



Probiotic Health Drink Supplementation to Hyperglycemic and Hypercholesterolemia Population In and Around Nungambakkam–A Suburb in Chennai City

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Abstract

The City of Chennai is India's fourth largest metropolitan city with multi-national commercial establishments, important government offices, foreign consulates, sprawling educational institutions, shopping malls, sporting facilities, tourist spots, star hotels, restaurants, and cultural centers. Nungambakkam is one of the oldest suburbs of Chennai and forms the western limits of Madras. The adjoining regions of Nungambakkam include **Egmore, Chetpet, T. Nagar, Kodambakkam, Choolaimedu and Kilpauk**. Choolaimedu is a large residential commercial locality comprising of low income groups. Situated in this busy area is the McDoughal Memorial Nursery School - a Balwadi for the underprivileged children managed by the Alumnae Association of Women's Christian College and WCC Outreach Centre. Unhealthy lifestyle and improper dietary pattern of the people expose them to the risk of Diabetes and Hypercholesterolemia. Diabetes doubles the risk of cardiovascular disease, the main being "macrovascular" diseases which is related to atherosclerosis of larger arteries, ischemic heart disease which comprises of angina and myocardial infarction, stroke and peripheral vascular disease. The present study was aimed at preparing a Probiotic health drink using *lactobacillus* from yogurt under aerobic conditions along with 16 natural ingredients and distributing to the required population and analyzing the effect of the supplementation of this probiotic health mix on the serum high density lipoprotein, serum low density lipoprotein, serum very low density lipoprotein, serum triglyceride, and blood glucose levels through blood tests. The present study has significantly revealed the reduced the level of Blood Glucose and Serum Cholesterol.

Keywords: Probiotic health drink, Choolaimedu, Lactobacillus, Blood Glucose and Serum Cholesterol

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1. Introduction

Nungambakkam is one of the oldest suburbs of Chennai and forms the western limits of Madras. Most of Nungambakkam's principal lanes, such as College Road, Haddows Road and Sterling Road, are over 100 years old and appear in a 1909 map of Madras city. Three out of the city's four prime residential areas; Wallace Gardens, Khader Nawaz Khan Road and Kothari Road, are in Nungambakkam. Loyola College, MOP Vaishnav college, SDAT Tennis Stadium, Ispahani Center, Women's Christian College, Valluvar Kottam and Padma Seshadri Bala Bhavan are some of the city's prominent landmarks. The SDAT stadium hosts the long-running ATP event, the Chennai Open. Valluvar Kottam, dedicated to the Tamil Saint-Poet Thiruvalluvar (வருவளர் in Tamil), is a popular tourist attraction in Chennai (Map 1). The adjoining regions of Nungambakkam include Egmore, Chetpet, T. Nagar, Kodambakkam, Choolaimedu and Kilpauk. [www.mapsofindia.com/chennai/localities/nungambakkam.html].



MAP 1: NUNGAMBAKKAM

Choolaimedu is a large residential commercial locality comprising of low income groups. It borders Kodambakkam, Vadapalani, M.M.D.A. Colony, Aminijikarai, Mahalingapuram and Nungambakkam (Map 2). Situated in the busy area is the McDoughal Memorial Nursery School - a Balwadi for the underprivileged children managed by the Alumnae Association of Women's Christian College and WCC Outreach Centre. Unhealthy lifestyle and improper dietary pattern of the people expose them to the risk of Diabetes and Hypercholesterolemia. Diabetes doubles the risk of cardiovascular disease, the main being "macrovascular" diseases which is related to atherosclerosis of larger arteries, myocardial infarction, stroke and peripheral vascular disease. [http://en.wikipedia.org/wiki/Nungambakkam].



Fermented milks have historically been the most common foods containing Probiotics. However it was not until 1908, When Elie Metchnikoff published his book entitled "The Elongation of Life" that health benefits were first attributed to the consumption of milk fermented with specific types of bacteria. Bacteria promoted as Probiotics has had an established history of safe use and documentation of efficacy [Hamilton-Miller, *et.al.*, 2003]. They are the normal inhabitants of the human body. A Minimum dose of billions of probiotic bacteria per day is generally regarded as necessary to observe health benefits. Probiotics are thought to influence the immune response also [Cheplin H.A., and Rettger L.F, 1920].

