

EFFECT OF YOGURT INTAKE ON PLASMA GLUCOSE AND SERUM LIPID PROFILE IN APPARENTLY HEALTHY STUDENTS OF COLLEGE OF HEALTH SCIENCES, NNEWI, ANAMBRA STATE, NIGERIA

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ABSTRACT

This study was designed to investigate the effect of oral intake of yogurt on plasma glucose and serum lipid profile levels (total cholesterol, triglyceride, high density lipoprotein and low-density lipoprotein) in apparently healthy students. A total of 30 subjects (16 males and 14 females) were recruited to serve as both test and control groups. Each subject was advised to abstain from milk and similar probiotic food consumption for three weeks. Baseline samples (after an overnight fast and 2 hours postprandial after oral intake of carbohydrate meal) were collected from both males and females at day 0 as control samples, and levels of glucose and lipid profile were evaluated. Subsequently, in addition to their normal diet, each of the subjects received 100ml of yogurt daily for 21 day. After an overnight fast, post research (test 1st and 2nd) samples (fasting blood sample and 2 hours postprandial after oral intake of carbohydrate meal) were collected on days 11 and 22 respectively and the levels of glucose and lipid profile were re-evaluated. Blood glucose and lipid concentrations were determined using standard methods. There was significant increase in mean serum triglyceride (TG) value 11 days following yogurt intake (intermediate consumption) when compared to baseline level (0.63±0.15 Vs 0.53±0.19; p<0.05). Also, there was a significant decrease in mean serum TG value 21 days following yogurt intake (post consumption) when compared to baseline and intermediate levels (0.50±0.19 Vs 0.53±0.19 and 0.50±0.19 Vs 0.63±0.15; p<0.05) respectively. There was a significant increase in mean serum high density lipoprotein (HDL) value 21 days following yogurt intake when compared to day 11 (intermediate consumption) and baseline levels (1.36±0.34 Vs 1.14±0.24 and 1.36±0.34 Vs 0.99±0.19; p<0.05) respectively. Also, there was a significant increase in mean serum total cholesterol (TC) value 21 days following yogurt intake when compared to day 11 and baseline levels (p<0.05) respectively. The low-density lipoprotein (LDL) level remained unchanged 11 and 21 days following yogurt intake (p>0.05). There was significant increase in the mean blood glucose level (p<0.05). In conclusion, this study has shown that the lipid profile and blood glucose levels in individuals consuming yogurt may experience significant alterations which may have important clinical implications in the management of diabetes. Further studies may be necessary in understanding the mechanism behind these effects.

Keywords: Yogurt; Probiotics; Diabetes mellitus; Cardiovascular disease; Glucose; Lipid profile.

INTRODUCTION

Diabetes mellitus is a metabolic disorder of multiple etiologies which is characterized by hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both [1]. Type II diabetes (T2DM) is a common metabolic disorder, the prevalence rate of which is on a growing trend and this rate is estimated to

reach 592 million by 2035 [2]. Diabetes mellitus has become an issue of great public health importance globally, accounting for a prevalence of 8.5% in 2014 [3], and is exerting heavy burden on global health and becoming one of the main causes of death around the world [4]. According to World Health Organization, in 2016, diabetes was the direct cause of 1.6 million deaths worldwide [5]. Importantly, abnormal metabolic profiles in T2DM could lead to several severe complications, such as cardiovascular disease, diabetic retinopathy, neuropathy, and nephropathy [6].

Cardiovascular disease, as one of several chronic disorders, is the major complication of type 2 diabetes mellitus (T2DM). Cardiovascular diseases are the



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leading causes of mortality in patients with type II diabetes, as the relative risk of developing these diseases is two to four times higher in diabetic patients than in healthy individuals [7]. Hypertension and dyslipidemia, which are highly prevalent, are the known risk factors for cardiovascular complications in diabetics [8]. Cardio-vascular disease may result from associated abnormalities of plasma lipid and lipoprotein metabolism [9]. Alteration in plasma lipid and lipoprotein profile has been documented in diabetic patients [10].

