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ORIGINAL

The effect of kefir consumption on the lipid profile for individuals with normal and dyslipidemic properties: a randomized controlled trial

O efeito do consumo de kefir no perfil lipídico em indivíduos com propriedades normais e dislipidêmicas: um ensaio clínico randomizado

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ABSTRACT

Objective

This research was conducted as a prospective, self-controlled, eight-week clinical trial to investigate the effect of kefir consumption on the lipid profile of individuals with normal and dyslipidemic properties.

Methods

Kefir microorganisms given to volunteer subjects were determined using classical microbial count methods and qReal-Time Polymerase Chain Reaction. The study was carried out with 23 volunteer hospital health personnel between the ages of 20 and 55 who met the research criteria and did not have any health problems. The volunteers regularly consumed kefir on an empty stomach for four weeks. In the last stage, the eight-week study was completed by making blood and anthropometric measurements of the subjects, who continued to be studied without kefir consumption for four more weeks

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Results

Considering the changes in the serum lipid profiles of 13 individuals with dyslipidemic symptoms during the 4-week period they consumed kefir, Total Cholesterol values decreased by 9.15% compared to initial values, LDL-Cholesterol values decreased by 10.64%, HDL-Cholesterol values decreased by 6.9%, and triglyceride values decreased by 2.46%. The changes in the serum lipid profiles of 13 individuals with dyslipidemic findings at the end of an eight-week study were a 5.71% decrease in total cholesterol values ($p<0.018$) considered statistically significant, as well as a 5.31% decrease in LDL-Cholesterol values ($p<0.021$); the HDL-Cholesterol results were found to be significant with an 8.58% decrease in the values ($p<0.035$) and insignificant with a 17.21% increase in the triglyceride values ($p<0.926$). We concluded that regular kefir consumption was effective in both women and men in lowering total cholesterol and LDL-Cholesterol from blood lipid profiles, especially in individuals with dyslipidemic symptoms, while this effect was not observed in normal individuals.

Conclusion

Kefir can positively affect the total cholesterol and LDL-Cholesterol blood parameters of dyslipidemic individuals with high serum lipid values.

Keywords: Cholesterol. Dyslipidemia. Kefir. Probiotics. Triglycerides.

RESUMO

Objetivo

Esta pesquisa foi conduzida como um ensaio clínico prospectivo e autocontrolado de oito semanas para investigar o efeito do consumo de kefir no perfil lipídico de indivíduos com propriedades normais e dislipidêmicas.

Métodos

Microrganismos kefir dados a voluntários foram determinados usando métodos clássicos de contagem microbiana e de reação em cadeia da polimerase em tempo real. O estudo foi conduzido em 23 profissionais de saúde de hospitais voluntários, com idades entre 20 e 55 anos, que atendiam aos critérios da pesquisa e não apresentavam problemas de saúde. Os voluntários consumiram kefir com o estômago vazio regularmente durante quatro semanas. No último estágio, o estudo de oito semanas foi concluído com medidas de sangue e antropométricas dos indivíduos, que continuaram a ser avaliados sem consumo de kefir por mais quatro semanas.

Resultados

Considerando as mudanças nos perfis lipídicos séricos de 13 indivíduos com sintomas dislipidêmicos durante o período de quatro semanas em que consumiram kefir, os valores de colesterol total diminuíram em 9,15% em comparação com os valores iniciais; os valores de LDL-Colesterol diminuíram em 10,64%, os valores de HDL-Colesterol diminuíram em 6,9% e os valores de triglicerídeos diminuíram em 2,46%.

Ao final de um estudo de oito semanas, o resultado foi considerado estatisticamente significativo, com queda de 5,71% nos valores de colesterol total ($p<0{,}018$); de 5,31% nos valores de Colesterol-LDL ($p<0{,}021$) e de 8,58% nos valores de HDL-Colesterol ($p<0{,}035$), e insignificantes com aumento de 17,21% nos valores de triglicerídeos ($p<0{,}926$).

Como resultado do estudo, concluiu-se que o consumo regular de kefir foi eficaz em mulheres e homens na redução do colesterol total e do LDL-Colesterol dos perfis de lipídios no sangue, especialmente em indivíduos com sintomas dislipidêmicos, enquanto esse efeito não foi observado em indivíduos normais.

Conclusão

O kefir pode afetar positivamente os parâmetros sanguíneos do colesterol total e do LDL-Colesterol de indivíduos dislipidêmicos com altos valores de lipídios séricos.