Probiotic cultures have been shown in a variety of test systems to stimulate certain cellular and antibody functions of the immune system. Animal and some human studies have shown an effect of yogurt or probiotic bacteria on enhancing levels of certain immune reactive cells (e.g. macrophages, lymphocytes) or factors (e.g. immunoglobulin's, interferon). Probiotic Cultures suggests that certain strains consumed at high Levels positively influence human health [Fuller, R, 1989].

Food sources of Probiotics, like milk and yogurt can be healthy additions, but due to intolerance and lower culture levels, Supplementation becomes a more viable option (Table 1). The purpose of antibiotics is to kill harmful bacteria but unfortunately, they kill normal bacteria also [Reid *et.al.*, 2003]. Instead of wiping out bacteria, Probiotics promote growth of friendly flora, which in turn fight disease and Infectious-causing bacteria. The present study has significantly reduced the level of Blood Glucose and Serum Cholesterol.

Why Probiotics? Trillions of bacteria inhabit and colonise the human digestive system. These bacteria are referred to as the gut flora [Sanders, M.E, 2000]. In a healthy adult body there is around 2kgs of bacteria. The gut flora or the beneficial bacteria take part in our digestion and absorption of our food, they produce a number of enzymes that break down proteins, carbohydrates, fibre and fats. They can actively synthesise a number of nutrients that are essential for us such as Vitamin k2 (menaquinone), B1, B2, B3, B6, B12, folic acid, pantothenic acid and some amino acids. They also discourage harmful bacteria and 'bad' yeasts from invading the body [Osset, *et.al.*, 2001].

There are around 500 bacteria species known to science so far, some of these are beneficial, while others are potentially harmful. All of these bacteria live in a highly organised micro world with certain species predominating and controlling others. A balance between the two is vital for good health and well-being [Hamilton-Miller J.M, 2003]. Probiotics are the beneficial bacteria that are indigenous to a healthy digestive system. A healthy digestive system is primarily made up of these beneficial bacteria or probiotics. Probiotics are now made available in foods and probiotic supplements as well [Pascual, *et.al.*, 2008].

Example of foods containing probiotics are yogurt, fermented foods like sauerkraut and fermented milk, miso and soy beverages. The dominant members of the beneficial bacteria or probiotics are Bifidobacteria (*Bifidobacterium bifidum*), Lactobacteria (*Lactobacillus acidophilus*, *Lactobacillus plantarum*, *Lactobacillus rhamnosus*), Propionobacteria, Peptostreptococci and Enterococci. Some probiotic supplements have a yeast strain within the probiotic blend, the most common is *Saccharomyces boulardii* which are different from bacteria but indigenous in a healthy gut flora. *Saccharomyces boulardii* also helps to keep the digestive tract clear and is beneficial to sufferers of diarrhoea and Crohn's disease [D'Souza, *et.al.*, 2003].

Probiotics being live micro-organisms, which, when administered in adequate amounts, confer a health benefit on the host. Probiotics work by crowding out the bad bacteria within the digestive system [Gilliland S.E, and Walker D.K, 1990]. The probiotics then attach to the intestinal wall where they increase the number of beneficial bacteria regulating and maintaining balance between the beneficial and harmful bacteria [Allian, *et.al.*, 1947]. There are many areas of health in which probiotics have beneficial effects. It is said by many experts that the lack of probiotic bacteria in the gut flora is the main root cause to many diseases of today. Probiotics are best taken as a supplement. The best probiotic supplement would be a probiotic blend of the dominant species of bacteria in capsule or powder form [Werner, *et.al.*, 1981].

The present study is aimed at preparing a Probiotic health drink using *lactobacillus* from yogurt under aerobic conditions along with 16 natural ingredients such as Oats, Ragi, Maize, Jower, Wheat, Rice, Barley, Fried gram, Soya bean, Green gram, Cashew nut, Ground nut, Badam, Sago, Cardamom and Fenugreek seeds (Tables 1 & 2). After preparing it in a powdered form it will then be distributed to the required population and the effect of the supplementation of this probiotic health mix on the serum high density lipoprotein, serum low density lipoprotein, serum very low density lipoprotein, serum triglyceride, and blood glucose levels will be determined through blood tests (Figures 1 & 2).