In recent time, nutritional interventions are among the primary recommendations for dealing with diabetes mellitus and dairy products have been implicated as an adjunct in the management of diabetes mellitus. Dairy products are high in calcium, magnesium, vitamin D, and specific FAs; and it has been suggested that moderate dairy consumption is associated with a lower risk of type 2 diabetes [11]. Probiotic foods are among dietary ingredients that have shown significant health benefits. Probiotics are defined as live microorganisms which have beneficial health effects on their host, when enter the intestine with an adequate amount [12].

Generally, two main groups of probiotic bacteria are most commonly used, and these involve *Lactobacilli* and *Bifidobacteria* [13]. According to FAO/WHO standards, yogurt is 'the coagulated milk product obtained by lactic acid fermentation through the action of *Lactobacillus delbrueckii* sp. *bulgaricus* and *Streptococcus thermophilus*' [14]. However, in recent years yogurts containing probiotics have gained popularity. These products contain *Lactobacillus* and *Bifidobacterium* species at 10^6 viable cells per millilitre of the product at the time of consumption [15].

Thus, Yogurt is a food produced by the fermentation of milk, and there has been increased interest recently in the effect of probiotics in yogurt to improve cholesterol metabolism. Several studies suggest that consumption of dairy products such as yogurt have beneficial effects on CVD-related comorbidities such as hypertension [16, 17], type 2 diabetes [18, 19], insulin resistance [20] and dyslipidemia [17, 19, 21]. Therefore, the present study seeks to assess the effects of yogurt intake on plasma glucose and lipid profile in apparently healthy students of College of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi campus, Anambra State, Nigeria.

MATERIAL AND METHODOLOGY

Study Design: Clinical trial human based study

Study Site: This study was carried out in College of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi campus, Anambra State, Nigeria.

Ethics approval: Participants were properly informed about the study and only those who gave their consent were recruited for the study. The ethical approval for this study was sought and obtained from the Ethics Committee of Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Okofia, Otolu, Nnewi, Anambra State, Nigeria.

Sample size: Thirty human volunteers

Inclusion and exclusion criteria: Apparently healthy subjects (16 male and 14 female) aged between 18 and 30 years were recruited for this study.

Exclusion criteria: Individuals consuming milk, individuals with known cardiovascular disease, hypertension, on antihypertensive or hypolipidaemic drugs, or those outside the age bracket of 18-30 years were excluded from the study.

Methodology:

Each subject was advised to abstain from milk and similar probiotic food consumption for three weeks. 6mls each of baseline samples (after an overnight fast and 2 hours postprandial after oral intake of carbohydrate meal) were collected from both males and females at day 0 as control samples, and levels of glucose and lipid profile were evaluated. Subsequently, in addition to their normal diet, each of the subjects received 100ml of yogurt daily for 21 day. After an overnight fast, 6mls of post research (test 1st and 2nd) samples (fasting blood sample and 2 hours postprandial after oral intake of carbohydrate meal) were collected on days 11 and 22 respectively and the levels of glucose and lipid profile were re-evaluated.

Estimation of plasma glucose (FBS and 2HPP) (Glucose oxidase method as described by Barham and Trinder) [22], Total cholesterol (Enzymatic method as described by Roeschlau *et al.* [23]), Triglycerides (Enzymatic method as described by Tietz [24]), High density lipoprotein cholesterol (Burstein *et al.* [25]), Low density lipoprotein cholesterol (Enzymatic method described by Assman *et al.* [26]).

Statistical analysis: The data were presented as mean±SD and the mean values of the baseline and test group were compared by one way analysis of variance (ANOVA) and Students t-test using Statistical package for social sciences (SPSS) (Version 23) software. Statistical significance was tested at $P < 0.05$.

RESULTS

The mean ± SD of serum levels of total cholesterol (TC), triglyceride (TG) and high density lipoprotein (HDL) in pre-yogurt consumption, intermediate and post yogurt consumption were significantly different at $P < 0.05$ respectively ($F = 6.165, 3.856, 4.731$), but LDL level did not differ significantly ($p > 0.05$) when compared across the groups. Using paired t-test comparison, serum TC level was significantly decreased in pre yogurt consumption when compared with intermediate yogurt consumption ($P = 0.001$). Serum levels of TG and HDL were observed to be significantly decreased in pre yogurt consumption when compared with intermediate consumption at $p < 0.05$, but LDL level did not differ significantly ($P = 0.971$). Again, the mean serum TC, TG and HDL levels were observed to be significantly decreased in pre yogurt consumption when compared with post yogurt consumption at $p < 0.05$. Also, the mean serum level of TG was significantly increased in intermediate yogurt

consumption when compared with post yogurt consumption ($P=0.006$). The mean serum HDL and LDL levels were significantly increased in post yogurt consumption when compared with intermediate yogurt consumption ($p < 0.05$), while the mean serum TC level was observed to be the same ($p=0.375$).

