



Case Study

A CASE STUDY ON HYPOLIPIDEMIC EFFECT OF A RICE BASED MIX FORTIFIED WITH *TERMINALIA ARJUNA*, *TRIGONELLA FOENUM- GRAECUM* AND *CINNAMOMUM VERUM*

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ABSTRACT

A case study is done to observe the effect of a traditional Assamese breakfast item, namely *Sandohguri* fortified with *Vigna radiate*, *Terminalia arjuna*, *Trigonella foenum- graecum* and *Cinnamomum verum* to incorporate hypolipidemic property. As per the nutritive value analysis, 100g of the fortified mix contains 74.75g carbohydrates, 12.92g protein, 1.07g fat (saturated fatty acids 0.30%, monounsaturated fatty acids 0.41% and polyunsaturated fatty acids 0.44%) and 7.13g dietary fibre. Main nutrients with antioxidant properties in the mix are Vitamin A (29.8 IU), Vitamin E (0.57 mg), Vitamin C (0.16 mg), Selenium (11.2mcg), Copper (193.4 mcg), Zinc (529.2 mcg), Iron (2531mcg) and Manganese (810.7 mcg). A hyperlipidemic patient without any other medical complications is identified and prescribed to have 90 to 100g of the mix with water/milk and sugar twice daily. A little life style modification with 30 minutes walk is also advised. The patient's lipid profile is checked twice within two months from the day of using the mix. The results show an increase in high density lipoprotein (HDL) and reduction in triglyceride, cholesterol, very low density lipoproteins (VLDL) and low density lipoproteins (LDL). Furthermore, the mix is found to be helpful in minimizing various risk factors of Cardio Vascular Diseases, such as hyperlipidemia, atherosclerosis-index, body weight, body mass index and waist hip ratio.

KEYWORDS: Hypolipidemia, Hypolipidemic property, *Terminalia arjuna*, *Trigonella foenum- graecum*, *Cinnamomum verum*, hypolipidemic.

INTRODUCTION

Hyperlipidemia is a major medical as well as social problem of present time. It is often associated with obesity, diabetes, atherosclerosis and other cardio vascular diseases. Several factors likely to have contributed to accelerate hyperlipidemia and some of them are wrong dietary habits, faulty life style, lack of activity, lack of sleep and various stresses. An ICMR- INDIAB collaborative study done by Joshi *et al.*⁽¹⁾ reported that the prevalence of dyslipidemia ranges from 75.7% in urban Maharashtra to 87.2% in urban Chandigarh and 76.5% in rural Tamil Nadu to 81.1% in rural Chandigarh. Hyperlipidemia is a disorder which may be controlled by proper diet and exercise. Diet has a complex but powerful effect on health. All macro nutrients, namely total energy, carbohydrates, fats and to a lesser extent proteins and micro nutrients such as antioxidants, vitamins, beta carotenes, minerals and trace metals play important roles in modifying hyperlipidemia. Dietary factors like antioxidants, dietary fibres etc. have great impact on it. The most beneficial changes result from reducing intake of saturated and trans fats and increasing the intake of polyunsaturated and monounsaturated fats. Fortification of foods with plant sterols also has favorable effect. Consumption of a low-carbohydrate or low-fat diet has smaller but still beneficial effects on body lipid levels. Reduced intake of dietary cholesterol with increased intake of soluble fibre, soy protein, fatty marine fish or marine-derived omega-3 fatty acid supplements help to

sustain good lipid levels. Red yeast rice supplements have favourable effects on blood cholesterol. From different scientific and non-scientific publications, it has been observed that in last few years the number of people have developed interest in more holistic, natural, healthful and preventative approach to wellness and healthcare has been increased. So the present study is carried out to evaluate the hypolipidemic effect of a health mix⁽²⁾ fortified with herbs namely *Terminalia arjuna*, *Trigonella foenum-graecum* and *Cinnamomum verum*⁽²⁾ to combat hyperlipidemia in a natural way.

MATERIALS AND METHODS

An adult male patient of age 38 years having hyperlipidemia without any other medical complications is selected from Govt. Ayurvedic College and Hospital, Guwahati, Assam, India for the case study. The information on the patient regarding his dietary habit, lifestyle, anthropometry are obtained through the following methods.

Anthropometric assessment

The anthropometric measurements, namely height, weight, body circumferences of the patient are measured using standard procedures. For detection of central and peripheral obesity, BMI⁽³⁾ and Waist to Hip Ratio (WHR)⁽⁴⁾ are calculated. The BMI classification as per WHO 2004⁽³⁾ is shown in Table I.