Table 1: Nutritive Value of Probiotic Health Drink

Materials	Values	Materials	Values
1. Energy	314.5 kilo calories(approx)	10. Vitamin A	4.56 mg/gm
2. Carbohydrate	43.55 % w/w	11. Iron.	2.959 mg/gm
3. Protien	21.6856% w/w	12. Zinc	2.446 mg/gm
4. Fat	5.665% w/w	13. Potassium	6.78 mg/gm
5. Fibre	1.7867% w/w	14. Magnesium	4.4363 mg/gm
6. Vitamin B1	0.0081 mg/gm	15. Sodium	120.3mg/gm
7. Vitamin B2	0.07726 mg/gm	16. Ash	1.88% w/w
8. Vitamin B6	0.1303 mg/gm	17. Calcium	25.6103 mg/gm
9. Vitamin C	29.8819 mg/gm	18. Phosphorus	12.11 g/gm

Table 2: Nutrient, nuts, grains & seeds chart- (USDA)

Nut/Seed	Protein/Fiber	Minerals	Vitamins
Cashews	One ounce of raw, unsalted cashew nuts contains 5.17 grams of protein, 157 calories and 0.94 grams of fiber	Potassium - 187 mg Phosphorus - 168 mg Calcium - 10 mg Magnesium - 83 mg Iron - 1.89 mg Sodium - 3 mg Manganese - 0.469 mg Zinc - 1.64 mg Copper - 0.622 mg Selenium - 5.6 mcg	Vitamin C - 0.1 mg Vitamin B1 (thiamine) - 0.12 mg Vitamin B2 (riboflavin) - 0.016 mg Niacin - 0.301 mg Pantothenic Acid - 0.245 mg Vitamin B6 - 0.118 mg Folate - 7 mcg Vitamin E - 0.26 mg Vitamin K - 9.7 mcg
Almonds	1 ounce (23 whole nuts) of raw almonds contains 6.02 grams protein, 163 calories and 3.5 grams of dietary fiber.	Potassium - 200 mg Phosphorus - 137 mg Calcium - 75 mg Magnesium - 76 mg Iron - 1.05 mg Selenium - 0.7 mcg Zinc - 0.87 mg Manganese - 0.648 mg Copper - 0.282 mg	Vitamin B1 (thiamine) - 0.06 mg Vitamin B2 (riboflavin) - 0.287 mg Niacin - 0.96 mg Folate - 14 mcg Pantothenic Acid - 0.133 mg Vitamin B6 - 0.041 mg Vitamin E - 7.43 mg
Barley (Pearled)	100 grams of cooked, pearled barley contain 2.26 grams protein, 123 calories and 3.8 grams dietary fiber.	Potassium - 93 mg Phosphorus - 54 mg Calcium - 11 mg Magnesium - 22 mg Iron - 1.33 mg Sodium - 3 mg Manganese - 0.259 mg Zinc - 0.82 mg Copper - 0.105 mg Selenium - 8.6 mcg	Vitamin B1 (thiamine) - 0.083 mg Vitamin B2 (riboflavin) - 0.062 mg Niacin - 2.063 mg Pantothenic Acid - 0.135 mg Vitamin B6 - 0.115 mg Folate - 16 mcg Vitamin A - 7 IU Vitamin E - 0.01 mg Vitamin K - 0.8 mcg
Millet	100 grams of cooked millet contain 3.51 grams protein, 119 calories and 1.3 grams dietary fiber.	Potassium - 62 mg Phosphorus - 100 mg Calcium - 3 mg Magnesium - 44 mg Iron - 0.63 mg Sodium - 2 mg Manganese - 0.272 mg Zinc - 0.91 mg Copper - 0.161 mg Selenium - 0.9 mcg	Vitamin B1 (thiamine) - 0.106 mg Vitamin B2 (riboflavin) - 0.082 mg Niacin - 1.33 mg Pantothenic Acid - 0.171 mg Vitamin B6 - 0.108 mg Folate - 19 mcg Vitamin A - 3 IU Vitamin E - 0.02 mg Vitamin K - 0.3 mcg
Oats	100 grams of oats contain grams 16.89 protein, 389 calories and 10.6 grams dietary fiber	Potassium - 429 mg Phosphorus - 523 mg Calcium - 54 mg Magnesium - 177 mg Iron - 4.72 mg Sodium - 2 mg Manganese - 4.916 mg Zinc - 3.97 mg Copper - 0.626 mg	Vitamin B1 (thiamine) - 0.763 mg Vitamin B2 (riboflavin) - 0.139 mg Niacin - 0.961 mg Pantothenic Acid - 1.349 mg Vitamin B6 - 0.119 mg Folate - 56 mcg



