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Full Length Research Paper

Effects of probiotic yoghurt consumption on the serum cholesterol levels in hypercholestromic cases in Shiraz, Southern Iran

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This study was conducted to see the effects of probiotic yoghurt on serum cholesterol levels. About 4% of the deaths in Iran are due to cardiovascular diseases and hypercholesterolemia is among the aggravating factors. Diet therapy and cholesterol lowering agents are the treatments recommended. Probiotics are being investigated as cholesterol lowering agents. The study was carried out with 46 individuals with cholesterol levels between 200 - 304 mg/dl. Initially, they received 200 ml/day sterilized milk for 4 weeks and were instructed not to consume yoghurt. At the beginning, blood samples were collected for measuring total cholesterol, triglyceride, LDL *(*Low-density lipoprotein) and HDL (High-density lipoprotein) levels. Group A received 300 g/day probiotic yoghurt and group B received normal yoghurt of the same amount for 6 weeks. Again blood samples were collected and analyzed. In the next round, the groups reversed their consumption patterns. Again blood samples were collected and analyzed. The results were indicative of the reducing effects of probiotic yoghurt on total cholesterol and LDL levels and raising effect on HDL. The difference between the reduced levels of LDL in both treatments was statistically significant. Consumption of the probiotic yoghurt containing *Lactobacillus acidophilus* and *Bifidobacteria* results in the decreased total cholesterol and LDL and increased HDL.

Key words: *Lactobacillus acidophilus*, *Bifidobacteria*, total cholesterol, LDL, HDL.

INTRODUCTION

Cardiovascular diseases are the most serious cause of mortalities in most countries including Iran (Pan and Zhang, 2008). As statistics shows, about 4% of the deaths in Iran are due to such diseases (Lebsors, 2007). Hypercholesterolemia is among the remarkable aggravating factors in cardiovascular diseases (Pan and Zhang, 2008). According to the reported studies, the prevalence rate of hypercholesterolemia among individuals over 15 years of age is 11% (Bruckert, 2006). It has been recognized for many years that elevated serum cholesterol concentration is a risk factor associated with atherosclerosis and coronary heart disease (Barr et al., 1951). As demonstrated, each 1% reduction of the cholesterol level results in 2.3% reduction of the coronary related risks. Therefore, lowering the cholesterol level can best serve in reducing the mortalities caused by the cardiovascular diseases in Iran.

Diet therapy, food intervention and cholesterol lowering agents are among the treatments recommended

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(Bruckert, 2006). Numerous drugs that lower cholesterol have been used to treat hypocholesterolemic individuals (Berg, 1979). However, the undesirable side effects of these compounds have caused concerns about their therapeutic use (Erkelens et al., 1988).

Ingestion of probiotic lactic acid bacteria possibly would be a more natural method to decrease serum cholesterol concentrations in humans (McNamara et al., 1989). Probiotics are being investigated as lowering agents. Probiotics, the useful microbes, play a critical role in sustaining health condition and they can create a balance between the useful and harmful microbes, once they are settled in the intestines (particularly the distal end of large intestine) and as a result leave positive impacts on the organs and especially the digestive tract (Fuller, 1992). So this study was conducted to see the effects of probiotic yoghurt on serum cholesterol in some individuals.

Cardiovascular diseases and the related complications are among serious health issues in modern times. Both national and international figures are indicative of high prevalence rates of such conditions, increasing referrals to health centers, and rising mortality rates.

High cholesterol level is a major causative agent. Dietary and nutritional cares, daily balanced food ingredients and avoiding overuse of fats especially saturated ones can help ward off the fat deposit in tissues and blood vessels.

Investigations involving the role of probiotics in preventing the increased level of total cholesterol, LDL and balancing the LDL and HDL levels and consequently preventing and reducing the rate of cardiovascular diseases and mortalities which have been reported in numerous studies.

