Evaluation of Supplementation of Ashgourd Fermented Beverage to Geriatric Population

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Abstract: Existing data indicates a significant morbidity among the aged and most may remain subclinical. Vegetables being good source of vitamins and minerals, further their concentration has been improved by fermentation process. In recent years elderly institutions are being more common and a need for nutritional studies to provide better service. Thus the present study was conducted on geriatrics population to see the effect of ashgourd fermented beverage on anthropometric, nutritional and biochemical status of institutional elderly inmates. Ashgourd Fermented beverage (180ml) was provided to inmates of experimental group with the instructions to drink in fasting condition as a first drink in the morning for 60 days and control group received no supplementation. The parameters which were selected to evaluate the effect of ashgourd fermented beverage were anthropometric data, nutritional status, dietary pattern, clinical, biochemical parameters such as fasting and post prandial blood glucose levels, lipid profile, haemoglobin level and medical histories of the inmates. The selected parameters were assessed before and after the supplementation to see the effect of fermented beverage. It can be concluded from the present study that supplementation of fermented beverage showed significant improvement in BMI grades, heamoglobin and reduced blood glucose level, triglycerides and improved HDL cholesterol levels in experimental group when compared with the control group.

Keywords: Ashgourd fermented beverage, geriatrics, supplementation, biochemical parameters.

INTRODUCTION

Ageing can be described as the progressive constriction of the homeostatic reserve of organ system. India is the second most populous country in the world with 72 million elderly, constituting approximately eight percent of the total Indian population [1]. With the increasing pace of population ageing, the health of the elderly persons in India has been the focus in recent years. Existing data indicates a significant morbidity among the aged and most may remain subclinical [2]. Ash gourd (*Benincasa hispida*), a member of the family Cucurbitaceae is one of the familiar crops that are grown primarily for its use as a vegetable and usually recognized for its nutritional and medicinal properties especially in Asian countries. As a rich source of functionally important bioactives and therapeutics such as triterpenes, phenolics, sterols, glycosides and soluble dietary fiber the vegetable has been widely used for therapeutic treatments [3-5].

Fermented foods provide several health benefits. Though vegetables are often used for fermentation in other countries [6, 7] it is less commonly used in India. Vegetables being good source of vitamins and minerals, further their concentration has been improved by fermentation process [8, 9]. Fermentation process is known for improving digestibility and flavour. As well Yoon, *et al*. [6] showed that Fermented cabbage juice serve as a healthy beverage for vegetarians and lactose – allergic consumers. However, the studies on evaluation of fermented foods has not received much attention. In recent years, due to the current change in the life style of the families, majority of elderly are not taken care of and therefore elderly institutions are being more common in India and there is a need for nutritional studies to provide better service to the geriatric population. Thus the present study was conducted on geriatrics population to see the effect of Ashgourd Fermented Beverage on anthropometric, nutritional and biochemical status of institutional elderly inmates.

MATERIALS AND METHODS

The evaluation of the Ashgourd Fermented Beverage has been carried out by conducting the clinical study at Sri Vasavi Old Age Home, Alanahalli, Mysore. A total number of 60 out of 130 (46%) inmates of 60-90 years age have been selected for the study with the permission of the administrators and supervisors of the old age home and were interviewed, examined and the subjects who were not having serious health problems were considered for the study and the required information was collected. Human Ethical Committee approval was obtained by University of Mysore, Mysore for the approval of the protocol and to undertake the study. A written consent was taken from the volunteering inmates of the institution. The questionnaire included background information such as information regarding their age, gender, marital status,

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education, living conditions, dietary pattern, clinical and medical histories of the inmates.

Tools for Assessing Nutritional Status

Anthropometric measurements such as height, weight, mid upper arm circumference (MUAC), waist hip ratio (WHR) [10] were selected to assess the nutritional status using standard techniques. Weight, body fat, hydration, muscle were measured using Belita-Body fat/hydration/muscle monitor scale with ± 0.1 gm difference. Height, mid upper arm, waist and hip circumference were measured using non-expandable fibre tape. Body Mass Index (BMI) was calculated as the ratio of [Weight (Kg) / Height^2 (m)]. These were compared with the World Health Organizations (WHO) suggested Asian standards [11].

Dietary Pattern

Frequency of consumption of various food groups were elicited by the inmates. Diet survey using 24 hour dietary recall method was carried out for assessing dietary intake using standardized cups. The nutrient intake of the subjects was calculated using a ready reckoner [12].