Palavras-chave: *Colesterol. Dislipidemias. Kefir. Probióticos. Triglicerídeos.*

INTRODUCTION

Cardiovascular Diseases (CVD) are the major cause of death worldwide, and dyslipidemia is considered one of the most important risks for these diseases. In order to reduce dyslipidemic symptoms in CVD, sustainable changes must be made in social life and nutrition such as "dietary changes, quitting smoking, losing weight in obese patients, reducing alcohol consumption, and increasing physical activity" (Kılıçarslan and Şahin [1]).

Cardiovascular diseases associated with dyslipidemia are considered among the most important causes of death or disability in several countries. Therefore, serum lipid levels' standard values are vital, especially in terms of reducing these diseases' risk factors. One of the positive effects of functional products containing probiotic bacteria on our health is that they reduce serum lipid levels. In recent studies, the consumption of functional foods and probiotic foods added to the diet is often recommended as they contribute to the correction of dyslipidemic symptoms. There is increasing evidence that diets supplemented with probiotic and symbiotic-containing functional foods that can interfere with the intestinal flora and protect the beneficial bacteria of the digestive system have effects that prevent and reduce the risk factors for CVD [2].

The consumption of prebiotics and probiotics from functional foods may be an alternative strategy for preventing and reducing the effects of cardiovascular and metabolic diseases for the healthy development of intestinal microbiota. Moreover, the beneficial effects of kefir, a mixture of yeast and probiotics, have been a striking and widely researched topic [3].

A fermented beverage, kefir's health benefits are related to the diversity of the probiotic bacteria available in it. It is known that kefir makes an additional contribution to the treatment of many diseases, from the immune system to inflammatory bowel diseases, from lowering serum LDL-Cholesterol (LDL-C) and Triglyceride (TG) levels to controlling lactose intolerance [4].

In the study conducted by Jones *et al.* [5] on hypercholesteroleomic individuals, when comparing the initial anthropometric measurements of the group given yogurt containing Lactobacillus reuteri and the group given placebo yogurt, their weight and body mass indexes were 76.05-76.02kg and 26.04-26.09 kg/m^2, respectively, and there was no statistically significant difference (p>0.05) between these measured values [5].

Five strains (L. Delbrueckii subsp. delbrueckii LS-1, L. pentosus LS-2, L. plantarum1 LS-11, L. plantarum1 LS-12, and L. fermentum2 LS-15) which have low acidity, high bile salt resistant, and high bile salt activity with an antagocytic effect, were selected in a study to determine the probiotic properties of Lactobacillus spp, and it was observed that these bacteria assimilated cholesterol between 8-55 mg/dl in different media [6].

While the efficacy of several probiotic bacteria on dyslipidemia is uncertain, Lactobacillus reuteri NCIMB 30242 (8.9--11.6%), Enterococcus faecium (5%), Lactobacillus acidophilus La5, and Bifido bacterium lactis Bb12 (0--7.5%) combinations of probiotic bacteria are effective in reducing dyslipidemia. Their effectiveness is known, and it has been determined in studies that they reduce LDL-C values. It is thought that the bacteria do this by using the mechanisms of reducing cholesterol in the cell membrane construction, converting cholesterol in the colon to coprostanol to be excreted with feces, and removing bile from the intestines by deconjugation [7]. The TC (Total Cholesterol) was significantly reduced by 0.26 mmol/l (95% CI, -0.40 to -0.12) and LDL-C (Low-Density Lipoprotein - Cholesterol) was 0.23 mmol/l (95% CI, -0.36 to -0.10), and it has been determined that TG and HDL-C (High-Density Lipoprotein – Cholesterol) values are positively affected due to the consumption of symbiotic foods in a combined systematic meta-analysis of 15 studies including 15 randomized controlled trials and 976 subjects on the effects of L.reuteri and L.plantarum, which are probiotic bacteria of fermented milk products and kefir, on lipid profile [8]. Bifidobacteria strains as well as Lactobacillus strains have been reported to cause a significant decrease in serum cholesterol levels in different studies conducted in recent years [9].

It has been supported that Lactobacillus acidophilus, which is a frequently used species whose efficacy of bacteria on hyperlipidemia differs depending on the strain used, is more effective on hyperlipidemia if compared to other strains and that it reduces total cholesterol by 2.9% [9].

