this study was experimental approach with pretest-post test only design. Sample was selected randomly (20 experimental and 20 control). Both the groups were undergone pretest and then the post test of both experimental and control group was compared by using t-test, to assess the effectiveness of apple cider vinegar therapy. Data were collected by collecting the blood lipid profile of all subjects (Fasting).

Results

Part- 1 Sample characteristics

Table 1:_Frequency, percentage and cumulative percentage of men according to their AGE N= 20 (EXPERIMENTAL GROUP)

Age in years		Frequency	Percent	Valid Percent	Cumulative Percent
	18	1	5.0	5.0	5.0
	20	2	10.0	10.0	15.0
	21	1	5.0	5.0	20.0
	29	1	5.0	5.0	25.0
	31	1	5.0	5.0	30.0
	32	1	5.0	5.0	35.0
	34	2	10.0	10.0	45.0
	36	1	5.0	5.0	50.0
	38	1	5.0	5.0	55.0
	39	2	10.0	10.0	65.0
	41	1	5.0	5.0	70.0
	44	1	5.0	5.0	75.0
	54	1	5.0	5.0	80.0
	56	1	5.0	5.0	85.0
	62	2	10.0	10.0	95.0
	68	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

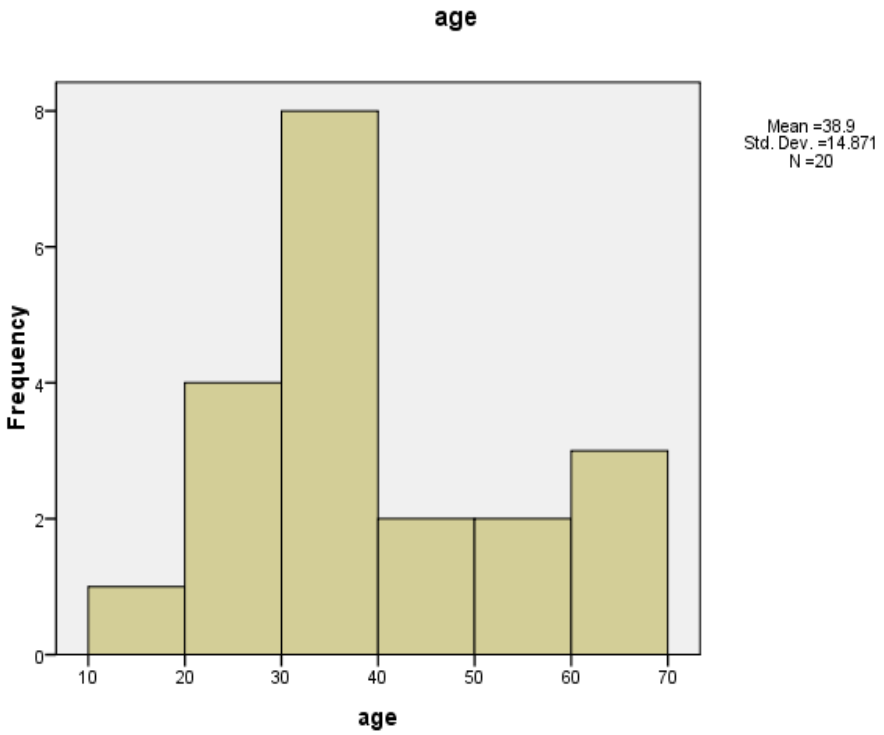

Table 1 depicts: Majority of subjects (84%) were in age group of 30-40 years, and 10% were in age group of 41-50 years and only 6% were having age more than 50 years.

Table 2: Frequency, percentage and cumulative percentage according to their diet pattern, N= 20 (EXPERIMENTAL GROUP)

	Diet pattern	Frequency	Percent	Valid Percent	Cumulative Percent
	Non Veg	9	45.0	45.0	45.0
	Veg	11	55.0	55.0	100.0

	Total	20	100.0	100.0	

Table 2: Depicts that, Out of 20 subjects, 45% were non-vegetarian and 55%were vegetarian in experimental group.