Figure 1: Lactobacillus (*L. acidophilus*)

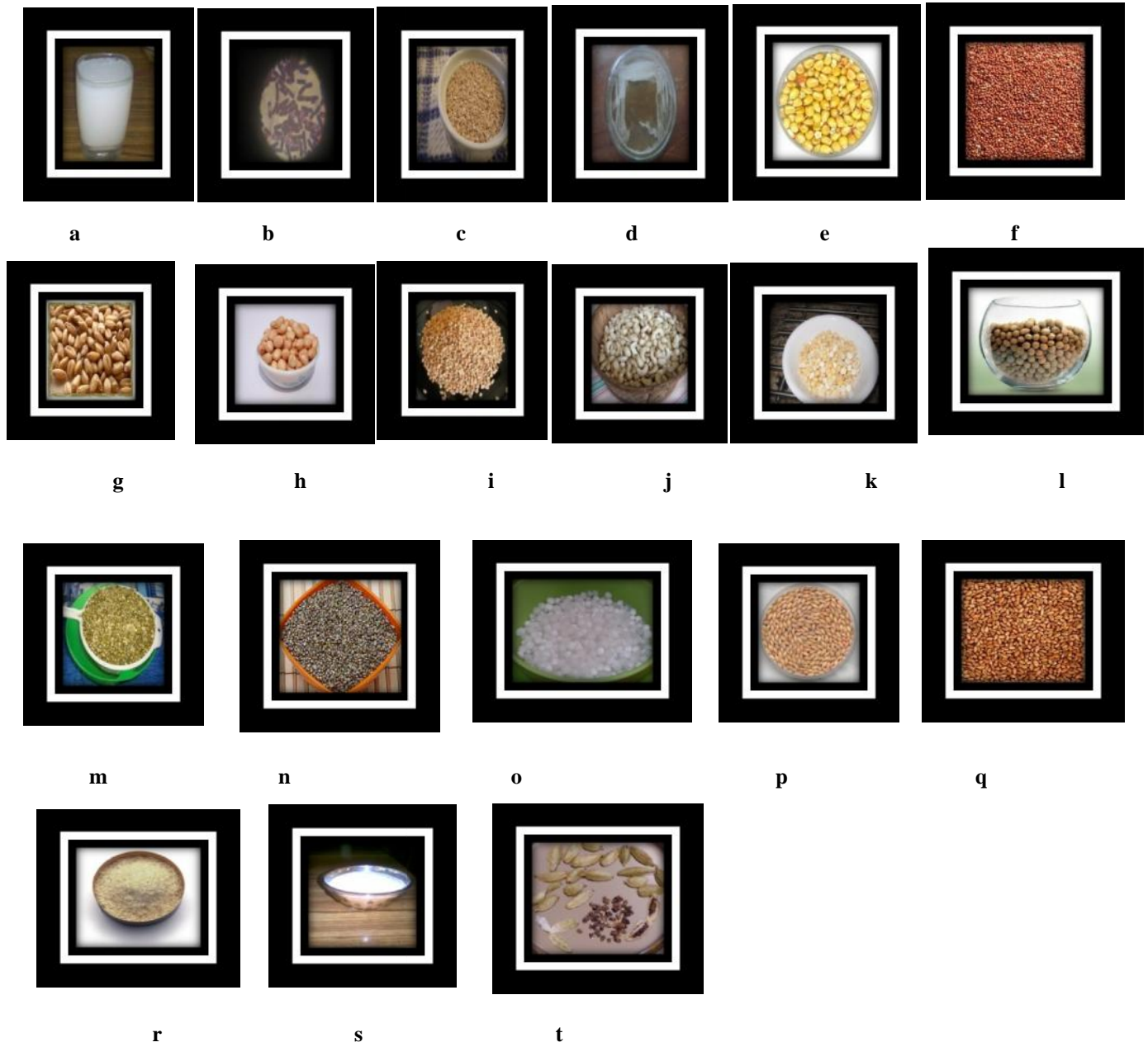


Figure 2: Probiotic Ingredients (a – t)

