

Effect of Supplementation of Vitamin C Antioxidant on the Nutritional Profile of Male Smokers

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ABSTRACT Smoking is a uniquely common habit and has been identified as a major risk factor for coronary heart disease and number of other diseases. With the hypothesis that dietary antioxidant may help to prevent the development of atherosclerosis and other associated problems. Twenty five male smokers in the age group of 25-40 years with similar smoking habits and physical activity pattern were selected from Ludhiana. The effect of supplementation of vitamin C by food as their dietary, blood lipid, antioxidant profile and anthropometry was studied among smokers. Supplementation with vitamin C, the consumption of cereals, GLV and fruit intake increased significantly ($p < 0.05$) and that of roots and tubers, fats and oil and sugar and jaggery decreased significantly ($p < 0.05$). The energy, carbohydrate, total and visible fat intake decreased significantly ($p < 0.05$) after vitamin C supplementation. Total cholesterol and LDL cholesterol decreased significantly. Serum β carotene and serum ascorbic acid increased significantly ($p < 0.05$). The serum tocopherol level did not alter much with supplementation of vitamin C. The anthropometric parameters of smokers did not vary significantly after supplementation of vitamin C. The decrease in blood pressure of smokers was also non-significant after supplementation of vitamin C. It was concluded that supplementation of vitamin C improved the status of vitamin C in body. Consumption of vitamin C lowers the blood cholesterol and changes other parameters on better side. So, smokers are advised to consume foods rich in vitamin C.

INTRODUCTION

Man's search for pleasure and contentment has led him to seek the aid of various drugs and tobacco is one of them. Smoking cigarettes is probably the most important single factor in the causation of ischaemic heart disease, cancer of lung, chronic bronchitis and emphysema (The Tribune, 2000).

Smokers have approximately 15-20% lower concentration of ascorbate in the blood than non smokers. Ascorbic acid, a potent antioxidant in human body is constantly oxidized by cigarette smoke. Thus, it is established that cigarette smokers are at a continuous oxidant stress (Cross et al., 1998). The antioxidant vitamins available in abundance from variety of fruits and vegetables may relieve the smokers from this oxidant stress and protect the human body from many diseases. Ascorbic acid can be derived from fresh fruits, cruciferous vegetables, potatoes and other vegetables (Duell, 1996). In normal healthy human, the free radicals formed are quenched and removed by antioxidant defence mechanisms, but in smokers, this removal of free radical is disturbed because of depletion of antioxidant nutrients by smoke and this, results in oxidative stress (Gautam and Malhotra, 1997).

Thus, with the hypothesis that dietary antioxidant may help to prevent the development of atherosclerosis, the study was planned with the objective of observing the effect of antioxidant supplementation of vitamin C by food on dietary, blood lipid antioxidant profile and anthropometry of the male smokers.

MATERIAL AND METHODS

A group of 25 smokers aged 25-40 years, belonging to upper middle socio-economic group having similar physical activity pattern and smoking habits were selected purposively from Ludhiana city for the study. General information and dietary habits of smokers was collected using questionnaire-cum-interview method. Selected subjects were observed for a period of one month in which no antioxidant were supplied. After that food rich in vitamin C were supplied to their existing diets for three months. Daily supplementation of approximately 50 mg of ascorbic acid was made by food. The food and nutrient intake was calculated from the values per 100g of edible portion by MSU Nutriguide (Song et al., 1992). Haemoglobin estimation was determined by Cyanmethaemoglobin Method of Dacie and Lewis (1975). Glucose was estimated by the Glucose Oxidase Method of Trinder (1969). The concentration of total cholesterol and

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triglycerides were analysed by Enzymatic Calorimetric Method (Allian et al., 1974). HDL by method given by Lopes Virella et al. (1977), LDL-C and VLDL-C were estimated by using method given by Friedewald et al. (1972). Serum β carotene was measured by Method of Carr and Price (1971). Serum ascorbic acid by Varley (1989). The data obtained was then analysed statistically by applying one way analysis of variance (Anova).

RESULTS AND DISCUSSION

Among smokers, supplemented with vitamin C, the cereals, green leafy vegetables and fruit intake increased significantly ($p < 0.05$) whereas that of roots and tubers, meat and egg, fat and oil and sugar and jaggery decreased after vitamin C supplementation (Table 1). Pulses and legumes were consumed in lower amount as compared to the suggested value prior to and after supplementation. The intake of milk was increased but was not significantly different from the intake values prior to supplementation. The intake of meat and eggs was high as compared

to recommended values of intake 30 g/day. The intake decreased non-significantly after supplementation but was still higher than the suggested intake.