Table I: BMI classification

Classification	BMI(kg/m ²)	
	Principal cut-off points	Additional cut-off points
Underweight	<18.50	<18.50
Normal range	18.50 - 24.99	18.50 - 22.99
		23.00 - 24.99
Overweight	≥25.00	≥25.00
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
Obese	≥30.00	≥30.00

According to Croft *et al.*⁽⁴⁾, the cut-off point of WHR is below 0.95 for male and 0.8 for female. The cut off points of WHR for male and female are shown in Table II.

Table II: Waist Hip Ratio

Gender	Cut off point
Male	0.95
Female	0.8

Dietary assessment

Dietary information is gathered through food frequency questionnaire and diet history method. A food frequency questionnaire including names of common Assamese food items with frequency is used and in addition to obtain a clear picture on the subject's common dietary habit, his diet history is enquired through an interview.

The subject is advised to substitute his regular breakfast and evening food items with the health mix. For calculation of diet and recommended dietary allowance (RDA), the Dietary Guidelines for Indians by NIN, India⁽⁵⁾ is referred. The RDA for the subject is calculated as follows:

Group: Men
 Particular: Moderate
 Body weight: 60kg
 Net energy: 2875 Kcal
 Protein: 60 g/d
 Visible fat: 20g/d

Lifestyle assessment

Data on life style is gathered through interview method.

Biochemical assessment

Sample of blood is sent to standard pathological laboratory for estimation of lipid parameters.

Table III: Comparison of the patient's previous and subsequent nutrient intake

Nutrients	Previous	Subsequent	RDA ⁽⁵⁾
Total Energy (Kcal)	2204 - 2341	2175 - 2241	2787
Carbohydrates (g)	386.7 - 408.7	385.7 - 393.2	488 - 557
Protein (g)	65.7 - 70.9	70.5 - 82	69
Total Fats (g)	40.3 - 47.3	43 - 44.1	20-50
Visible Fat (g)	31.4 - 40.1	17.4- 19.4	20

Treatment

The patient is prescribed 90-100 g of the health mix twice per day as an alternative of his regular breakfast item and evening refreshment along with a little life style modification of 30 minutes brisk walking per day.

RESULTS AND DISCUSSION

The patient is a 38years old non-alcoholic and non-smoker centrally obese (WHR = 1.108) individual with BMI of 23.88. The patient is suffering from hyperlipidemia without any other medical complications. Initially the patient consumed 2204 to 2341 kcal diet, composed of 368.7 to 408g carbohydrate, 65.7 to 70.9g protein and 40.3 to 47.3g total fat. The visible fat intake is 31.4 to 40.1g per day. According to the recommended dietary allowances⁽⁵⁾ of Indian, male, the patient visible fat intake is above the normal limit. His daily diet plan is modified by alternating his breakfast and evening meal with total 90-100g of health mix per day. The patient is advised to have the mix with sugar and water or milk only without any extra fat. The mix is a good source of carbohydrate (74.75 g) and protein (12.92 g) and at the same time contains very less quantity of fat (1.07 g) per 100 grams. Out of the total fat, the ratio of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) is approximately 17: 46.5: 36.5, respectively. The total dietary fibre in 100 g of mix is 7.13g. It also contains Vitamin A (29.8 IU), Vitamin C (0.16 mg), Vitamin E (0.57 mg), Selenium (11.2 mcg), Copper (193.4 mcg), Zinc (529.2 mcg), Iron (2531 mcg) and Manganese (810.7 mcg). The estimated moisture percentage of the mix is 8.93%. The patient dietary/nutrient intake is subjective to inclusion of the mix in his daily diet plan and the comparison of the previous and subsequent (when the patient had health mix in breakfast and evening time) nutrient intake by the patient is shown in Table III.

Due to the diet modification major alteration in intake of total visible fat and protein is occurred. The total daily energy, carbohydrate and fat intake by the patient are modified to 2175 to 2241kcal, 385.7 to 393.2g and 43-44.1g, respectively. Low carbohydrate and fat diet demonstrates significant reduction on non HDL lipids levels in blood⁽⁶⁻⁷⁾. During the study period a negative calorie balance diet is planned for the patient, which is lower than the RDA for carbohydrate. Though there is no enormous change in total fat consumption, but the total visible fat consumption has been changed massively. The total visible fat consumption is reduced to 17.4 to 19.4g, which is within the RDA for visible fat. Reduction in total visible intake to the normal limit of RDA is become possible only because the mix does not need extra fat for preparation. Despite of the fact that the RDA for protein in

case of the patient is 69, the total protein in the diet plan is increased to increase the proportion of protein to carbohydrate. The protein intake is increased to 70.5 – 82 g per day. The increased proportion of protein to carbohydrate is proved to reduce bad lipids in blood, improve body composition and glucose homeostasis⁽⁸⁻¹¹⁾. The mix provides additional supplementation of different micronutrients, such as dietary fibre, vitamin A, E and C along with selenium, iron, manganese, zinc and copper which have individual effects on hyperlipidemia.