a: PROBIOTIC DRINK; b: LACTOBACILLUS; c: OATS;
d: STARTERCULTURE; e: MAIZE; f: RAGI

g: WHEAT; h: PEANUT; i: FENUGREEK;
 j: CASHEW NUT; k: FRIED GRAM; l: SOYA BEAN
 m: GREEN GRAM; n: BAIJIRA; o: CARDOMOM;
 p: SAGO; q: JOWER; r: RICE
 s: BARLEY; t: POWDERED FORM

Scientifically Researched Healthful Effects of Probiotics

- Control of acute diarrhea - with *Lactobacillus casei* strain Shirota
- Prevention of traveler's diarrhea - via *Saccharomyces boulardii*, and *Bifido bacterium bifidum*
- Reducing high blood pressure & mild hypertension - *Lactobacillus helveticas*
- Immunity enhancement
- Maintenance of Crohn's disease - *S. boulardii*
- Reducing symptoms of IBS
- Treating Vaginitis and Vaginosis - with acidophilus supplements

2. Materials and Method

The various health drink ingredients taken for the present study are oats, ragi, maize, jower, wheat, rice, barley, fried gram, soya bean, green gram, cashew nut, ground nut, badam, sago, cardamom, fenugreek seeds and starter culture (Figures 1 & 2). This PROBIOTIC HEALTH DRINK is rich in cereals, nutrients and energy. 30 grams of this health mix was supplemented for 45 days, it was given daily before breakfast in empty stomach. After 45 days it was found that there was significant reduction in post prandial blood glucose levels and lipid profile levels. This study was proposed to investigate whether the inclusion of the mix before breakfast for the period of 45 days will have any protective effect on glycemia or lipidemia when added and taken with milk. Since the subjects volunteered to participate in the study the information obtained from them is reliable. The subjects consumed the supplement daily for the period of 45 days supplied to them. Soluble dietary fiber and other constituents have been shown to improve the control of blood glucose, serum lipid levels possibly. Recommended dietary allowances have been omitted because they vary based on country, age, sex and pregnancy. Studies conducted in previous years revealed its significant role in reducing blood glucose levels and serum lipid levels.