Clinical Tests

Clinical manifestation of nutrition deficiencies and morbidity profile were recorded [10].

Biochemical Analysis

The biochemical attributes namely Fasting Blood Sugar (FBS), Post Prandial Blood Sugar (PPBS), Blood Lipid Profile – Serum Cholesterol, Triglycerides (TGL), Low Density Lipoprotein (LDL cholesterol), High Density Lipoprotein (HDL cholesterol), haemoglobin were carried out on all the selected subjects, prior and after supplementation. Biochemical attributes in blood were analysed by M/s Biochemical Diagnostic Laboratory, Mysore using standard methods.

Safety Test

Before supplementing the fermented beverage, as per the regulations and protocol, the safety of the product was evaluated through animal experiments. Fermented beverage was fed to Male Wister Rats weighing 150g to 200g for a period of 15 days and evaluated for physical appearance, liver enzyme test and kidney functioning test.

Supplementation of Ashgourd Fermented Beverage

Fermented beverage was prepared and supplied by Defence Food Research Laboratory (DFRL), Siddharthanagar, Mysore for supplementation. Out of total of 60 inmates 30 inmates were taken for the experimental group and 30 inmates to the control group. Ashgourd fermented beverage (180ml) was provided to inmates of experimental group with the instructions to drink in fasting condition as a first drink in the morning and control group received no supplementation. Inmates of both experimental and control group were re-examined after period of 60 days supplementation for all above mentioned parameters to observe the impact of the supplement on anthropometric, nutritional and biochemical parameters.

Statistical Analysis

The data collected before and after supplementation of the study were tabulated in a hyper table using computed excel software programme. The data was analysed for test of significance using Student's't' test in order to observe the impact of ashgourd fermented beverage supplementation before and after the study on anthropometric, nutritional, and biochemical parameters.

RESULTS AND DISCUSSIONS

Ashgourd, a strengthful vegetable with B vitamins and soluble fibre has further improved with ashgourd juice fermentation process, both in terms of nutritional status as well as preservation. The optimized ashgourd fermented beverage [13] had thiamine 71µg%, riboflavin 4.6 µg%, niacin 284 µg%, pyridoxine 551 µg% and vitamin C 1.24mg%. Besides these, the total phenols 16mg% and antioxidant activity of 4.4% are present in the beverage. The alcohol content was 1.6 % which was within the limits of 5% as per FSSA, 2006 to fall under the food category. Safety test on animal models revealed Serum Glumatic-Oxaloacetic Transaminase (SGOT) and Serum Glutamic-Pyruvate Transaminase (SGPT) enzymes of liver and creatinine and urea for kidney functioning were within the limits of normal range and proved that the product was safe and fir for consumption. In the present Human study we examined impact of supplementation of ashgourd fermented beverage on anthropometric, nutritional and biochemical parameters on Old Age Home inmates. The subjects have been given one serving of ashgourd fermented beverage in the morning in fasting condition. Among the total subjects of 60, 42% were males and 58% were females (Table **1**). Most of the inmates were staying alone (70%) and 30% of inmates lived with their spouses in old age home. The mean age of female was 70 and male was 73 years. Around 48% of male were

Table 1: Age Distribution of the Inmates

Number	Gender		Age Range (years)				Mean age	
	n (%)		60-75		75-90			
	Male	Female	Male	Female	Male	Female	Male	Female
60 (Total)	25(42)	35(58)	12(48)	24(69)	13(52)	11(31)	73	70
30 (Experimental)	15(50)	15(50)	8(53)	12(80)	7(47)	3(20)	73	67
30 (Control)	10(33)	20(67)	4(40)	12(60)	6(60)	8(40)	74	72

degree/diploma qualified, followed by secondary level at 32% and primary 20%. Majority (34%) of female were studied primary level, followed by 29% secondary and 23% degree. It is more evident from Table **2** that no male was illiterate where as 14% of females were illiterates.

Table 2: Educational Levels of the Inmates According to Gender

Qualification	Gender N (%)	
	Male	Female
Total	60	
	25(42)	35(58)
Illiterate	0(0)	5(14)
Primary	5(20)	12(34)
Secondary	8(32)	10(29)
Degree/Diploma	12(48)	8(23)

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Grouping for the Study

Out of 60, 30 inmates were experimental group and 30 were control. Experimental group contained 50% female and 50% male where as control group had 67% female and 33% male.