This research has been planned to examine whether kefir, which contains probiotic bacteria, has an influence on the individuals' blood lipid profiles when consumed regularly, without changing the current eating habits of individuals with normal and dyslipidemic characteristics.

METHODS

Microbiological analysis of kefir

Kefir microorganisms given to volunteer subjects in the study were determined using qReal-Time PCR (Roche) and classical microbial count methods. Kefir was serially diluted and inoculated into de Man, Rogosa and Sharpe (Oxoid CM361) agar and incubated at 37 °C for 48 to 72 h under anaerobic conditions (anaerobic jars, Anaerocult C Merck) for Lactic Acid Bacteria and Potato Dextrose Agar (Oxoid CM139) at 22 °C for five days for yeast. The colonies obtained in the tests were cultured and purified. Pure bacterial cultures for species identification of isolates were performed by qReal-Time PCR (Roche). The result is given as the number of colony-forming units (cfu)/mL in the kefir solution.

Clinical Trial

The study was conducted as a prospective, self-controlled, eight-week clinical trial that included the hospital personnel aged 20 to 55 who met the inclusion criteria and who accepted to drink kefir, while having a previous history of blood lipid profile disorders or not.

The ethics committee approval required for the study was given by the Istanbul Istinye University Clinical Research Ethics Committee, and the individuals included in the study agreed to participate in it as volunteers (Ethics Committee Decision nº 2017-KAEK-120) / 2/2020.G-127).

Valid all over the world, lipid profile classification was used under the internal medicine specialist's consultation in order to determine whether 23 volunteers (13 dyslipidemic + 10 normal) who were randomly selected using the computerized randomization method and determined using the quota sampling method were normal or dyslipidemic depending on their serum lipid profiles.

The volunteers who signed the voluntary consent form were included in the study either as part of a group of subjects consuming kefir for the first four weeks or as of a group without kefir consumption for the last four weeks, without interfering with their eating habits. Participating volunteers' serum lipid profiles (Total cholesterol, LDL-cholesterol, HDL-cholesterol, Triglycerides) were measured, and anthropometric measurements (height, weight, percentage of body fat, Body Mass Index(BMI)) were first made in the study (n=23). All parameters were studied photometrically with Roche / Cobas Integra 400 plus brand analyzer series by using the Roche brand kit. The TANITA BC 418 brand body analyzer was used to measure the subjects' body weight and evaluate their body composition. By means of the general information questionnaire, personal and family disease information, physical activity, and nutritional information were obtained.

The inclusion criteria were: being between the ages of 20 and 55, being able to drink kefir regularly, being dyslipidemic or non-dyslipidemic. Non-inclusion criteria were: having liver diseases, chronic gastrointestinal system diseases, being a cancer patient, being pregnant or breastfeeding, having entered menopause, having diabetes, taking cholesterol or triglyceride-lowering medication, regularly consuming probiotic foods (kefir, probiotic yogurt, *etc*.), using nutritional supplements that may affect metabolic parameters (prebiotic, omega-3, *etc*.), being intolerant or allergic to milk and dairy products, having received antibiotic treatment one month before the study, regular alcohol consumption and smoking, and being on dietary treatment for any disease. Exclusion criteria were not to consume the drinks given during the research regularly (less than 90% consumption), getting sick and using antibiotics during the research process, the development of a situation that will lead to exclusion criteria, leaving the research voluntarily without given reasons, and any situation that may pose a risk to health during consultant doctor controls.

The kefir drinks used in the study were supplied in 250 ml glass bottles, and volunteers were allowed to consume them on an empty stomach regularly for four weeks. In the last stage, the eight-week study was completed by making blood and anthropometric measurements of the subjects, who continued to be studied without kefir consumption for four more weeks. No health problems occurred during the study for the volunteer subjects participating in it, and there were no problems related to kefir consumption.

The results were collected by the main researcher, and the statistical data were blind-evaluated. The statistical analysis was performed in IBM SPSS 23.0 (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.) statistical package program. $p<0.05$ was considered statistically significant.

RESULTS

Lactobacillus 10.54 log (cfu)/mL, Lactococcus 10.62 log (cfu)/mL, Total yeast 2.69 log (cfu)/mL, Lactobacillus acidophilus 8.25 log (cfu)/mL, Bifidobacterium 7.78 log (cfu)/mL, were the results of the analysis.