3. Results and Discussion

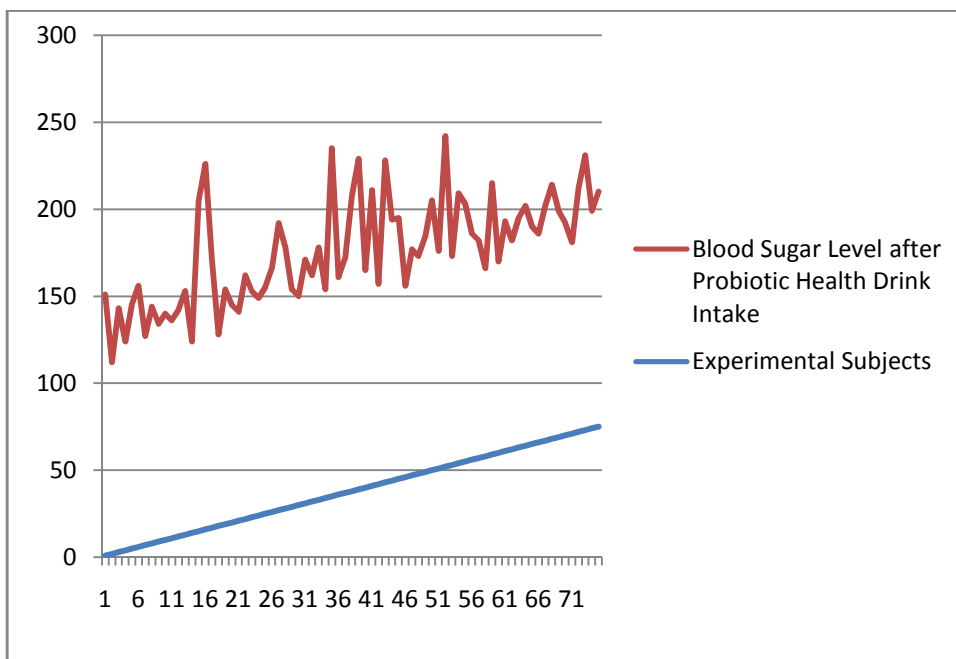
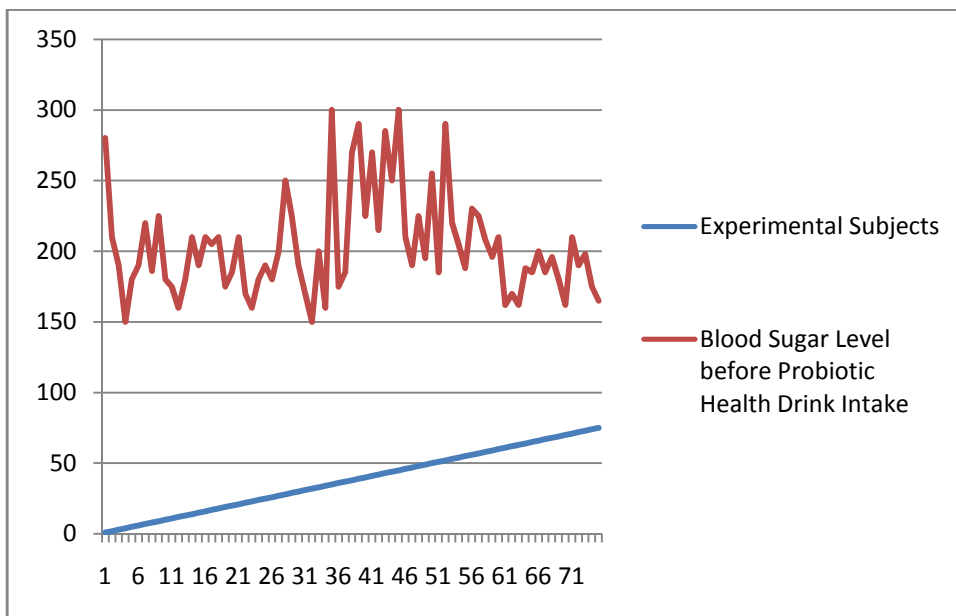
The present investigation carried out using "Probiotic health mix" in the form of health drink revealed a significant hypoglycemic and hypolipidemic effect on the serum lipid profile and plasma glucose level (Tables 3 and Graphs 1 - 4). Paired Sample Statistics and One-Sample Kolmogorov-Smirnov Test were employed for the analysis of data obtained (Tables 4 - 6).

Table 3: Blood Sugar and Blood Cholesterol of Experimental Subjects before and After Intake of Probiotic Health Drink