Anthropometric Data

The mean overall height of males was 163±7 cms and that of the female subjects was 149±7cms. The impact of supplementation of ashgourd fermented beverage on anthropometric data of inmates is shown in Table **3**. In experimental group before supplementation the weight of experimental male and experimental female was 69 and 58 kgs and it reduced by 1 to 3 kg after the supplementation with the significance level of $p<0.05$, while in control group there was 1kg increase in control male. BMI was used as the indicator to determine the nutritional status. BMI ≤ 18.5 kg/m^2 was observed as under nourished, ≥ 23 kg/m^2 and ≥ 27.5 kg/m^2 represent an increased risk and a high risk of suffering from Non Communicable Diseases (NCDs) respectively. BMI values of both experimental group and control group were higher when compared with the WHO standards. An improvement was seen experimental group in the nutritional grades after the supplementation. The nutritional grades of the experimental female were decreased by 70% within the overweight grade and very mildly decreased by 32% in experimental male, where as there was no improvement in control group. There was shift in control male from increased risk to a high risk of suffering from NCDs. It is evident from Table **3** that MUAC in experimental group decreased by 2cm after supplementation with significance level of $p<0.05$ and there was no change observed in control group. The supplementation of ashgourd fermented beverage on waist circumference showed reduction of 5cms in experimental female and 3cms in experimental male with a significance level of $p<0.05$ and $p<0.01$ respectively. Hip circumference was reduced by 108cms to 101cms in experimental female and from 104cms to 98cms in experimental male after the supplementation. As shown in Table **3** decrease in hip circumference was more significant in experimental male ($p<0.001$) than experimental female ($p<0.05$). WHR was estimated by dividing waist circumference by hip circumference. The threshold WHR was ≥ 0.85 for females and ≥ 1.00 for males, above which superior distribution of adipose tissue was considered. In the present study the WHR showed normal in experimental group before and after the supplementation while it was 0.1 higher in control group. As shown in Table **3** the supplementation of ashgourd fermented beverage showed an improvement in body water and body muscle status by decreasing body fat in experimental group. No change was observed in body muscle and body water content in the control group.

Table 3: Anthropometric Data of Experimental and Control Group

	Parameters	Gender N (%)			
		Male	Female	Male	Female
		Experimental		Control	
		15(50)	15(50)	10(33)	20(67)
	Height (cms)	163 ± 7	149 ± 8	162 ± 6	148 ± 6
Before	**Weight (Kgs)**	69 ± 11.1	58 ± 14.7	58 ± 13.6	58 ± 16.6
After		68 ± 10.1*	55 ± 13.7*	59 ± 12.2	58 ± 17.8
Before	**BMI (kg/m^2)**	26.0 ± 4.2	27.3 ± 7.8	23.5 ± 4.4	26.5 ± 6.4
After		25.0 ± 3.6*	25.8 ± 7.02*	25.9 ± 4.1	27.0 ± 6.7
Before	**MUAC (cm)**	30 ± 2.4	29 ± 5.8	29 ± 3.6	29 ± 3.8
After		28 ± 1.5**	27 ± 7.1***	29 ± 4.5	29 ± 4.1
Before	**Chest (cm)**	96 ± 7.5	89 ± 12.4	91 ± 7.7	92 ± 13.7
After		95 ± 6.2	84 ± 10.7*	92 ± 10.5	93 ± 14.5
Before	**Waist (cm)**	100 ± 8.9	91 ± 13.1	91 ± 8.7	94 ± 13.16
After		97 ± 8.4**	86 ± 11.3*	94 ± 8.7	95 ± 14.5
Before	**Hip (cm)**	104 ± 8.4	108 ± 13.7	98 ± 8.9	105 ± 12.9
After		98 ± 6.5***	101 ± 11.34*	99 ± 11.0	105 ± 13.9
Before	**WHR**	1.0 ± 0.1	0.8 ± 0.1	0.9 ± 0.1	0.9 ± 0.1
After		1.0 ± 0.1	0.8 ± 0.2	1.0 ± 0.1	0.9 ± 0.1
Before	**Body fat (%)**	25 ± 9.8	29 ± 17.3	19 ± 8.2	26 ± 17.6
After		23 ± 8.6*	26 ± 16.6***	20 ± 9.3	27 ± 17.9
Before	**Body Water (%)**	47 ± 13.2	34 ± 17.8	50 ± 16.9	35 ± 21.4
After		48 ± 13.5	35 ± 16.1*	50 ± 15.2	34 ± 21.3
Before	**Body Muscle (%)**	34 ± 9.2	23 ± 13.1	36 ± 11.4	24 ± 15.3
After		36 ± 9.4*	24 ± 11.4**	36 ± 12.5	24 ± 15.2

Note: Significance level - * p<0.05, ** p<0.01, ***p<0.001.