The microorganism content in kefir counted Lactobacillus kefiri, Lactobacillus kefiranofaciens subsp. kefiranofaciens, Lactobacillus kefiranofaciens subsp. Kefirgranum, Lactobacillus parakefiri, Lactobacillus acidophilus, Lactobacillus casei, Lactobacillus reuteri, Lactobacillus bulgaricus, Lactobacillus helveticus, Lactobacillus fermentum, Leuconostoc mesentereoides, Lactococcus lactis, Streptococcus thermophilus, Bifidobacterium bifidum, Acetobacter pasteurianus, Kluyveromyces marxianus, Saccharomyce scerevisiae, Kluyveromyce slactis.

Examining individuals' sex distribution, 47.8% are men and 52.2% are women. Although there was a significant difference statistically considering the result of the general comparison, no difference was found between the groups in paired comparisons. A statistically significant difference was found between the 1st measurement of weight (kg) values and the weight (kg) values in the dyslipidemic group ($p<0.005$). There was an increase in kg after the first measurement. While there is a statistically significant difference between the first and the third measurements in terms of BMI ($p<0.010$), an increase is seen in the third measurement. Although the second and third measurement values look the same, it is possible that they are not different.

Data showed that 43% presented normal nutritional status, 57% were overweight (13% obesity and 44% pre-obesity). The analysis of fat percentages finds no significant difference. When the nutrition of the subjects was not interfered with during the study, the subjects experienced an increase of 1.75% in weight. Accordingly, there was an increase in BMI values, but no significant increase in fat percentages was observed.

There were no significant differences in weight changes in the normal group ($p<0.112$). However, there was a significant difference in BMI values ($p<0.048$). When the fat percentages were examined, no statistically significant difference was found ($p<0.49$).

Considering the changes in the anthropometric findings of 13 individuals with dyslipidemic features, an average weight gain of 1.75% ($p<0.005$) was found as a significant result of the eight-week study, and accordingly, an also statistically significant ($p<0.010$) increase of BMI values by 1.58% has been found. When the percentage of fat was examined, although 1.13% ($p<0.69$) was lost, it was not found statistically significant.

Considering the changes in the anthropometric findings of 10 individuals with normal features, although an average weight gain of 1.14% ($p<0.112$) for the individuals was found insignificant as a result of the eight-week study, a 1.35% increase ($p<0.048$) for BMI values was found as significant. Also, when the normal individuals' fat percentage was examined, it was found as insignificant statistically with $p<0.49$ in spite of a 3.57% increase.

Eight-week TC values of kefir consumption of the 13 subjects were found as statistically significant in Table 2 ($p<0.018$) with a 5.71% decrease in Table 1. Eight-week changes in the LDL-C values of 13 subjects in kefir consumption were found as statistically significant ($p<0.021$) with a 5.31% decrease. Eight-week changes in the HDL-C values of 13 subjects in kefir consumption were found as statistically significant ($p<0.035$) with a decrease of 8.58%. It was found that the eight-week changes of the TG values of 13 subjects in kefir consumption were not statistically significant ($p<0.926$), with an increase of 17.21% (Table1 and 2).

When the TC values in the serum lipid profiles of the 10 subjects with normal characteristics were examined, the changes in the eight-week period resulted in a 5.33% decrease and the statistical evaluation was not found as significant with a value of $p<0.302$.

When the LDL-C values of the serum lipid profiles of the 10 subjects with normal characteristics were examined, the changes in the eight-week period resulted in a decrease of 2.67% and the statistical evaluation was not significant with a value of $p<0.831$.

Table 1 – Change rates in the biochemical findings of dyslipidemic ındividuals. Istanbul, Turkey, 2020.

First, second and third measurements	Dyslipidemic (n=13)	*p*
	mg/dl	
TC (1.measurement-initial)	237.31	
TC (2.measurement)	215.61 (-9.15%)	
TC (3.measurement)	223.76 (3.77%)	
Total change	-5.71%	0.018
LDL-C (1.measurement)	161.31	
LDL-C (2.measurement)	144.15 (-10.64%)	
LDL-C (3.measurement)	152.76 (5.97%)	
Total change	-5.31%	0.021
HDL-C (1.measurement)	44.92	
HDL-C (2.measurement)	41.84 (-6.90%)	
HDL-C (3.measurement)	41.07 (-1.85%)	
Total change	-8.58%	0.035
TG (1.measurement)	122	
TG (2.measurement)	119 (-2.46%)	
TG (3.measurement)	143 (20.16%)	
Total change	17.21%	0.926

Note: $p<0.05$ significant. HDL-C: High-Density Lipoprotein; LDL-C: Low-Density Lipoprotein; TC: Total Cholesterol; TG: Triglyceride.