Table 3: Frequency, percentage and cumulative percentage of according to their height, N= 20 (EXPERIMENTAL GROUP)

	Height in cm	Frequency	Percent	Valid Percent	Cumulative Percent
	167	1	5.0	5.0	5.0
	168	1	5.0	5.0	10.0
	170	5	25.0	25.0	35.0
	172	5	25.0	25.0	60.0
	174	1	5.0	5.0	65.0
	175	2	10.0	10.0	75.0
	178	1	5.0	5.0	80.0
	179	2	10.0	10.0	90.0
	180	1	5.0	5.0	95.0
	185	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Table 3 depicts that, majority (65%) was having height between, 170-175 cm and 20% have height between 176-180cms and 5% have height between 181-185cms.

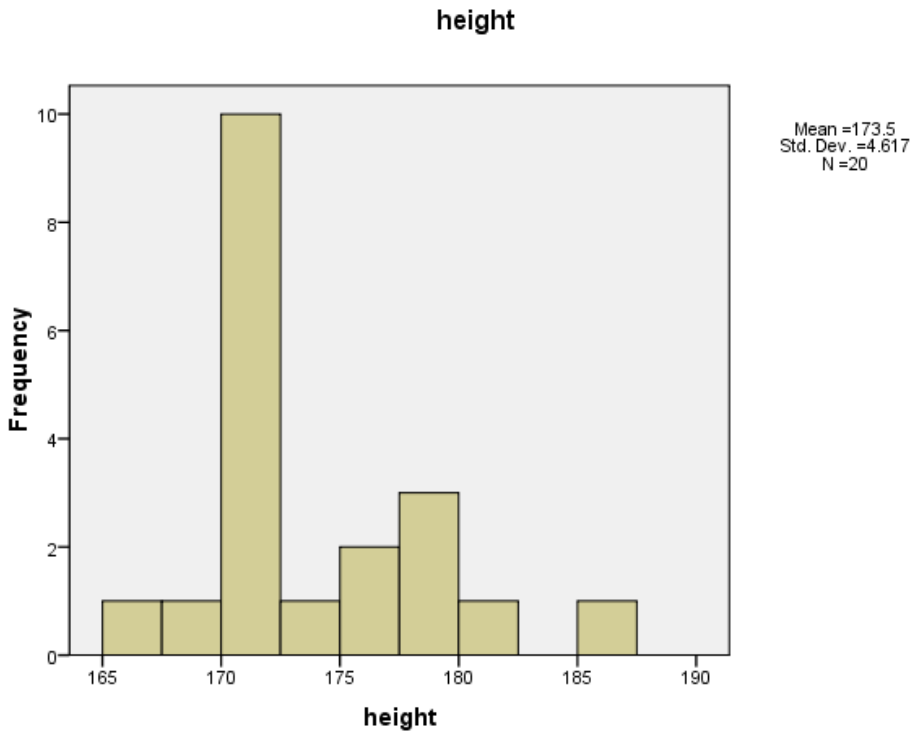

Table 4: Frequency, percentage and cumulative percentage of according to their weight, N= 20 (EXPERIMENTAL GROUP)

	Weight in kg	Frequency	Percent	Valid Percent	Cumulative Percent
	52	1	5.0	5.0	5.0
	54	2	10.0	10.0	15.0
	56	2	10.0	10.0	25.0
	59	1	5.0	5.0	30.0
	60	2	10.0	10.0	40.0
	62	1	5.0	5.0	45.0
	64	1	5.0	5.0	50.0
	65	2	10.0	10.0	60.0
	66	1	5.0	5.0	65.0
	67	1	5.0	5.0	70.0
	68	1	5.0	5.0	75.0
	73	1	5.0	5.0	80.0

	75	1	5.0	5.0	85.0
	77	1	5.0	5.0	90.0
	80	1	5.0	5.0	95.0
	81	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Table 4, depicts that 15% subjects have body weight between 50- 55 kg, 25% subjects have body weight between 56-60 kg, 20% have body weight between 61-65 kg, 15% have body weight between 66-70 kg, 10% have between 71-75 kg and 10% have body weight between 76-80 kg.