The mean \pm SD of serum fasting blood sugar (FBS), (mmol/l) and 2 hours postprandial (2hrpp), (mmol/l) in pre, intermediate and post yogurt consumption were significantly different at $p < 0.05$ respectively ($F= 5.410$ and 3.460) using ANOVA. However, using paired t-test comparison showed that the mean serum FBS and 2hrpp levels were significantly decreased in pre yogurt consumption when compared with intermediate yogurt consumption ($p < 0.05$). Again, FBS and 2hrpp were observed to be significantly decreased at pre yogurt consumption when compared with post yogurt consumption ($p < 0.05$). FBS and 2hrpp were observed to be significantly increased at post yogurt consumption when compared with intermediate yogurt consumption ($p < 0.05$), (See table 1).

The mean serum HDL level in the female subject was significantly higher when compared with male subject in pre yogurt consumption ($p= 0.007$), whereas the mean serum levels of TC, TG and LDL were not statistically significantly different between both groups ($P > 0.05$), (See table 2).

DISCUSSION

In this study, it was observed that the mean value of total cholesterol, triglyceride and high density lipoprotein were significantly higher 11 days following yogurt intake (intermediate consumption) when compared with baseline stage (day 0), but there was no significant difference in the mean serum level of low density lipoprotein in 11 days following yogurt intake (intermediate consumption) when compared with baseline stage (day 0). This increase in the mean serum high density lipoprotein (HDL), total cholesterol (TC) and triglyceride (TG) levels with no significant change in low density lipoprotein (LDL) level is in contrast with the previous study carried out in Iran on the effect of probiotic yogurt containing *Lactobacillus acidophilus* and *Bifidobacterium lactis* on lipid profile in individuals with type 2 diabetes mellitus in which a decrease in TC and LDL with no change in TG and HDL had earlier been documented [27]. Again, it was observed that total cholesterol, and high-density lipoprotein were significantly higher 21 days following yogurt intake (post consumption) when compared with baseline value. On the other hand, the mean serum of TG was significantly reduced on post yogurt consumption when compared with baseline value. However, the mean serum level of LDL did not differ significantly post yogurt consumption than in baseline. Mohammad *et al.* had earlier reported a significant increase in HDL level after 8 weeks consumption of yogurt in type 2 diabetic

Table 1. Serum lipid profile in groups before and following yogurt consumption (Mean \pm SD)

Variables	TC (mmol/l)	TG (mmol/l)	HDL (mmol/l)	LDL (mmol/l)	FBS (mmol/l)	2hrpp (mmol/l)
Pre yogurt consumption (Day 0)	3.61 \pm 0.30	0.53 \pm 0.19	0.99 \pm 0.19	2.02 \pm 0.38	3.44 \pm 0.53	4.30 \pm 0.58
Intermediate yogurt consumption (Day 11)	4.21 \pm 0.92	0.63 \pm 0.15	1.14 \pm 0.24	2.02 \pm 0.91	3.78 \pm 0.43	4.59 \pm 0.46
Post yogurt consumption (Day 22)	4.43 \pm 1.04	0.50 \pm 0.19	1.36 \pm 0.34	2.71 \pm 0.52	4.30 \pm 0.68	5.04 \pm 0.54
F – value	6.165	3.856	4.731	0.001	5.410	3.460
P- value	0.003*	0.025*	*0.011	0.999	0.006	0.036
A v B t- value	22.741	0.465	1.096	14.598	1.148	0.442
p-value	0.001*	0.025*	0.008*	0.971	0.008	0.032
A v C t-value	22.741	0.465	1.096	14.598	1.148	0.442
p- value	0.001*	0.0025*	*0.008	0.971	0.008	0.032
B v Ct-value	0.020	0.133	3.471	5.997	3.347	0.081
p-value	0.375	0.006*	*0.005*	0.001*	0.001*	0.001

*Statistically significant at $P < 0.05$.