Table 2 – Comparison of variables in groups. Istanbul, Turkey, 2020.

First, second and third measurements	Dyslipidemic (n=13)	Normal (n=10)
kg1	80.52±18.34[a]	68.85±10.07
kg2	81.55±18.62[b]	69.43±9.72
kg3	81.95±18.18[b]	69.64±10.02
p	**0.005**	**0.112**
BMI 1	28.1 (20.6-41)[a]	23.4 (18.9-33.4)
BMI 2	28.4 (20.7-41.4)[ab]	23.7 (19.1-33.5)
BMI 3	28.4 (20.7-41.4)[b]	23.9 (18.5-33.4)
p	**0.010**	**0.048***
TC1	237.31±63.11	183.9±34.33
TC2	215.62±53.98	175.7±39.34
TC3	223.77±60.31	174.1±40.64
p	**0.018***	**0.302**
LDL1	161.31±58.50	97.7±24.12
LDL2	144.15±49.50	95.7±27.31
LDL3	152.77±53.86	95.1±30.00
p	**0.021***	**0.831**
HDL1	44.92±8.62	70.4±20.68
HDL2	41.85±8.97	65.1±20.42
HDL3	41.08±8.18	61.4±18.16
p	**0.035***	**0.013**
TG1	122 (72-538)	75.5 (51-118)
TG2	119 (61-341)	67 (37-129)
TG3	143 (53-371)	85 (47-165)
p	**0.926**	**0.122**

Note: Descriptive statistics are expressed as mean±standard deviation or median (minimum-maximum). Numbersin bold: $p<0.05$.
[a,b,ab]: Values with different letters are different from each other ($p<0.05$), values with the same letter are not different ($p>0.05$). *Although there was a statistically significant difference as a result of the general comparison, no difference was found between the groups in paired comparisons. $p<0.05$ significant. BMI: Body Mass Index; HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein; TC: Total Cholesterol; TG: Triglyceride.

Table 3 – Comparison of variables between groups. Istanbul, Turkey, 2020.

First, second and third measurements	Dyslipidemic (n=13)	Normal (n=10)	*p*
kg1	80.52±18.34	68.85±10.07	0.085
kg2	0.01±0.02	0.01±0.02	0.660
kg3	0.02±0.02	0.01±0.02	0.480
BMI1	28.1 (20.6-41)	23.4 (18.9-33.4)	0.131
BMI2	0.01 (-0.01-0.05)	0.01 (-0.03-0.03)	0.927
BMI3	0.01 (-0.01-0.08)	0.02 (-0.02-0.04)	0.738
%F1	29.08±9.57	28.39±12.5	0.881
%F2	0±0.07	0.06±0.19	0.311
%F3	-0.01±0.07	0.04±0.15	0.366
TC1	237.31±63.11	183.9±34.33	0.025
TC2	-0.08±0.12	-0.05±0.1	0.454
TC3	-0.05±0.1	-0.05±0.12	0.963
LDL1	161.31±58.5	97.7±24.12	0.004
LDL2	-0.1±0.15	-0.02±0.13	0.212
LDL3	-0.04±0.13	-0.03±0.12	0.864
HDL1	44.92±8.62	70.4±20.68	0.004
HDL2	-0.07±0.09	-0.07±0.1	0.858
HDL3	-0.08±0.13	-0.12±0.15	0.470
TG1	122 (72-538)	75.5 (51-118)	0.003
TG2	-0.07 (-0.37-1.6)	-0.12 (-0.44-0.58)	0.648
TG3	-0.09 (-0.35-0.82)	0.06 (-0.29-0.49)	0.376

Note: $p<0.05$ significant. F: Fat; HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein; TC: Total Cholesterol; TG: Triglyceride.

When HDL-C values of the serum lipid profiles of the 10 subjects with normal characteristics were examined, the changes in the eight-week period resulted in a decrease of 12.79%, and it was statistically significant with a value of $p<0.0132$.

When the TG values of the serum lipid profiles of 10 subjects with normal characteristics were examined, the change in the eight-week period resulted in a 12.65% increase, and the statistical evaluation was not found significant with a value of $p<0.122$ (Figure 1) (Tables 3 and 4).

Table 4 – Comparison of variables' within-group of serum lipid profiles. Istanbul, Turkey, 2020.