Probiotics are the useful microbes which play an influential role in maintaining human health condition, as shown in reported studies across the world. The following are the positive contributions of probiotics to health conditions in humans:

1. Treatment of severe infections, diarrhea especially in children
2. Preventing microbial, hospital acquired and travelers' diarrheas and also antibiotic induced diarrhea
3. Preventing the occurrence of atopic diseases
4. Preventing the allergic conditions
5. Preventing the post surgery infections
6. Lowering the blood cholesterol level, balancing LDL and HDL levels and raising HDL levels
7. Controlling, preventing, and treating gastric ulcer caused by Helicobacter pylori

Mann and Sporry were among the first investigators who demonstrated the reducing effects of fermented milk on cholesterol concentration (Gary et al., 2000). Gillard et al. (2000) from Oklahoma University conducted several studies on the absorption and decomposition of cholesterol by *Lactobacillus acidophilus in vitro* and the results confirmed the capabilities of such bacteria in absorbing and decomposing cholesterol.

There are different mechanisms responsible for the reduced serum cholesterol by the bacteria, the most important of which are as follows:

1. Deconjugation of bile, bile salt and cholesterol deposit through deconjugation of the bile.
2. Hydrolysis of bile salts and bond with bile and lack of bile reabsorption
3. Increasing absorption of cholesterol by the bacteria

To ensure the reducing effect of probiotics on the cholesterol through the above- mentioned mechanisms, the probiotic microorganisms including *L. acidophilus* and *Bifidobacteria* should pass through the digestive tract intact and alive and then reach their activity locus in the large intestine.

Although the same reducing effects have been observed in the bacteria existing in the normal yoghurt under lab conditions, the reason why they are as effective as *Lactobacillus delbrueckii subsp. bulgaricus* and *Streptococcus thermophilus* in the probiotic yoghurt is that they cannot pass through the above mentioned route intact and alive (Naruszewicz et al., 2002). So, this study was conducted to see the effects of probiotic yoghurt on serum cholesterol in some individuals.

METHODS

This is a cross-sectional prospective study which is one side blinded. Having reviewed the periodic blood tests results in Fars Pegah dairy Company staff and Shiraz university of Medical Sciences personnel, 46 participants of the age range of 20 - 67 years with serum total cholesterol level of 200 - 304 mg/dl were enrolled in the study. The procedures were under the supervision of the trained physician team and the informed written consents were obtained from the participants. As the physician instructed, the participants were not allowed to take reducing cholesterol medications and they were examined for history of cardiovascular diseases, diarrhea, and renal disorders. During the study, consumption of cholesterol reducing or raising agents was not allowed.

Initially blood samples were taken from all the participants which was carried out in Shiraz Pasteur Lab to measure total cholesterol LDL and HDL levels and the results were recorded. Height and weight measurements were also performed and the data were recorded. The participants were also instructed not to change their diets or physical activities and were asked to promptly report any sudden change or complications in their conditions to the physician team.

For four weeks, the subjects consumed 200 cc/day low fat sterilized milk and were asked not to have yoghurt. Then they were divided into two groups; the first group consisting of Shiraz University of Medical sciences personnel and the second were selected from Fars Pegah Dairy company staff. At the outset, blood samples were taken for measuring LDL and HDL.

The first group received 300 gr/day of probiotic yoghurt containing *L. acidophilus* and *Bifidobacteria* for 6 weeks and parallel to it the second group received 300 gr/day of normal yoghurt containing *L. delbrueckii subsp. bulgaricus* and *S. thermophilus*. Following this period, blood samples were taken to measure

Table 1. Serum lipid indexes for the period of normal and probiotic yoghurt consumptions.

	Normal yogurt	Probiotic yogurt	t	p
Cholestrol	-9.73- ± 36.68	-16.59 ± 31.27	-0.893	0.379
LDL	7.99 ± 30.42	- 20.16 ± 25.13	-3.301	0.003
HDL	1.93 ± 9.98	2.17 ± 12.86	0.073	0.973
TG	51.04 ± 102.33	-3.36 ± 84.055	-1.87	0.07

total cholesterol, LDL and HDL levels, and the results were recorded.

Afterwards, both groups received 200 ml/day sterilized milk for an interval of 4 weeks. Prior to the second phase of the study, blood samples as previously mentioned, were taken for all the subjects in both groups. It is worth mentioning that all the milk products including sterilized milk, normal and probiotic yoghurts are produced by Fars Pegah Dairy Company, Shiraz, Iran. Data analysis was done using SPSS version 11. Paired t test was used for comparing the quantitative variables and p values less than 0.05 were considered significant.

