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Effect of lycopene in papaya (*carica papaya*) and water melon (*Citrullus lanatus*) on the serum lipid profile

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Abstract
The aim of the study was to investigate the effect of supplementation of a lycopene rich fresh fruit blend of watermelon and papaya on the serum lipid profile (Total cholesterol (TC), Low density lipoprotein (LDL), Very Low density lipoprotein (VLDL) and High density lipoprotein (HDL)) of hypercholesterolemic female subjects aged between 30 to 45 years. The design adopted was a pretest post test experimental research design with control group. Hundred grams of papaya and hundred grams of water melon blended together was supplemented for 60 days as a mid-morning drink. At the end of the supplementation period, a statistically significant reduction ($p<.001$) in the TC (Before supplementation 217.2±15.89 mg/ dL, after supplementation 197±20.42 mg/ dL) and LDL cholesterol values (Before supplementation 143.9±10.91 mg/ dL, after supplementation 119.48±17.79 mg/ dL) was observed in the experimental group. There was no statistically significant change in the HDL and VLDL levels in the experimental group after intervention. This study proves that a fresh fruit blend of papaya and water melon has the potential to reduce blood lipid parameters that are linked with increased risk for heart disease.

Keywords: Lycopene, Hypercholesterolemia, Total cholesterol, fruit blend.

1. Introduction

Lycopene, an acyclic non-provitamin A carotene that is relatively abundant in tomato and tomato products has received considerable attention for its possible role in cancer prevention, especially prostate cancer and in the prevention of heart disease (Khachik, 2002). The antioxidant activity of lycopene is twice as high as that of β-carotene and 10 times higher than that of α-tocopherol (Agarwal and Rao, 2010). Lycopene is also a potent hypocholesterolemic agent (Riso *et al*., 2006). The lycopene content of tomato and vegetable crops is variable and depends on the growing conditions. Fruits that are rich in lycopene include tomato, guava, watermelon, Papaya, grapefruit and apricots.

Globalization has led to drastic changes in the lifestyle that is directly reflected on the diet of individuals. Availability of all kinds of foods coupled with affordability has led to increased intake of unhealthy foods and a concurrent elevation in blood lipids. Elevated blood lipids are the major risk factors for cardio vascular disease (CVD). Increased intake of foods loaded with fats and simple carbohydrates coupled with the low intake of fruits and vegetables loaded with natural pigments that have cholesterol lowering effects, is predisposing many at an early age to elevated blood lipids. Therefore, there is an urgent need to reconsider the types of foods that individuals eat in order to reduce the risk of cardio vascular disease. Reviving the ingestion of fruits may be one food based approach that may help maintain blood lipids within acceptable limits.

Fruits rich in lycopene have a proven effect on reducing blood lipids. In order to effectively control blood lipids, fruits such as watermelon and papaya that are an excellent source of lycopene may serve as an affordable, natural replacement to expensive hypocholesterolemic, pharmaceutical products.

Aim of the study

The aim of the study was to investigate the effect of supplementation of a lycopene rich fresh fruit blend of watermelon and papaya on the serum lipid levels of hypercholesterolemic female subjects.

2 Methodology

2.1 Objectives of the study

1. To assess the anthropometric measurements such as height (cm), body weight (kg) and Body Mass Index (BMI) of subjects in the experimental and control groups before and after the supplementation period.
2. To study the effect of supplementation of lycopene rich fresh fruit blend of papaya and water melon on the serum lipid profile (Total cholesterol (mg/dl), Low density lipoprotein (mg/dl), Very Low density lipoprotein (mg/dl) and High density lipoprotein (mg/dl)) of hypercholesterolemic female subjects in the experimental group after a supplementation period of 60 days.

2.2 Design of the study

The design of the study was a pre-test, post-test experimental research design with control group. In this design two identical groups of subjects were selected and the serum lipid profile was measured in both, before and after the period of supplementation. The supplement was administered only to the experimental group whereas the control group did not receive any supplement. The anthropometric and biochemical assessments were carried out a day before the commencement of the supplementation period and a day after the completion of the supplementation period. Comparisons were made between the two to study the effect of supplementation.

2.3 The criteria used for the selection of subjects

Inclusion criteria

- Female subjects in the age group of 30 - 45 years based on initial screening.
- Subjects with cholesterol levels between 200-239 mg/dl (borderline high)
  (Source: NCEP, 2013)
- Subjects willing to participate in the study
- Subjects who have a sedentary lifestyle.

Exclusion criteria

- Subjects on oral hypocholesterolemic drugs
- Subjects who are diabetic and pregnant
- Subjects with gastro-intestinal problems
- Subjects who are allergic / intolerant to papaya and watermelon.

c. Sampling design

The purposive sampling technique was used to select subjects for the study

d. Sample size

The above mentioned criteria were used to select twenty subjects who were randomly assigned as 10 in the control and 10 in the experimental groups.

e. Duration of supplementation

The supplement was administered for a period of 60 days as a mid-morning drink.

2.4 Lycopene content of the supplement

The supplement contained 6.3 mg of lycopene per serving. Lycopene does not have an established RDA, but the optimal amount of lycopene that has to be consumed by a person is around 6-12 mg/day. Therefore the supplement provided the optimal amount of lycopene to the subjects in the experimental group. Hence subjects in the control group were on a low lycopene diet (lycopene only from their regular diet) and subjects in the experimental group were on a high lycopene diet (lycopene from their regular diet plus supplement).