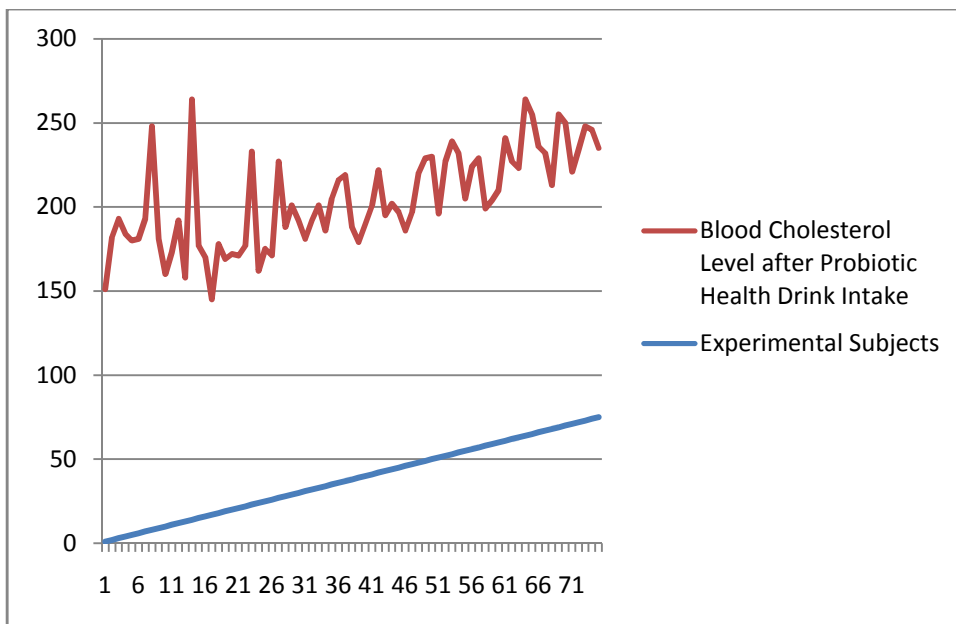
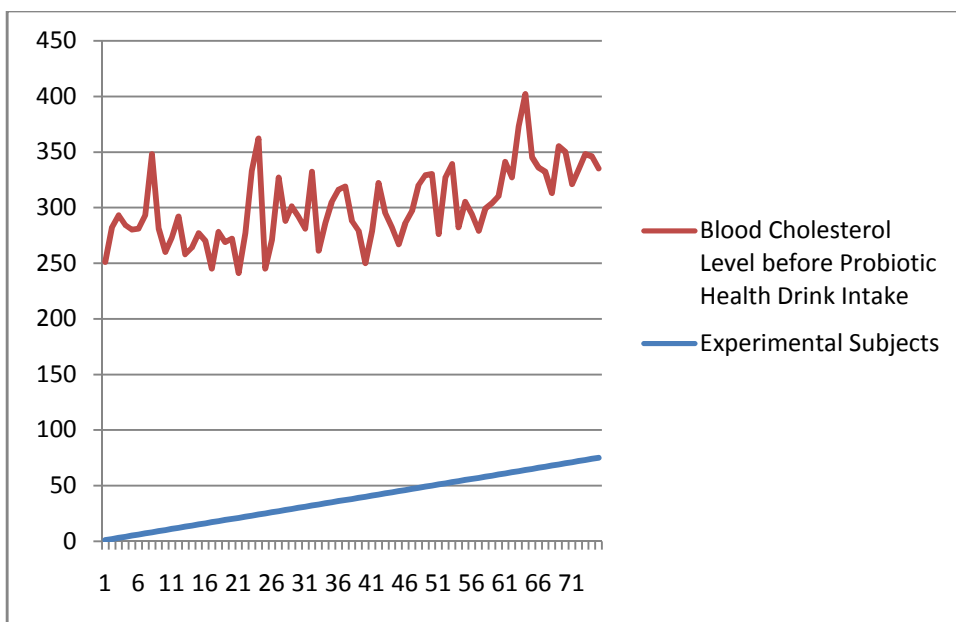
Subject No	Before Intake of Probiotic Health Drink		After Intake of Probiotic Health Drink	
	Blood Sugar mg/ml	Blood Cholesterol mg/ml	Blood Sugar mg/ml	Blood Cholesterol mg/ml
1	280	250	150	150
2	210	280	110	180
3	190	290	140	190
4	150	280	120	180
5	180	275	140	175
6	190	275	150	175
7	220	286	120	186
8	186	340	136	240
9	225	272	125	172
10	180	250	130	150
11	175	262	125	162
12	160	280	130	180
13	180	245	140	145
14	210	250	110	250
15	190	262	190	162
16	210	254	210	154

17	205	228	155	128
18	210	260	110	160
19	175	250	135	150
20	185	252	125	152
21	210	220	120	150
22	170	255	140	155
23	160	310	130	210
24	180	338	125	138
25	190	220	130	150
26	180	245	140	145
27	200	300	165	200
28	250	260	150	160
29	225	272	125	172
30	190	262	120	162
31	170	250	140	150
32	150	300	130	160
33	200	228	145	168
34	160	252	120	152
35	300	270	200	170
36	175	280	125	180
37	185	282	135	182
38	270	250	170	150
39	290	240	190	140
40	225	210	125	150
41	270	238	170	160
42	215	280	115	180
43	285	252	185	152
44	250	238	150	158
45	300	222	150	152
46	210	240	110	140
47	190	250	130	150
48	225	272	125	172
49	195	280	135	180
50	255	280	155	180
51	185	225	125	145
52	290	275	190	175
53	220	286	120	186
54	205	228	155	178
55	188	250	148	150
56	230	238	130	168
57	225	222	125	172
58	208	241	108	141
59	196	245	156	145
60	210	250	110	150
61	162	280	132	180
62	170	265	120	165
63	162	310	132	160
64	188	338	138	200
65	185	280	125	190
66	200	270	120	170
67	185	265	135	165
68	196	245	146	145