First, second and third measurements	Dyslipidemic (n=13)	Normal (n=10)
TC1	237.31±63.11	183.9±34.33
TC2	215.62±53.98	175.7±39.34
TC3	223.77±60.31	174.1±40.64
p	0.018*	0.302
LDL1	161.31±58.50	97.7±24.12
LDL2	144.15±49.50	95.7±27.31
LDL3	152.77±53.86	95.1±30.00
p	0.021*	0.831
HDL1	44.92±8.62	70.4±20.68
HDL2	41.85±8.97	65.1±20.42
HDL3	41.08±8.18	61.4±18.16
p	0.035*	0.013
TG1	122 (72-538)	75.5 (51-118)
TG2	119 (61-341)	67 (37-129)
TG3	143 (53-371)	85 (47-165)
p	0.926	0.122

Note: **p*<0.05. p<0.05 significant. HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein; TC: Total Cholesterol; TG: Triglyceride.

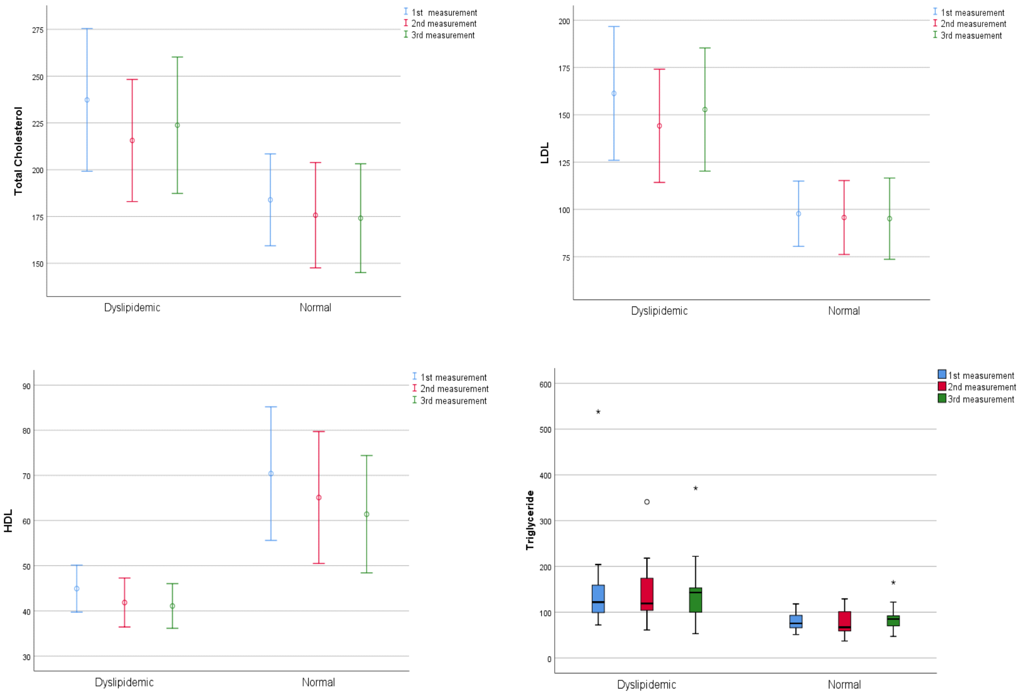

Figure 1 – Changes in serum lipid profiles of individuals (Total Cholesterol, LDL, HDL, Triglyceride). Istanbul, Turkey, 2020.

DISCUSSION

In a meta-analysis study focused on the effect of probiotics on weight loss, four randomized controlled studies found suitable for examination show that probiotics do not have a significant effect on body weight and BMI [10]. Since the subjects' food consumption did not interfere with our study, the change in weight gain is due to the increase in their daily diet and total calorie intake, not to kefir. Since the individuals are healthcare professionals and they spend most of their time in the hospital, they move less and their food intake increases relatively depending on the season.

In a meta-analysis in which 33 randomized controlled clinical studies were evaluated, compiling similar results to our study, it was concluded that probiotic intervention provided an average decrease of 6.6 mg/dl in total cholesterol levels and 8.5 mg/dl in LDL cholesterol levels [11].

When the results of short-term studies (between 4-8 weeks) with probiotic dairy products were examined, it was found that there was a 4% decrease in the TC level and a 5% decrease in the LDL-C level. It was also observed that an eight-week probiotic dairy consumption decreased the LDL-C level by 8%, supporting previous studies [12].