Dietary Intake

The diet served in the institution was a vegetarian one. Breakfast and two meals were served to the inmates per day.

Nutrient Intake

The nutritive value of the food consumed by the individual subjects was calculated using a ready reckoner [12]. Percentage of adequacy of nutrients is calculated and given in Table **4**. Twenty four hour recall method was used to estimate the food intake by all the subjects. The nutrient intake of the subjects was compared with the RDA for Indians given by ICMR [14] and found to be alarming. Generally diets were providing 1400-1600 kcals per day and adequacy was met as per the ICMR requirements. Before supplementation in experimental female the energy intake was deficit (70%) but after the supplementation as the ashgourd fermented beverage provided extra energy, the energy requirements (75%) were meeting the ICMR recommendations. Protein (53%-73%) intake was not adequate in inmates. The fat intake of the inmates was very high (110%-192%) compared to RDA and this was reflected in their high BMI values (Table **3**). Calcium intake was meeting the ICMR recommendations as they were given 250ml of milk and its products every day.

Food Frequency

Rice was the only cereal used daily by the old age home inmates. Other cereals such as wheat and ragi were used on alternate days. Redgram dhal was used daily to prepare sambar or rasam. Horsegram dhal, blackgram dhal, greengram dhal, bengalgram dhal and field bean were used occasionally. Vegetables though served in the form of gravy daily, fresh green leafy vegetables were served weekly once. Milk was used in beverages like coffee, tea and milk was also given

Table 4: Percent Adequacy of Nutrient Intake with Reference to RDA

		n (%)	Energy	Protein	Fat	Calcium	Iron
			Kcal	gm	gm	mg	mg
Before	**Total**	60(100)	78	65	152	83	68
After			80	65	162	88	72
Before	**Total male**	25(42)	74	68	158	98	68
After			78	69	156	107	78
Before	**Total female**	35(58)	79	62	170	73	59
After			80	62	172	79	63
Before	**Experimental male**	15(50)	75	65	156	102	78
After			81	66	149	112	86
Before	**Experimental female**	15(50)	70	53	110	60	73
After			75	56	106	80	79
Before	**Control male**	10(33)	76	72	159	109	72
After			71	70	162	109	70
Before	**Control female**	20(67)	84	72	180	83	59
After			78	73	192	96	46

during dinner time. Buttermilk and curd was given during lunch and dinner time. Jaggery and sugar was used occasionally on some special days in the preparation of sweets. No non-veg items were served as the inmates were pure vegetarians. Fruits were served occasionally during the season.

Clinical Manifestation and Morbidity Profile of Inmates

Figure **1** shows clinical manifestations of deficiency disorders, 81% of the inmates had shortness of breath followed by swollen gums (73%) then pallor (48%) which is probably due to associated low iron intake and was found in experimental group before supplementation The prevalence of night blindness and angular stomatitis were 24% and 6% respectively. This is probably because of lower intake of green and root vegetables in the institution. Additionally symptoms like swollen gums, pale and flat nails point to a higher rate of vitamin and mineral deficiency. It is evident from Figure **1** that the supplementation of ashgourd fermented beverage had an impact on glossitis, pallor, angular stomatitis, pale and flat nails in experimental group and reduced by 4, 26, 3 and 9% respectively. As shown in Figure **2** ganeto urinary disorder (73.1%) was