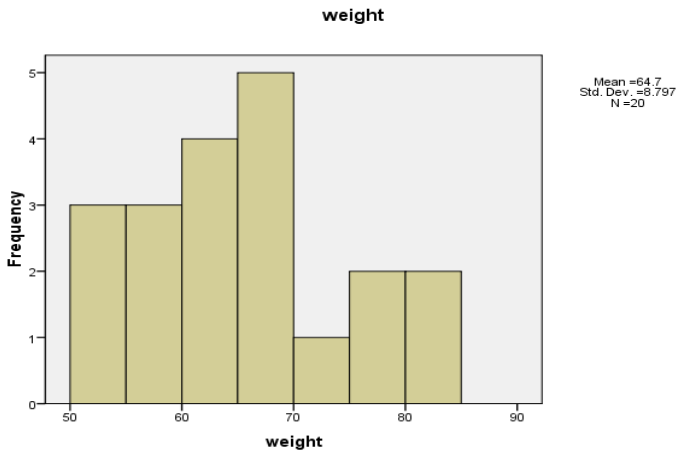

Table 5, Mean, median and standard deviation score of total cholesterol for experimental and control group, N= 40

Paired Samples Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
	Experimental grp	132.0	20	18.8	4.2
	Control grp	141.0	20	23.3	5.2

Table 5 depicts that the Mean and SD of experimental group is 132±18.8 with standard error of 4.2 on the other hand control group has 141.0±23.3 with standard error of 5.2.

Table 6, **t-test score of total cholesterol for experimental and control group, N= 40**

(Post test comparison of Experimental and Control group)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
	EXPERIMENTAL (cholesterol)CONTROL (cholesterol)	9.000	6.325	1.414	6.040	11.960	6.364	19	.002

TABLE 6, Depicts that at 5% level of significance the t-test value is 6.364 at degree of freedom 19, which is less than tabled value, so we rejects the null hypothesis. Hence the results are significant (p=.002). It means the serum cholesterol values decreases after regular consumption of apple cider vinegar in experimental group. So it proves that Apple cider vinegar has significant effect on total serum cholesterol level.

Table 7, t-test score of serum LDL for experimental and control group, N= 40.

	Mean	N	Std. Deviation	Std. Error Mean
LDL(EXP)	31.45	20	15.869	3.549
LDL (CONTR OL)	41.90	20	18.812	4.206

Table 7 depicts that the Mean and SD of experimental group is 31.4±15.8 with standard error of 3.5 on the other hand control group has 41±18.8 with standard error of 4.2.

Table: 8- t-test score of serum LDL for experimental and control group, N= 40.

(Post test comparison of Experimental and Control group)

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
EXP LDL CONT LDL	-.450	18.216	4.073	8.976	8.076	110	19	.003

TABLE 8, Depicts that at 5% level of significance the t-test value is 11.1 at degree of freedom 19, which is less than tabled value, so we rejects the null hypothesis. Hence the results are significant (p=.0031). It means the serum LDL values decreases after regular consumption of apple cider vinegar in experimental group. So it proves that Apple cider vinegar has significant effect on LDL.

TABLE 9- **Association between weight, age and height with cholesterol level of subject.**

Test Statistics

	Age	Height	Weight	Cholesterol
Chi-Square	2.400[a]	12.000[b]	2.400[a]	2.100[c]
df	15	9	15	16
Asymp. Sig.	1.000	.213	1.000	1.000

The data presented in **table 9** shows the association between weight, age and height with serum cholesterol level, which were not found to be significant at 5% of level of significance.

CONCLUSION

Angioplasty and various cardiac interventions are available now days to save the life of heart. Unhealthy life style, unhealthy food pattern, sedentary life style is the contributor factors that increase the risk of cardiac disorders. But if one include such supplement in the life style which makes the heart healthy by normalizing the serum cholesterol then life become easier and less risky. So this study proves such a intervention that is apple cider vinegar, which significantly reduces the raised serum

cholesterol level. Apple cider Vinegars is known for its best of vinegar as the main effect of it is to help to get rid of the fats around the liver. When it is consumed it has gentle effect on the digestive tract as compared to the other forms of the vinegar. It has also got the special ability to breakdown the fats over a period of time and that will help in easy and healthy functioning of the kidneys bladder and liver. The apple cider vinegar has acidic properties which will reduce the irritability and inflammation of the liver.

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References:

1. Jenkins DJ proved that consumption of Almond reduce LDL-cholesterol concentrations and increase HDL-cholesterol concentrations in hyperlipidaemic individuals[22]

2. Jenkins DJ, Kendall CW, Marchie A, et al. (2002) Dose response of almonds on coronary heart disease risk factors: blood lipids, oxidized low-density lipoproteins, lipoprotein(a), homocysteine, and pulmonary nitric oxide: a randomized, controlled, crossover trial. Circulation106, 1327–1332 [PubMed]

3. Wojdylo A., Oszmianski J., Laskowski P. Polyphenolic compounds and antioxidant activity of new and old apple varieties. J. Agric. Food Chem. 2008;56:6520–6530. doi: 10.1021/jf800510j. [PubMed] [Cross Ref]
4. Koutsos A., Lovegrove J.A. An apple a day keeps the doctor away: Inter-relationship between apple consumption, the gut microbiota and cardiometabolic disease risk reduction. In: Tuohy K., Del Rio D., editors. Diet-microbe interactions in the gut: Effects on human health and disease. Academic Press, Elsevier; London, UK: 2015. pp. 173–194.