Anthropometric details

Gradual positive changes are observed in weight, BMI and WHR of the patient that are associated with reduction of bad lipid and increase of good lipid in blood. The details are shown in Table IV.

Table IV: Changes in anthropometric measurements

Anthropometry	Day 1	Day 60
Weight (kg)	69	64
BMI	23.88	22.15
WHR	1.108	1.054
Height (cm)	170	

Change in lipid profile

On the day one, the patient has triglyceride, cholesterol and LDL levels more than the normal limit, i.e. 182 mg/dl, 278 mg/dl and 191.6 mg/dl, respectively and HDL (50 mg/dl) level below the normal limit. The cholesterol – HDL ratio is 5.56. The change in lipid profile is presented in Table V.

Table V: Change in lipid profile

Parameters	First	Second (on 30th day)	Third (on 60th day)	Normal Blood Lipid levels ^[12]
Triglyceride (md/dl)	182	83	87	<150
Cholesterol (md/dl)	278	193	190	< 200
VLDL (md/dl)	36.4	16.6	17.4	-
LDL (md/dl)	191.6	136.4	115.6	<100
HDL (md/dl)	50	40	57	>40
Cholesterol: HDL	5.56	4.82	3.33	-
LDL:HDL	3.83	3.41	2.03	-

The patient lipid profile is checked on 1st, 30th and 60th day and changes in blood lipids observed as follows:

Triglyceride (TAG): On 30th day, the TAG is reduced to 83 mg/dl and on 60th day, it is 87mg/dl. The normal range of TAG is 150 mg/dl. Hence both levels are desirable and within the normal value.

Cholesterol: On 30th day, the cholesterol is reduced to 193 mg/dl and on 60th day, it is 190 mg/dl which are inside the normal value of less than 200 mg/dl.

LDL: On 30th day, the LDL is reduced to 136.4 mg/dl and on 60th day, it is 115.6mg/dl which are higher than the normal value of less than 100 mg/dl.

HDL: On 30th day, the HDL is reduced to 40 mg/dl and on 60th day, it is increased to 57 mg/dl which are lesser than the normal value of less than 60 mg/dl.

VLDL: On 30th day, the TAG is reduced to 16.6 mg/dl and on 60th day, it is 17.4 mg/dl.

Cholesterol / HDL: The ratio is reduced to 4.82 and 3.33 on 30th and 60th day, respectively. After 60 days the ratio is in normal value.

LDL / HDL: The LDL- HDL ratio is also reduced desirably to 3.41 on 30th day and 2.03 on 60th day.

So it is obvious that the mix has positive influence on lipid profile, for which the levels of TAG, cholesterol, LDL and VLDL are reduced and level of HDL is increased, though not in desirable level. Although on 60th day the level of LDL is slightly higher than normal limit but the LDL level showed gradual reduction with time and it could farther reduce to normal level with time if the patient continuously consumes the health mix for a longer period of time. In case of HDL, there is significant reduction in HDL level (40mg/dl) on 30th day but on 60th day the HDL level (57mg/dl) is improved. The change in non HDL and HDL lipids levels may be due to the followings-

- Increase in protein intake mainly from plant sources has positive effect on blood lipids. It prevents oxidation of LDL and serum triacylglycerol.
- Low-carbohydrate diet as compared to protein intake shows significant decrease in triglycerides, non-HDL cholesterol and TAG/HDL ratio. Further, low fat diet helps in reduction of total cholesterol and LDL cholesterol.
- The fibre content of the patient diet is increased by inclusion of the health mix. High fibre diet increases gastric transit time, binds cholesterol, increases bile secretion and lowers the total cholesterol and LDL: HDL cholesterol ratio⁽¹³⁻¹⁵⁾.
- The health mix provides additional supplementation of different micronutrients such as Vitamin A, E and C along with selenium, iron, manganese, zinc and copper. Dietary supplementation of beta-carotene shows reduction in serum total cholesterol, non-HDL cholesterol, atherogenic index, and total hepatic lipid and an increase in the total lipid and cholesterol contents excreted in the stool. ⁽¹⁶⁻¹⁸⁾ Vitamins C, E and C&E significantly prove to reduce hypertension and improve insulin action, lipid profile and stimulate the production and secretion of HDL.⁽¹⁹⁻²³⁾ Different cross-sectional findings confirm positive association of selenium, iron, manganese, zinc and copper intake with serum lipids status. ⁽²⁴⁻²⁸⁾
- Fortification of the health mix with fenugreek, *Arjuna* and cinnamon has significant effect on maintaining blood lipid levels. It is scientifically proved that daily intake of 10g fenugreek seed soaked in hot water significantly reduces (30 % and 30.6 %, respectively) the TAG and VLDL level without changing BMI, energy, carbohydrate, protein and fat intake for 8 weeks ⁽²⁹⁾.