The average daily nutrient intake of smokers before and after vitamin C supplementation is given in Table 2. The energy, carbohydrate, total fat, visible fat decreased significantly ($p < 0.05$) and fibre intake increased. The decrease in carbohydrate was due to decrease in the intake of refined flour products, potatoes and sugar. The fibre intake of smokers was poor because of low intake of fresh fruits and vegetables.

The average daily vitamin and mineral intake of smokers before and after supplementation is given in Table 3. Vitamin C intake of smokers prior to supplementation was lower than RDA of 2400 mg/day because of lower intake of green leafy vegetables, yellow and orange vegetables and fruits. Thus, after supplementation of vitamin C intake increased significantly. This is in accordance to the findings of Williams (1996). According to him nutrathery proved to be beneficial because of food supplied as a source of one particular nutrient proved to be a

Table 1: Average food intake of smokers before and after vitamin C supplementation.

Good Groups (g/day)	Before supplementation (n=25)	After supplementation (n=25)	Suggested intake ¹	t-value
Cereals	389.05±31.56	453.64±30.34	420	16.43*
Pulses and Legumes	44.23±0.75	50.0±0.73	60	0.61
Green Leafy Vegetables	58.93±22.14	98.91±23.25	100	23.17*
Other Vegetables	52.16±5.38	67.0±5.62	100	1.53
Roots and Tubers	143.91±1.28	98.43±1.52	200	38.26*
Fruits	82.26±10.23	195.3±9.59	100	29.53*
Milk and Milk Products	236.91±0.71	243.0±0.30	300	0.09
Meat and Eggs	49.13±1.26	42.26±1.93	30	0.79
Fats and Oils	62.59±7.02	39.56±7.08	20	11.51*
Sugar and Jaggery	53±2.68	32.48±2.34	25	18.18*

Values are mean ±SE Vitamin C was supplemented by food

* Significant at $p < 0.051$. ICMR, 1999

Table 2: Average food nutrient intake of smokers before and after vitamin C supplementation.

Nutrients (per day)	Before supplementation (n=25)	After supplementation (n=25)	RDA ¹	t-value
Energy (kcal)	2763±71.01	2451±69.48	2425	10.30*
Proteins (g)	77.13±2.42	66.35±2.33	60	0.51
Carbohydrates (g)	505±6.21	387±6.01	-	12.12*
Total fat (g)	72.41±0.39	43.52±0.42	40	20.36
Visible fat (g)	33.60±0.61	28.71±0.60	20	18.23±
Fibre (g)	3.71±0.40	8.01±0.42	4-6	2.95*

Values are mean ±SE Vitamin C was supplemented by food

* Significant at $p < 0.051$. ICMR, 1992

conjugated source of other nutrients as well. Thus, the subjects were at more benefit than previously expected and it was observed that when smokers were supplemented with one vitamin by food, other nutrients accompanied naturally. The intake of thiamine, riboflavin and niacin was adequately as per the RDA, prior to supplementation period. The folic acid intake of smokers was low because of lower intake of green leafy vegetables and fruits and increased significantly after supplementation but the intake was not adequate as per RDA. The vitamin C and E intake was increased significantly after supplementation period. Thus, vitamin C supplementation was helpful in increasing the intake of vitamin A, C and E significantly. The calcium and iron intake increased significantly after supplementation. The increase in calcium intake was due to increased intake of milk and milk products and fresh fruits and vegetables.

The iron intake increased because of higher intake of fresh fruits, green leafy vegetables and foods which were rich sources of vitamin C and iron.

Blood glucose, haemoglobin and lipid profile of smokers before and after supplementation of vitamin C is presented in Table 4. The blood glucose level of the smokers was within the normal range and as per reference as given by DMCandH (1997). The decrease in glucose level was non-significant but is considered good by clinical practitioners, as a low level i.e. level towards the lowers side of normalcy is considered safe by the doctors. The blood haemoglobin count of smokers increased significantly after supplementation of vitamin C rich foods. These findings are similar to the findings of Mayne et al. (1998) according to whom, the increase in haemoglobin values on increased consumption of vitamin C is because of the biochemical

Table 3: Average daily vitamin intake of smokers before and after vitamin C supplementation.