3. Results

3.1 Effect of fresh fruit blend supplementation on body weight and BMI

An assessment of the weight, BMI and waist circumference of subjects was made both before and after the period of study. A comparison was made between both assessments for all these parameters, to check whether the lycopene rich fresh fruit blend had an effect on these anthropometric measurements. It was observed at the end of the study period that the fresh fruit blend of papaya and water melon did not bring about any change in the body weight, body mass index and the waist circumference of the subjects in the experimental group. No change was observed in the control group at the end of the study period as well.

3.2 Effect of fresh fruit blend on serum lipid profile

There was a statistically significant reduction ($p<.001$) in the total cholesterol and LDL cholesterol values of the experimental group after the intervention Table 1. There was no statistically significant change in the HDL levels in the experimental group after the intervention. However, the VLDL showed a statistically significant increase ($p< 0.05$) in the experimental group. But the VLDL value was well within the acceptable limits (< 30 mg/ dl). No statistically significant change was observed in the total cholesterol, HDL, LDL and VLDL levels in the control group at the end of the study period (Table 2). These findings indicate the cholesterol lowering effect of the fresh fruit blend of papaya and water melon.

Table 1: Lipid profile of control and experimental groups before and after supplementation

Blood lipid Parameters desirable values (WHO, 2006)	Experimental group				
	0th day	61st day	0th day Vs 61st day		
	(mean±SD)	(mean±SD)	t value	p value	Lev of sig
Total Cholesterol (mg /dl) <200	217.2±15.89	197±20.42	4.624	0.001	1%
HDL >60	51.3±9.04	50.4±9.35	.612	0.556	NS
LDL < 100	143.9±10.91	119.48±17.79	5.141	0.001	1%
VLDL	22±6.4	27.32±7.23	2.28	0.048	5%

NS – not significant

Table 2: Lipid profile of control group before and after supplementation

Blood lipid Parameters desirable values (WHO, 2006)	Control group				
	0th day	61st day	0th day Vs 61st day		
	(mean±SD)	(mean±SD)	t value	p value	Lev of sig
Total Cholesterol (mg /dl) <200	222.6±11.16	223±16.24	0.167	0.871	NS
HDL >60	48.1±5.84	48.9±5.33	0.631	0.544	NS
LDL < 100	142.27±10.99	142.57±10.8	0.873	0.405	NS
VLDL	25.18±7.22	22.88±10.19	1.059	0.317	NS

Reid and Fakler (2011) studied the effect of lycopene on serum lipid concentration. Cardiovascular disease is associated with oxidative stress, inflammatory processes, and vascular dysfunction. Their meta-analysis suggested that lycopene taken in doses ≥25 mg daily is effective in reducing LDL cholesterol by about 10 per cent which is comparable to the effect of low doses of statins in patient with slightly elevated cholesterol levels. They concluded that lycopene has a protective effect on the lipid peroxidation and anti-atherosclerotic capacity.

3.3 Cardiovascular risk factor ratio of subjects in the experimental and control group before and after supplementation

The cardiovascular risk factor ratio was calculated using formulas approved by the American Heart Association (AHA)/ World Health Organization (WHO). The results are presented in tables 3 & 4.

Table 3: Cardiovascular risk factor ratio of the experimental group (before supplementation vs after supplementation)

CVD risk factor ratios (AHA &WHO approved)	Desirable Value	Experimental Group (before supplementation Vs after supplementation)				
		(0^{th} day)	(61^{st} day)	t value	p value	Level of sig
		Mean ± SD	Mean ± SD			
TC : HDL ratio (coronary risk ratio)	4-5.7	4.33±0.60	3.98±0.51	3.669	0.005	5%
LDL : HDL ratio (Atherogenic index)	2.8-4.1	2.92±0.44	2.40±0.36	5.455	0.001	1%

Table 4: Cardiovascular risk factor ratio of control group (before supplementation vs after supplementation)

CVD risk factor ratios (AHA &WHO approved)	Desirable Value	Control Group (before supplementation Vs after supplementation)				
		(0^{th} day)	(61^{st} day)	t value	p value	Level of sig
		Mean ± SD	Mean ± SD			
TC : HDL ratio (coronary risk ratio)	4-5.7	4.34±0.19	4.59±0.33	2.478	0.305	NS
LDL : HDL ratio (Atherogenic index)	2.8-4.1	2.97±0.25	2.87±0.40	1.136	0.285	NS

Tables 3 and 4 show the CVD risk factor ratios (TC: HDL ratio (coronary risk ratio) and LDL: HDL ratio (Atherogenic index), that were calculated for the experimental and control groups before commencement of the supplementation (0^{th} day) and after the supplementation period (61^{st} day). A comparison was made between the initial and final values. In the experimental group, TC: HDL and LDL: HDL indexes had shown a highly statistically significant reduction ($p<0.01$ and $p< 0.001$) after supplementation of fresh fruit blend of papaya and water melon for a period of 60 days. The control group did not show any significant change in the risk factor ratio at the end of the study period.

This is a very significant finding of the present study which proves that the fresh fruit blend of papaya and water melon has the potential to reduce the blood lipid parameters that are linked with increased risk for heart disease. These fruits are widely available and can be afforded by individuals belonging to all income levels. Consumption of a lycopene rich fresh fruit blend of papaya and water melon may be one simple and effective strategy to help individuals keep their blood lipids under control.

3. Conclusion

The results of the present study significantly brought to light the hypercholesterolemic effect of fresh fruit blend of papaya and water melon on the serum lipid profile of hypercholesterolemic female subjects. Thus it can be concluded that a blend of these lycopene rich fruits can be suggested as the most safe, cost effective and natural food based approach that can be used to prevent and/or manage hypercholesterolemia, which is the major risk factor for mortality due to coronary heart disease among Indians.

4. References

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