5. Arts I.C.W., Jacobs D.R., Harnack L.J., Gross M., Folsom A.R. Dietary catechins in relation to coronary heart disease death among postmenopausal women. Epidemiology. 2001;12:668–675. doi: 10.1097/00001648-200111000-00015. [PubMed] [Cross Ref]
6. Knekt P., Kumpulainen J., Jarvinen R., Rissanen H., Heliovaara M., Reunanen A., Hakulinen T., Aromaa A. Flavonoid intake and risk of chronic diseases. Am. J. Clin. Nutr. 2002;76:560–568. [PubMed]
7. Proctor M., Murphy A. P. Herbal and dietary therapies for primary and secondary dysmenorrhoea. *Cochrane Database of Systematic Reviews*. 2009;3 doi: 10.1002/14651858.CD002124.CD002124 [PubMed] [Cross Ref]
8. The Ministry of Health. Traditional and Complementary Medicine Practices Regulation [07.01.2015] http://www.resmigazete.gov.tr/eskiler/2014/10/20141027-3.htm.
9. Beebe-Dimmer J. L., Pfeifer J. R., Engle J. S., Schottenfeld D. The epidemiology of chronic venous insufficiency and varicose veins. *Annals of Epidemiology*. 2005;15(3):175–184. doi: 10.1016/j.annepidem.2004.05.015. [PubMed] [Cross Ref]
10. Jeanneret C., Karatolios K. Varicose veins: a critical review of the definition and the therapeutical options. *Vasa*. 2011;40(5):344–358. doi: 10.1024/0301-1526/a000131. [PubMed] [Cross Ref]
11. Budak N. H., Aykin E., Seydim A. C., Greene A. K., Guzel-Seydim Z. B. Functional properties of vinegar. *Journal of Food Science*. 2014;79(5):R757–R764. doi: 10.1111/1750-3841.12434. [PubMed] [Cross Ref]
12. Fukami H., Tachimoto H., Kishi M., et al. Continuous ingestion of acetic acid bacteria: effect on cognitive function in healthy middle-aged and elderly persons. *Anti-Aging Medicine*. 2009;6(7):60–65. doi: 10.3793/jaam.6.60. [Cross Ref]
13. Sugiyama K., Sakakibara R., Tachimoto H., Kishi M., Kaga T., Tabata I. Effects of acetic acid bacteria supplementation on muscle damage after moderate-intensity exercise. *Anti-Aging Medicine*. 2009;7(1):1–6. doi: 10.3793/jaam.7.1. [Cross Ref]
14. Honsho S., Sugiyama A., Takahara A., Satoh Y., Nakamura Y., Hashimoto K. A red wine vinegar beverage can inhibit the renin-angiotensin system: experimental evidence in vivo. *Biological and Pharmaceutical Bulletin*. 2005;28(7):1208–1210. doi: 10.1248/bpb.28.1208. [PubMed] [Cross Ref]
15. Farquhar JW (1996) Plant sterols: their biological effects in humans In Handbook of Lipids in Human Nutrition, pp. 101–105 [Spiller G, editor]. Boca Raton, FL: CRC Press.
16. Maguire LS, O'Sullivan SM, Galvin K, et al. (2004) Fatty acid profile, tocopherol, squalene and phytosterol content of walnuts, almonds, peanuts, hazelnuts and the macadamia nut. Int J Food SciNutr 55, 171–178. [PubMed]

17. Phillips KM, Ruggio DM & Ashraf-Khorassani M (2005) Phytosterol composition of nuts and seeds commonly consumed in the United States. J Agric Food Chem 53, 9436–9445. [PubMed].
18. Fraser GE, Shavlik DJ. Risk factors for all-cause and coronary heart disease mortality in the oldest-old: the Adventist Health Study. Arch Intern Med. 1997; 157:2249-2258. [PubMed]