Nutrients (per day)	Before supplementation (n=25)	After supplementation (n=25)	RDA ¹	t-value
<i>Vitamins</i>				
Vitamin A (β carotene), μg	1376.72±128.12	2461.22±132.51	2400	16.21*
Thiamine (B ₁), mg	1.21±0.01	1.24±0.18	1.2	0.31
Riboflavin (B ₂), mg	1.41±0.12	1.42±0.11	1.4	1.21
Niacin (B ₃), mg	16.65±2.00	17.38±2.10	16.0	0.65
Folic acid, μg	50.93±10.01	90.48±9.82	100	9.32*
Vitamin C, mg	31.36±3.13	79.4±4.0	40	21.21*
Vitamin E, mg	68.16±0.71	90.21±0.19	10 ²	26.35*
<i>Minerals</i>				
Calcium, mg	373.15±8.25	398.01±8.01	400	12.63*
Phosphorus, mg	401.12±21.03	420.20±23.3	400	0.79*
Iron, mg	25.13±2.26	39.7±2.27	30	11.62*

Values are mean ±SE 1. ICMR, 1992

Vitamin C was supplemented by food 2. ICMR, 1997

* Significant at p<0.05

Table 4: Blood glucose, haemoglobin and lipid profile of smokers before and after vitamin C supplementation.

Parameters (mg/dl)	Before supplementation (n=25)	After supplementation (n=25)	Normal range	t-value
Blood glucose	91.13±2.01	87.05±2.07	70-110 ²	1.27
Blood haemoglobin	11.02±0.61	13.59±0.63	>12.0 ¹	0.97
Total cholesterol	233.15±12.01	201.32±11.51	150-250 ²	23.26*
LDL-C	148.13±10.20	129.40±10.21	80-160 ²	38.53*
VLDL-C	30.95±0.27	28.30±0.31	20-40 ²	0.93
HDL-C	31.36±1.25	45.51±1.25	30-70 ²	0.26
Triglycerides	183.53±14.26	170.34±14.21	50-250 ²	0.53

Values are mean ±SE Vitamin C was supplemented by food * Significant at p<0.05

LDL-C = Low density lipoprotein cholesterol VLDL-C= Very low density lipoprotein cholesterol

HDL-C = High density lipoprotein cholesterol WHO, 1972 DMCandH, 1997.

Table 5: Blood antioxidant status of smokers before and after vitamin C supplementation.

Parameters	Before supplementa- tion (n=25)	After supplementa- tion (n=25)	Normal range ¹	t-value
Serum β carotene (vitamin A), $\mu\text{g}/100\text{ mg}$.	63.16 \pm 2.50	93.70 \pm 2.30	40-110	8.53*
Serum ascorbic acid (vitamin C) mg/l	7.36 \pm 3.0	28.21 \pm 2.90	8-24	16.53*
Serum tocopherol (vitamin E) mg/100ml	1.03 \pm 0.32	1.21 \pm 0.37	0.8-1.2	0.75

Values are mean \pm SE Vitamin C was supplemented by food * Significant at $p < 0.05$ DMCandH, 1997.

Table 6: Average anthropometric parameters of smokers before and after vitamin C supplementation.

Parameters	Before supplementa- tion (n=25)	After supplementa- tion (n=25)	Reference value	t-value
Height (cms)	168.21 \pm 0.52	168.01 \pm 0.53	-	-
Weight (kgs)	79.75 \pm 0.30	72.21 \pm 0.21	60 ¹	0.59
BMI (kg/mt ²)	28.51 \pm 0.51	24.9 \pm 0.39	20-25 ²	1.27
MUAC (cms)	34.01 \pm 0.63	32.02 \pm 0.64	32.2 ³	0.93
TSFT (mm)	13.02 \pm 1.51	12.09 \pm 1.25	12.0 ³	0.27

Values are mean \pm SE Vitamin C was supplemented by food MUAC = Mid upper arm circumference TSFT = Triceps skinfold thickness BMI = Body mass index (Derived value) 1. ICMR, 1992 2. Garrow, 1981 3. NCHS standards, 1987

Table 7: Average blood pressure count of smokers before and after vitamin C supplementation.

Parameters (mm of Hg)	Before supplementation (n=25)	After supplementation(n=25)	Reference value ¹	t-value
Systolic	141.26 \pm 40.13	140.91 \pm 40.12	120	0.14
Diastolic	85.95 \pm 0.12	82.13 \pm 0.12	60	0.62

Values are mean \pm SE Vitamin C was supplemented by food 1. WHO, 1979

mechanism which promotes iron absorption from food when vitamin C level of food is adequate. Thus, supplementation of vitamin C by food helps to increase the iron level along with vitamin C level in the body of smokers. The total cholesterol level of smokers decreased significantly after supplementation. The cholesterol level touched the upper limit of normal range of 150-250 mg/dl (DMCandH, 1997). This decrease in cholesterol is because of decrease in the intake of fats and oil and increased intake of fibre by smokers. The decrease in LDL-C level was significant at 5% level of significance. This is in consistency with the findings of Codanolabany (2000). VLDL and triglycerides level decreased marginally in smokers after supplementation.

