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Effect of Watermelon (Citrullus Vulgaris) Seed Kernels on Serum Lipid Profile and Body Weight of Male Albino Rats

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Abstract: *Watermelon seeds usually thrown away, but are very good sources of protein, fat and minerals. Watermelon seeds collected, washed, dried and dehusked. The seed kernels were separated from the seed coat and ground in mixer grinder. Eight male Wister albino rats weighing 105-150g assigned into control and treated group (n = 4). The control group received normal stock diet (20% protein, 5 % fat, 60 % carbohydrate). The treated group received a modified diet (90g Stock diet excluding groundnut oil + 9g watermelon seed kernel + 1g sugar). Percentages of protein, fat and carbohydrate were kept same as that of the stock diet. All animals were given water ab libitum. Rats were weighed at weekly intervals. After 28 days blood samples collected via cardiac puncture and lipid profile analyzed. The results showed that the treated group had significantly higher ($p < 0.01$) weight gain and PER (Protein Efficiency Ratio) than the control group. Serum triglyceride (TG) and VLDL-C of the treated group were significantly decreased ($p < 0.05$ and $p < 0.05$ respectively) in comparison to the control group. Serum total cholesterol, LDL and AI (Atherogenic Index) were decreased whereas HDL increased in the treated group. Citrulline and Arginine in watermelon seeds may be the major factor of these beneficial effects related to lipid profile. Stimulatory effect on growth may be due to the presence of good quality protein (evidenced by increased PER) and high amount of fat.*

Keywords: *Body weight, Citrullus vulgaris seed kernels, PER, Serum lipid.*

I. Introduction

Now- a- days Food Science & Nutrition is considered as an important subject for the people. But even after tremendous advancement in the field of science and technology in last few decades, people suffer from chronic hunger. Statistical data reveals that 33% of women and 28% of men aged between 15-49 years have been reported to have BMI below normal range (NFHS III Fact sheet, 2004-2005). On the other hand CVD is still the no-1 killer disease in India. The first World Health Organisation (WHO) global status report on non-communicable diseases (NCDs) revealed that in 2008, 36.1 million people died due to heart disease, stroke, chronic lung disease, cancer and diabetes; putting NCDs on the top of the list of killer diseases. In India, 5,241,400 people (2,967,600 men and 2,273,800 women) died in 2008 due to NCDs. According to the report, the leading causes of NCD deaths in 2008 were cardiovascular disease (17 million or 48 per cent)[1]. Now, this is the high time to exploit the unconventional, cheap, thrown away and locally available food sources for achieving good nutrition. Watermelon (*Citrullus vulgaris*) seed, whose cultivar name is Sugar baby is one of such sources. These seeds have been categorized as less familiar foodstuffs in the book 'Nutritive Value of Indian Foods' published by ICMR[2] and from the analysis done by Gopalan et al (2000), it has been revealed that watermelon seeds have high amount of fat (52.6gm/100), considerable amount of protein (34.1gm/100gm), calcium (100mg/100gm), phosphorus (937mg/100gm) in comparison with other oil seeds. 59.64% Linoleic acid[3] and arginine (900mg/ g of N) are present in watermelon seeds which are reported to have positive effect on serum lipid profile parameters. NO produced from l-arginine by endothelial NO synthase (eNOS) plays an important role in regulating endothelium-dependent vasodilatation[4]. Inspite of being highly nutritious and having some known medicinal values, these seeds have still not come into the limelight and are less acceptable amongst the people as compared to other oilseeds. The nutritional importance of the seed kernels of *C. vulgaris* have been find in some discrete studies, but little work has been done on the effect of the seeds of *C. vulgaris* on different parts of animal body. Hence the aims and objectives of the present research are to :

- prepare a modified diet by adding watermelon seed kernel to the stock diet instead of groundnut oil so that its protein, fat, carbohydrate and calorie content will be same as that of the stock diet.
- study the effects of *C. vulgaris* seed kernels on serum lipid profile of male albino rats.
- compare the nutrient intake and growth pattern of the treated group of rats with that of the control group of rats.
- evaluate the quality of protein present in watermelon seed kernel by measuring Protein Efficiency Ratio (PER).

II. Materials and methods

2.1 Collection of seeds and preparation of sample

Watermelon seeds of the particular species were collected in large scale during summer season, washed thoroughly with water and dried in shade. The seeds were then dehusked in a decorticator and after that the seed kernels were grinded in a mixer grinder and preserved in a dry, clean container for preparing the experimental diet.

2.2 Animal experiment

Eight male albino rats of Wister strain weighing 105-150g were assigned into 2 groups, (n = 4), labeled as control and treated group. The control group received normal stock diet (20% protein, 5 % fat, 60 % carbohydrate)[5]. The experimental group received a modified diet (90g Stock diet excluding groundnut oil + 9g watermelon seed kernel + 1g sugar) and the percentages of protein, fat and carbohydrate were kept same as that of the stock diet. All animals were given water ab libitum. The total experimental period was 28days during which they were weighed at weekly intervals. After 28 days of feeding with the modified diet, the animals were anesthetized using chloroform anesthesia. Blood samples were then collected via cardiac puncture and lipid profile was analyzed.

Lipid profile was analyzed by the following methods-

1) Total cholesterol and HDL-C by CHOD-POD/ Phosphotungstate method. [6]
2) Serum triglyceride (TG) by GPO-POD method with TBHA chromogen. [7]
3) VLDL-C = TG/5 mg/dl.
4) LDL-C = Total cholesterol – (HDL-C + VLDL-C).
5) Atherogenic Index(AI) = LDL-C/HDL-C.