Our results also supported the meta-analyses from which the previous studies were compiled. According to the results of our eight-week research, high TC and LDL-C values, which are considered risk factors for dyslipidemia, support the studies with a significant ($p<0.018$) decrease in blood lipid profiles ($p<0.018$) and significant changes ($p<0.021$) with a decrease of 5.31% in blood lipid profiles after kefir consumption.

When one considers the results of the research conducted with kefir, which is one of the probiotic foods, for individuals with dyslipidemic properties, one obtains similar results to other studies. It is concluded that probiotics' effects are much larger than just on serum lipids, especially on TC and LDL-C, in the meta-analysis results of several previous studies [4-13].

We also found that individuals with high cholesterol were statistically more effective in lowering TC and LDL-C levels from serum lipid levels when compared to individuals with normal cholesterol values, and studies over four weeks compared to studies with less duration in meta-analyses on probiotic dairy products and probiotics. The process of analysis illustrates that it can be effective in preventing hypercholesterolemia and reducing cardiovascular risks [11]. The achievement of a similar result in our study supports the studies conducted. In a study conducted on patients with metabolic syndrome, the regular consumption of 180 ml kefir caused a 7.6% decrease in LDL-C levels for individuals with high LDL-C levels when compared to the control group [14].

Although the action mechanisms of probiotics on lipid metabolism are not clear, several hypotheses have been suggested. Among the proposed mechanisms are bile salt hydrolase activity, inhibition of the HMG-CoA reductase activity through the produced short-chain fatty acids and decreased intestinal absorption of dietary cholesterol [14]. In this context, kefir solutions have been suggested as a potential adjuvant treatment, as some studies have demonstrated its role in reducing oxidative stress and blood lipids.

Our study determined that the decrease in the TC value (9.65%) and the LDL-C values (10.64%) in the period when dyslipidemic individuals consumed kefir was higher than the decrease of these values for normal individuals when they consumed kefir. Individuals with high cholesterol values were divided into two groups depending on their initial cholesterol levels in another study (200-250 mg/dl and 250-300 mg/dl), and we found that probiotics had higher efficacy in the group with individuals with higher initial cholesterol values, to whom they reduced blood lipid levels more [15].

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In another randomized, crossover, placebo-controlled study conducted with 13 healthy hypercholesterolemic men for 4 weeks and supplemented with regular 500 mL/day kefir (LibertyCo, Candiac, Quebec) or milk, it was reported that kefir did not have an influence on blood lipid profiles, but it only increased fecal bacterial content, and it was reported depending on this result that kefir consumption was not effective in lowering the lipid profile. The investigator also interpreted it as the type and concentration of bacteria found in the kefir may not be sufficient to have an effect on cholesterol metabolism [16]. The most important difference between this study and ours is the variety of strains used in the kefir and the density of total bacteria per 100 ml, which is relevant due to the different effectiveness of the types of bacteria used in lowering blood cholesterol levels.

It is known that probiotic bacteria originating from Lactobacillus lower cholesterol more. Since the number and density of Lactobacillus in the kefir we used in our study are high, blood cholesterol levels were more affected in our study. Although the results of the studies have varied, one can conclude that the use of probiotics in individuals has beneficial effects on TC and LDL-C levels, but this effect is directly related to the selected strains [17-19].

The results obtained from the meta-analysis show that the use of multiple strains instead of a single strain is more effective in reducing serum lipids [4]. Although many research results point out that probiotics and kefir consumption do not affect HDL-K levels from serum lipid profiles, the HDL-C level was downwardly affected in our study.

The regulation of nutrition and physical activity positively affects serum lipid levels, whereas a high-fat cholesterol diet, weight gain, and inadequacies in physical activity decrease HDL-C levels together with genetic predisposition [1,20]. Since the subjects' social lives, physical activities, and diets were not altered, there were significant results (p<0.035) with a decrease of 8.58% for dyslipidemics and a significant decrease of 12.79% in HDL-C for the normal population (p<0.013) in our study, as an undesirable situation in HDL-C values. While some of the decrease is considered related to social life, lack of physical activity, and nutritional errors, the other factor may be the bacterial strains of kefir we use, to which kefir may contribute. It was reported that the strains were an important factor in affecting lipid parameters; however, Lactobacillus helveticus strain caused a decrease in HDL-C cholesterol unlike other probiotics in a previous study [13].