The serum β carotene level of smokers increased significantly after vitamin C nutrathery (Table 5). This defines the fact that supplementation of vitamin C increased the consumption and also blood levels of vitamin A along with vitamin C and vice-versa. Supplementation of vitamin C by food led to an increase in the serum ascorbic acid level of

smokers despite the fact that vitamin C is oxidized in the body of smokers by cigarette smoking. Lykkesfeldt et al (2000) also reported that serum ascorbic acid is depleted by smoking and is replenished by moderate supplementation in the blood of smokers. The serum tocopherol level did not alter much with supplementation of vitamin C.

The anthropometric parameters of smokers did not vary significantly before and after supplementation of vitamin C (Table 6). The average height of smokers did not alter before and after supplementation. The weight of smokers decreased but still they were overweight as per the reference standard of 60 kg (ICMR, 1992). The decrease in mid upper arm circumference and tricep skin fold thickness was non-significant. The decrease in blood pressure of smokers was also non-significant after supplementation of vitamin C (Table 7).

CONCLUSIONS

It was observed that supplementation of vitamin C by food would improve the status of

vitamin C in the body. Antioxidants lower the blood cholesterol and changes other parameters towards better side. So, smokers are advised to consume the food rich in vitamin C.

REFERENCES

- Allian, C.C., Roon, L.S., Chan, C.S. Richmand and Fu, P.C.: Enzymatic determination of total serum cholesterol. *Clin. Chem.*, **20**: 470 (1974).
- Carr, A. and Price, M.: *Clinical Vitaminology Methods and Interpretation*. Herman Baker and Oscar Frank. Inter Science Publishers, New York (1981).
- Codandabany, V.: Erythrocyte lipid peroxidation and antioxidants in cigarette smokers. *Cell Biochem. Funct.*, **18**: 90-102 (2000).
- Cross, C.E., Vliet, A.V. and Eiserich, J.P.: Cigarette smokers and oxidant stress. A continuing mystery. *Am. J. Clin. Nutr.*, **67**: 184-85 (1998).
- Dacie, J.V., and Lewis, S.M.: *Practical Haematology*. English Language Book Society and Church Hill Ltd., London (1975).
- DMCandH.: Dayanand Medical College and Hospital. Normal reference values for biochemical estimations. *Manual*, **III**: 26-75 (1997).
- Duell, P.B.: Prevention of atherosclerosis with dietary antioxidants; Fact or fiction? *J. Nutr.*, **126**: 10675-715 (1996).
- Friedwald, W.T., Levy, R.L. and Fredrickson, D.S.: Estimation of the concentration of low density lipoprotein cholesterol in plasma, without use of the preparative ultra centrifuge. *Clin. Chem.*, **18**: 499 (1972).
- Garrow, J.S.: *Treat Obesity Seriously. A Clinical Manual*. Edinburgh Church Hill Living Stone (1981).
- Gautam, C.S. and Malhotra, S.: Vitamin role of antioxidants. *The Tribune*, September 3: P 16 (1997).
- ICMR.: *Nutrient Requirement and Recommended Dietary Allowances for Indians*. NIN, Hyderabad. (1992).
- ICMR.: *Nutrient Requirements and Dietary Allowances for Indians*. NIN, Hyderabad (1997).
- ICMR.: *Dietary Guidelines for Indians*. NIN, Hyderabad (1999).
- Mayne, S.T., Cartmel, B., Silva, F., Kino, C.S., Fallon, B.G., Briskin, K., Lheng, T., Baum, M., Posner, G.S., and Goodwin, W.J.: Effect of supplemental β carotene on plasma concentrations of carotenoids, retinal and α tocopherol in humans. *Am. J. Clin. Nutr.*, **68**: 642-47 (1998).
- NCHS.: Anthropometric reference data and prevalence of over weight. *U.S. 1976 – 1980 Vital and Health Statistics*, Series III: No. 238 (1987).
- Song, W.O., Mann, S.K., Sehgal, S., Devi, P.R., Gurdaru, S. and Kakrala, N.: *Nutriguide: Asian Indian Foods. Nutritional Analysis Computer Programme*. Michigan State University, USA (1992).
- Tribune Special. How life goes up in smoke. *The Tribune*, May 31: 13 (2000).
- Trinder, G.: Colourimetric analysis of sugars. *Methods of Enzymology*, **IV**: 85-87 (1969).
- Varley, M.: *Practical Chemical Biochemistry*. New Delhi: 313-14, 632-35 (1989).
- WHO.: Nutritional anaemia, World Health Organisation, Geneva. *Tech. Ref. Ser.*, 503: 21(1972).
- WHO.: Report of WHO Expert Committee. *Tech. Rep. Ser.No.* 636, WHO, Geneva (1979)
- William, M.A.: Cardiovascular risk factors reduction in elderly patients with cardiac disease. *Phys. Ther.*, **76**: 469-80 (1996).