Table 2. Gender comparison of lipid profile in groups before and following yogurt consumption (Mean ± SD).

Variables	TC (mmol/l)	TG (mmol/l)	HDL (mmol/l)	LDL (mmol/l)	FBS (mmol/l)	2hrpp (mmol/l)
Pre yogurt consumption						
Male (n=16)	3.62 ± 0.31	0.56 ± 0.25	0.90 ± 0.18	2.06 ± 0.40	3.46 ± 0.57	4.21 ± 0.51
Female (n= 14)	3.59 ± 0.30	0.49 ± 0.10	1.08 ± 0.16	1.99 ± 0.36	3.42 ± 0.50	4.39 ± 0.66
t-value	0.001	4.450	0.121	0.618	0.976	0.622
p-value	0.821	0.317	0.007	0.635	0.861	0.405
Intermediate yogurt consumption (M)						
Female	4.23 ± 0.82	0.66 ± 0.17	1.17 ± 0.27	2.15 ± 0.66	3.79 ± 0.49	4.58 ± 0.52
t- value	4.19 ± 1.05	0.60 ± 0.12	1.10 ± 0.20	1.86 ± 1.13	3.77 ± 0.37	4.61 ± 0.41
p- value	1.151	3.067	1.871	3.067	2.109	2.750
Post yogurt consumption (M)						
Female	4.25 ± 1.17	0.53 ± 0.24	1.28 ± 0.36	2.73 ± 0.49	4.30 ± 0.74	5.17 ± 0.57
t-value	4.65 ± 0.87	0.47 ± 0.12	1.44 ± 0.29	2.07 ± 0.49	4.31 ± 0.64	4.91 ± 0.47
p- value	0.062	2.901	0.213	2.026	0.343	0.487
	0.307	0.409	0.201	0.740	0.978	0.186

*Statistically significant at $P < 0.05$; M= male, Serum FBS (mmol/l) and 2hrpp(mmol/l) when compared between male and female subjects were not significantly different ($P > 0.05$).

patients which is in keeping with our finding [21]. Also, Rezaei *et al.* reported no significant difference in the mean serum level of HDL after 4weeks of yogurt consumption in contrast with the present finding [19]. However, in contrast to our findings, Mohammad *et al.* recorded no significant differences in the mean levels of TG and TC, and a significant decrease in the mean serum level of LDL following 8weeks of yogurt consumption [21], but Bong-Kyung *et al.* observed that serum triglyceride levels were significantly lower in participants who consumed yogurt > 1 time per week than in those consuming yogurt < 1 time per week and this is in line with the present finding [28]. Hypertriglyceride is a prevalent risk factor for cardiovascular disease and is increasingly important in the context of the current epidemics of obesity and insulin resistance. High triglyceride levels are markers for several types of atherogenic lipoproteins [29-30]. These inconsistent findings could be partly because of varying strains and doses of probiotics, different duration of treatment periods, sample size, and clinical characteristics of participants [31].

In the present study, there was a significant increase in mean serum level of HDL in female than in male subjects when compared between values obtained in the baseline stage (day 0). This is in line with previous studies that noted higher HDL-C values in women than in the men, attributing the higher HDL-C to the lower

body mass index in women [32].

Interestingly, the mean fasting blood glucose and 2 hours postprandial levels were significantly higher 11 days (intermediate consumption) and 21 days (post consumption) following yogurt intake when compared with baseline values respectively. Again, the mean serum blood glucose level was significantly higher 21 days following yogurt intake (post consumption) when compared with 11 days following yogurt intake (intermediate consumption). This is in contrast with some previous similar studies [19], [33].

CONCLUSION

In conclusion, this study has shown that the lipid profile and blood glucose levels in individuals consuming yogurt may experience significant alterations which may have important clinical implications in the management of diabetes. Further studies may be necessary in understanding the mechanism behind these effects.

Conflict of Interest: Declared none

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