Since the kefir we used in our study also contains these bacteria, the decrease in HDL-K level we found may be due to the effect of the lactobacillus helveticus strain. More comprehensive and detailed studies are needed. Our study found that TG decreased by 2.46% in dyslipidemic individuals during the four-week period with kefir consumption, while a 4.72% decrease was found as a result of kefir consumption in normal individuals. At the end of the eight-week study, TG was found insignificant with an increase of 17.21% (p<0.926) for dyslipidemics and statistically insignificant, despite a 12.65% increase (p<0.122), for normals.

Although this finding is in parallel with the studies reporting that probiotics have no effect on triglyceride levels, it is observed that TG values decreased slightly during the periods of kefir consumption in our study. As a result of the eight-week study, TG levels started to rise again after the end of the kefir consumption. Blood cholesterol levels are not affected by nutrition for short periods of time; however, TG levels increase with nutrition due to the increase of chylomicrons in the blood. Therefore, subjects' TG levels increased again after the end of the kefir consumption.

Positive effects of the probiotic bacteria on serum lipid levels generally emerge by lowering TC and LDL-C. There is not a significant effect observed on TG levels in most studies. However, it was found that there was a decrease of 18.3% in TG levels in a study in which Lactobacillus plantarum and Lactobacillus curvatus were used together [21].

Most studies conducted with individuals with normal initial levels of cholesterol or lipid parameters report no positive effect on lipid levels [22-24]. Our study supports such research, with no significant changes found in serum lipid values (TC, LDL-C, TG) for individuals with initial normal values.

Probiotic bacteria produce short-chain fatty acids in the gut from indigestible carbohydrate sources. These fats can then reduce the levels of lipids in the blood by inhibiting the synthesis of hepatic cholesterol or by re-transporting cholesterol to the liver. For this, they ferment the indigestible dietary fiber in the colon. Short-chain fatty acids such as acetate, poripionate, and butyrate released at this time are absorbed from the colon and metabolized in the liver. Of these, acetate plays a role in cholesterol synthesis, while poripionate has the opposite effect and contributes to lowering cholesterol levels by playing an inhibitory role in cholesterol synthesis [25]. Bacteria taken with fermented foods hydrolyze the conjugated bile acids. Thus, the cholesterol that comes to the intestines with bile is prevented from re-transmitting into the blood. For example, L. Acidophilus multiplies rapidly in the environment containing bile and plays an important role in the elimination of cholesterol by converting to bile acids. In addition, probiotic bacteria are one of the mechanisms that have been suggested to ensure that dietary cholesterol combines with free bile acids and is excreted in the feces without being absorbed [26]. Probiotic bacteria affect the metabolism of cholesterol by deconjugation of bile salts, and accordingly, free bile acids bind to bacterial cells and insoluble fibers taken with food, preventing the intestines from absorbing it and increasing its excretion, thereby reducing cholesterol levels [27].

CONCLUSION

As a consequence of some of the results, one can claim that there is a need for more studies in which gender, age, and BMI values are prioritized and separately assessed regarding the consumption of kefir with different strains, more subjects, and control groups on the issue.

We concluded that regular kefir consumption was effective in dyslipidemic women and men in lowering Total Cholesterol and LDL-cholesterol from blood lipid profiles, while this was not observed in normal individuals. The reason for the lack of cholesterol reduction in normal individuals in our study can be explained as follows. Most of the cholesterol is produced in the liver. The reason why kefir consumption does not affect cholesterol in normal individuals is the lack of high cholesterol production in these individuals and the lack of products that probiotics can affect in the intestine. Cholesterol and bile absorption metabolism may be impaired due to dysbiosis in dyslipidemic individuals. Cholesterol reduction may have occurred with the regulation of dysbiosis of the probiotic kefir. There were no significant changes in Triglyceride levels for both groups. There has been a slight decrease in HDL cholesterol levels which we think are affected by strains of kefir alone, nutrition, and physical activity.

Limitations of the Study and Recommendations

Although kefir can be considered a good alternative for the control of dyslipidemia, there are contradictions in the results of studies conducted with kefir. The content of kefir and the kefir used in studies may vary depending on the type and variety of probiotic strains. Better-planned long-term studies with larger sample groups are required to evaluate that, along with well-planned clinical studies with kefir for dyslipidemic individuals, containing more subjects and strains, and having a high potential to reveal the relationship between kefir and dyslipidemia.

CONTRIBUTORS

I YILMAZ and B. ARSLAN contributed to the study design, data analysis and interpretation and article review. I YILMAZ approval of the final version.

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