The results of study done by *Gupta and Verma*⁽³⁰⁾ support that fenugreek supplementation is safe and may be considered as a potential means to lower the serum TAG, cholesterol, LDL and VLDL and increase HDL lipid level in diabetic patients. Results of study done by *Sarma et al.*⁽³¹⁾ indicate that *Arjuna* bark acts as a hypolipidemic, hypocholesterolemic and oxidative stress lowering agent. *Dwivedi and Chopra*⁽³²⁾ reviewed that crude drug of *Arjuna* possesses anti-ischemic, antioxidant, hypolipidemic, and antiatherogenic activities. Presence of triterpenoids and flavonoids in *Arjuna* are considered to be responsible for its beneficial antioxidant cardiovascular properties. *Askari et al.*⁽³³⁾ has found that daily supplementation of 1.5g cinnamon may significantly reduce cholesterol and triglyceride level, but does not have prominent effect on HDL.

- Brisk walking is proved to reduce triglyceride level ⁽³⁴⁾.

In this study intake of the health mix reduces the risk of Cardio Vascular Diseases (CVD), such as atherosclerosis-index body weight, BMI and WHR along with positive alteration on lipid profile. The person is a non-alcoholic person and co-operated well with us in diet and lifestyle modification. So this case study proves that the health mix has encouraging effect on hyperlipidemia.

The basic advantages of the mix as breakfast and evening food item are as follows:

- It is nutritionally well balance.
- It does not need of extra visible fat for preparation.
- It is rich in vitamins and minerals with antioxidant.
- It is rich in phytochemicals.
- It is rich in fibre.

Statistical analysis

Lipid profile

One way ANOVA analysis of blood lipids is shown in Table VI.

Table VI: ANOVA Analysis of blood lipids

Data	Mean	Variance	N
Triglyceride	117.33333	3140.33333	3
Cholesterol	220.33333	2496.33333	3
LDL	147.66667	1516.49333	3
HDL	49	73	3

F = 8.38194
p = 0.0075

At the 0.05 level, the mean values are significantly different.

Statistically the changes in lipid levels of the patient on 30th and 60th day after using the health mix are significant for triglyceride, cholesterol, LDL and HDL.

Probable basis of alteration in triglyceride

A. Incorporation of the health mix in daily diet causes

- i. Improvement in SFA, MUFA and PUFA ratio due to inclusion of vegetarian protein sources and limitation of non-vegetarian items.
- ii. Low oxidative stress due to intake antioxidants.
- iii. Increased thermic effect of food due to high protein diet.
- iv. A low amount of triglyceride converts to cholesterol ester for synthesis of HDL.

- v. Due to intake of visible fat, magnitude of triglyceride formation and storage of triglyceride in the body is reduced.

B. Regular physical activity – major source of energy is glucose and triglyceride. The released glycerol from adipose tissues via lipolysis is used as one of the ingredient for gluconeogenesis.

Probable basis of alteration in cholesterol level

- A. Incorporation of the health mix in daily diet causes
- Low intake of dietary cholesterol.
 - Increased thermic effect of food due to high protein diet leads to utilization of Acetyl CoA (precursor of cholesterol) for extra energy production.
 - High dietary fiber intake increases gastric transit time, binds cholesterol and increases bile secretion.
 - Increased reverse cholesterol transport of excess cholesterol from tissue to liver due to high HDL level.
 - Portion of cholesterol ester utilized for synthesis of HDL.

Probable basis of alteration in HDL level

- A. Incorporation of the health mix in daily diet causes
- Intake of complex carbohydrate and soluble fiber which associated with HDL production.
 - Increase intake of invisible unsaturated fatty acids helps in improving HDL level.
 - Removal of trans fatty acids in diet.

Probable basis of alteration in LDL level

- A. Incorporation of the health mix in daily diet causes
- Intake of high protein and low visible fat diet.
 - Regular brisk walking and other physical activity used up the free fatty acids released from VLDL as immediate source of energy and there by reduces LDL production.

CONCLUSION

The health mix has a positive effect on human blood lipid profile. From the nutritional point of view the health mix holds many hypolipidemic properties without any known side effects. It is nutritionally balanced and provides a wide range of essential nutrients. It is found that the mix helps to minimize various risk factors of Cardio Vascular Diseases, such as hyperlipidemia, atherosclerosis-index, body weight, body mass index and waist hip ratio.

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