69	180	286	130	186
70	162	280	122	180
71	210	250	110	150
72	190	262	140	162
73	198	275	158	175
74	175	272	125	172
75	165	260	135	160



Graphs 1 & 2: Blood Sugar Level of Experimental Subjects before and After Intake of Probiotic Health Drink



Graphs 3 & 4: Blood Cholesterol Level of Experimental Subjects before and After Intake of Probiotic Health Drink

Statistical Significance

The following statistical methods were employed for the analysis of data obtained. The t value at 74 degrees of freedom = 18.014, at $p < 0.0005$. Due to the means of the blood sugar levels and the direction of the *t*-value, we can conclude that there was a statistically significant decrease in the blood sugar level following the administration of the probiotic drink from 203.61 ± 36.384 to 137.81 ± 22.513 an significant decrease of 65 ± 31.634 . The t value at 74 degrees of freedom = 37.006, at $p < 0.0005$. Due to the means of the blood cholesterol levels and the direction of the *t*-value, we can conclude that there was a statistically significant decrease in the blood cholesterol level following the administration of the probiotic drink from 263.13 ± 26.721 to 166.39 ± 21.023 an decrease of 96.747 ± 22.641 . For the paired t test to be valid the difference between the paired values between blood sugar levels before and after the administration of the probiotic drink must be to be normally distributed and this is confirmed using the K-S Test in Tables 4 - 6.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	BLOOD SUGAR LEVEL BEFORE PROBIOTIC	203.61	75	36.384	4.201
	BLOOD SUGAR AFTER PROBIOTIC	137.81	75	22.153	2.558
Pair 2	BLOOD CHOLESTEROL BEFORE PROBIOTIC	263.13	75	26.721	3.085
	BLOOD CHOLESTEROL AFTER PROBIOTIC	166.39	75	21.023	2.428

		Blood Sugar Before Probiotic	Blood Sugar After Probiotic
N		75	75
Normal Parameters ^{a,b}	Mean	203.61	137.81
	Std. Deviation	36.384	22.153
Most Extreme Differences	Absolute	.164	.167
	Positive	.164	.167
	Negative	-.089	-.104
Kolmogorov-Smirnov Z		1.417	1.449
Asymp. Sig. (2-tailed)		.036	.030
a. Test distribution is Normal.			
b. Calculated from data.			

For the paired t test to be valid the difference between the paired values between blood cholesterol levels before and after the administration of the probiotic drink must be to be normally distributed and this is confirmed using the K-S Test given in the Table 6.

		Blood Cholesterol Before Probiotic	Blood Cholesterol After Probiotic
N		75	75
Normal Parameters ^{a,b}	Mean	263.13	166.39
	Std. Deviation	26.721	21.023
Most Extreme Differences	Absolute	.104	.112
	Positive	.104	.112
	Negative	-.058	-.088
Kolmogorov-Smirnov Z		.900	.970
Asymp. Sig. (2-tailed)		.392	.304
a. Test distribution is Normal.			
b. Calculated from data.			

4. Conclusion

Probiotic organisms thus have a wide range of health effects on the human body. These are natural inhabitants of the human gut. Naturally they are present in very small amounts according to the body's system. Yogurt the main ingredient used in this health drink is a fermented food product in which *lactobacillus* is the major organism. Regular intake of yogurt can lead to increase in *lactobacillus* and can be used as common medications for stomach ailments. Thus Probiotic health drink can help in maintaining the proper gut health and can act against several diseases related to digestive system and can benefit us by way of lowering cholesterol, lowering blood glucose, being active against diarrhea, reducing inflammation and preventing harmful bacterial growth. Hence as the saying goes "**Natural foods are best medicines** we can conclude from this present study that this probiotic health drink which contains a mixture of nearly 16 natural ingredients has a remarkable effect on blood glucose and serum lipid profile.

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