Growth parameters were calculated by the following methods-

1) Percentage weight increase was calculated from the formula :

$$\frac{\text{final body weight} - \text{initial body weight}}{\text{initial body weight}} \times 100$$

2) Percentage growth rate was calculated from the formula :

$$\frac{\text{final body weight} - \text{initial body weight}}{\text{number of days exposed}} \times 100$$

3) Protein Efficiency Ratio (PER) was calculated from the formula :

$$\frac{\text{gain in body weight in 4 weeks (g)}}{\text{protein intake in 4 weeks (g)}} = \text{gain in weight per gram of protein consumed}$$

2.3 Statistical analysis

Four Wister albino male rats had been randomly allocated to the control group and 4 to the treated group. The groups were similar with regard to demographic characteristics. All statistical tests were two-sided and performed at 5% significance level. For comparison of means Student's t-test was applied. Statistical analysis was done by using SPSS software version 16.0.

III. Results and discussions

Table 1: Effect of the modified diet on the serum lipid profile of male albino rats.

PARAMETERS OBSERVED	CONTROL GROUP (n = 4) mean ± SEM	TREATED GROUP (n = 4) mean ± SEM	p- VALUE
Total Cholesterol (mg/dl)	50.505 ± 2.353	48.532 ± 3.853	0.677 **NS**
HDL-C (mg/dl)	11.378 ± 1.213	18.484 ± 2.963	0.068 **NS**
TG (mg/dl)	115.540 ± 8.201	87.057 ± 5.626	0.029*****
VLDL (mg/dl)	23.108 ± 1.640	17.411 ± 1.125	0.029*****
LDL-C (mg/dl)	16.018 ± 4.601	12.636 ± 0.382	0.491 **NS**
AI	1.587 ± 0.574	0.764 ± 0.175	0.220 **NS**

Figure in the parenthesis indicates number of animals in each group.

df = 6, NS = Not-significant, * = $p < 0.05$, which means the values of the treated group are significantly less than that of the control group.

Table 2: Food & Nutrient consumed per day

PARAMETERS OBSERVED	CONTROL GROUP (n = 4) mean ± SEM	TREATED GROUP (n = 4) mean ± SEM	p- VALUE
Food consumed (g/day)	9.674 ± 0.581	10.216 ± 0.558	0.526 **NS**
Carbohydrate (g/day)	5.691 ± 0.342	5.928 ± 0.323	0.633 **NS**
Fat (g/day)	0.670 ± 0.040	0.728 ± 0.039	0.351 **NS**
Protein (g/day)	1.943 ± 0.116	2.065 ± 0.112	0.481 **NS**
Energy (K.cal/day)	36.639 ± 2.201	38.618 ± 2.110	0.540 **NS**

Figure in the parenthesis indicates number of animals in each group. df = 6, NS = Not-significant

Table 3: Effect of the modified diet on the total body weight and protein efficiency ratio

PARAMETERS OBSERVED	CONTROL GROUP (n = 4) mean ± SEM	TREATED GROUP (n = 4) mean ± SEM	p- VALUE
IBW (g)	135.0 ± 10.206	132.5 ± 3.227	0.823 **NS**
FBW (g)	153.25 ± 11.714	167.50 ± 6.219	0.325 **NS**
% WI	13.550 ± 1.628	26.316 ± 2.326	0.004 *****
% GR	65.178 ± 9.602	125.00 ± 12.627	0.009 *****
PER	0.334 ± 0.048	0.600 ± 0.038	0.003 *****

Figure in the parenthesis indicates number of animals in each group.
df = 6, NS = Not-significant, * = $p < 0.01$, which means the values of the treated group are significantly more than that of the control group. IBW = Initial body weight, FBW = Final body weight, %WI = Percentage weight increase, %GR = Percentage growth rate, PER = Protein efficiency ratio.

The results obtained from this study reveal that after consuming the modified diet containing watermelon seed, serum triglyceride (TG) and VLDL-C of the treated group were significantly decreased ($p < 0.05$ and $p < 0.05$ respectively) in comparison to that of the control group. Serum total cholesterol, LDL and AI (Atherogenic Index) were decreased whereas HDL (good cholesterol) increased in the treated group in comparison to that of the control group(Table-1). 2 to 4mg per kg Citrulline is present in watermelon seeds[8] which may be the possible reason of improving the lipid profile parameters in the treated group of animals who received the modified diet containing the watermelon seed kernels instead of groundnut oil for 28days. Preliminary data from animals suggest that L-citrulline can improve endothelium-dependent vasorelaxation, and relax arterial smooth muscle by an effect on cyclic-GMP[9,10,11] . 59.64% of Linoleic acid is present in watermelon seed kernels[3] which can be converted to gamma-linolenic acid (GLA) in the body. There is some preliminary evidence that GLA may help to reduce high blood pressure, either alone or in combination with omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)[12]. So, presence of high amount of linoleic acid in watermelon seed kernels may be one of the possible reasons of improving lipid profile parameters.

Inspite of consuming nearly the same amount of food (containing same amount of nutrient) as shown in Table-2, the treated group of rats showed significantly more percentage weight increase and percentage growth rate (Table-3). This proves that the modified diet containing watermelon seed kernel, also promotes growth due to the presence of good quality protein which was evidenced by significantly increased PER(Table-3) of the treated group of animals. It was worthy of note that the higher weight gain and the consumption of more amount of fat was not associated with any type of adverse effect on the serum lipid profile of the treated rats, rather the C. vulgaris seeds caused better effect on the serum lipid profile.

IV. Conclusion

This present study indicates that consumption of watermelon seed kernel would improve lipid profile parameters and growth rate and therefore may be useful in prevention and treatment of cardiovascular diseases and PEM.

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