RESULTS

The study was carried out on 46 individuals consisting of 14 females and 32 males. Because of medical reasons and personal problems, 11 cases were excluded from the second phase of the study. The results indicated that LDL level was significantly reduced following the consumption of probiotic yoghurt but this was not the case with normal yoghurt consumption (p = 0.003). The differences between total cholesterol and LDL levels following the consumption of probiotic and normal yoghurts were not significant. The other factors including total cholesterol with 31.5 units of average reduction and HDL with 14 units average increase were not significant and meaningful statistically (Table 1).

DISCUSSION

Considering the above mentioned findings, we can suggest that probiotic yoghurt containing 10^6 counts of *L. acidophilus* and *Bifidobacteria* per milliliter can significantly reduce the LDL level (p = 0.003). Also, the reduced level of cholesterol in the first group following the consumption of probiotic yoghurt was 30 units which was significant (p = 0/00.). The finding that bifidobacterium-fermented milk lowers serum total cholesterol concentrations agrees with data from other studies involving various milk products containing selected strains of lactic acid bacteria. These results were in agreement with the results of another study done in Iran which concluded that Consumption of probiotic yogurt in comparison with ordinary yogurt caused a significant decrease in serum total cholesterol (Ataie-Jafari et al., 2009).

In another study done by Xiao et al. (2003) on rats, they also concluded that probiotics have the potential to improve serum lipid, but the only difference in this study was the bacteria strain which was different from the present study. Randomized, double-blind, and placebo controlled studies also demonstrated significant reductions in serum total cholesterol and LDL-cholesterol by a milk product fermented with *Enterococcus faecium* and two strains of *S. thermophilus* (Agerbak et al., 1995; Richelsen and Kristensen, 1996). Kiessling and Schneider (2002) observed that consumption of yogurt increased the serum concentration of HDL-cholesterol and lead to the desired improvement of the LDL/HDL cholesterol ratio (Kiessling and Schneider, 2002).

However, regarding the type of study (intervention) and reduced 20 units in the second group, the reduction is not statistically significant.

Furthermore, the reduced total cholesterol level in the second group following the consumption of probiotic yoghurt (31.55 unit) was significant (p = 0.001). The results suggest that decreased total cholesterol and LDL levels and increased HDL levels are due to the capabilities of probiotic bacteria including *L. acidophilus* and *Bifidobacteria* to reduce the cholesterol level through cholesterol absorption mechanism in the cell walls, the decongugation of bile (biliary salts) and biliary salt hydrolysis. The insignificant decrease of total cholesterol levels and increased HDL levels, despite the significant decrease of total cholesterol level in both groups following the consumption of probiotic yoghurt and significant increase of HDL level in the first group following the probiotic yoghurt intake, all can be attributed to the participants' avoidance in taking the given food, attention to serum total cholesterol level and increased physical activities in the second group coming from Fars Pegah Milk Company. The results also lend support to the hypothesis that significant LDL reduced levels occur in the cases with mild to moderate hypercholesterolemia. Meanwhile, the reduced levels of total cholesterol in both groups following the consumption of probiotic yoghurt was significant. Following the intervention, the difference was no longer significant.

The mechanisms of serum lipid improvement have been suggested from *in vitro* and *in vivo* studies. *In vitro* experiments demonstrated that intestinal lactic acid bacteria have the capacity to assimilate and bind cholesterol as well as bile acids with the bacterial cells (Gilliland et al., 1985). From these results, it is conceivable that serum total cholesterol is reduced by inhibiting absorption in the intestine as a result of the assimilation and binding of cholesterol as well as bile acids by the

lactic acid bacteria. Promotion of bile acid excretion due to deconjugation to produce free bile acids was proposed as another mechanism for serum lipid improvement. It is known that the serum cholesterol level decreases when a component suppresses resorption of bile acid in the intestine because the catabolism of cholesterol is promoted in the liver.

Further studies could be conducted on individuals who are strictly controlled. Finally, as the study demonstrated, it is suggested that individuals with hypercholesterolemia (Mild to moderate cases) consume probiotic yoghurt containing *L. acidophilus* and *Bifidobacteria* with the amount of 10^6 counts per ml. The consumption can reduce LDL levels in such cases.

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