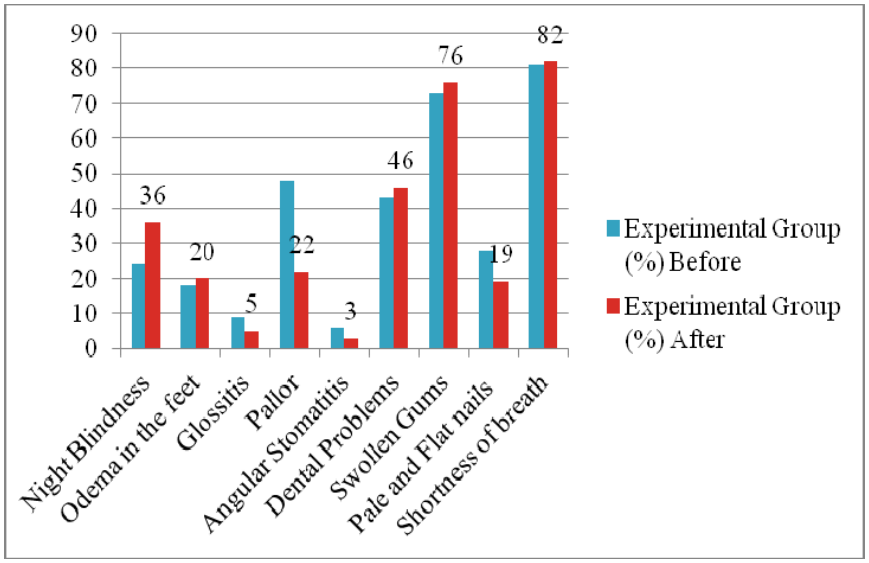

Figure 1: Effect of Feeding on Clinical Manifestation of Deficiency Disorders in Experimental Group.

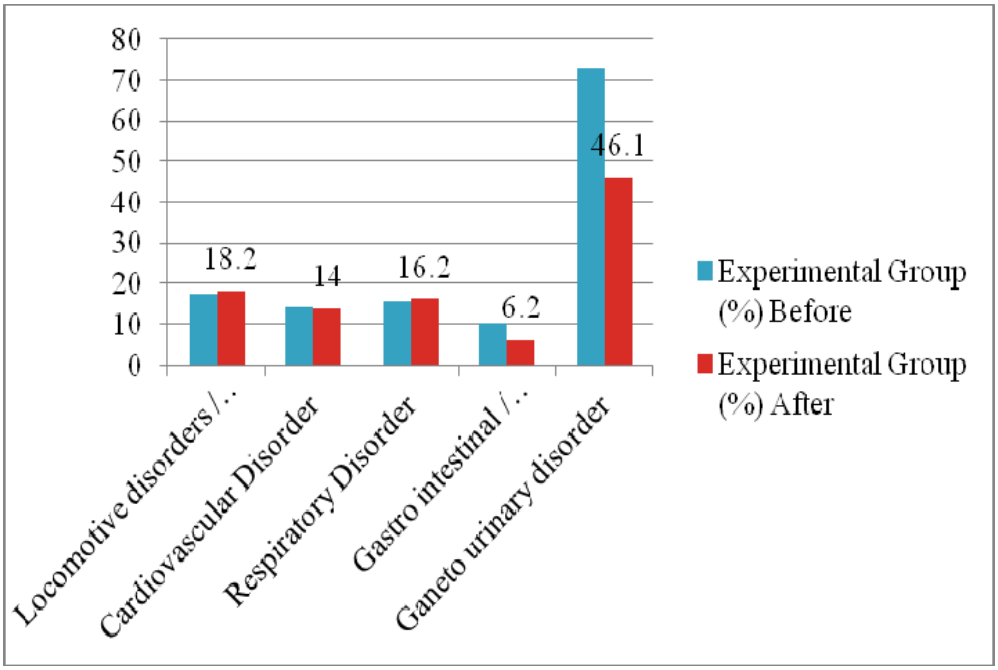

Figure 2: Effect of Feeding on Morbidity Profile in Experimental Group.

the most common disorder seen in the inmates of Experimental group followed by locomotive disorders, joint muscles (17.5%). Respiratory disorders, cardiovascular disease and gastro intestinal / abdominal disorders were 15.6%, 14.2% and 10.2% respectively in experimental group. After the supplementation of the ashgourd fermented beverage the inmates in experimental group showed 27% decrease in ganeto urinary disorder and gastro intestinal disorder by 4%. A supplementation study carried out by DFRL and DMRC on adult population of desert area of Rajasthan, revealed that supplementation of ashgourd juice declined gastritis significantly from 50 to 29.7% ($p<0.05$), urinary tract infection from 34.7 to 16%, over breathing from 25 to 5% and thirstiness from 97 to 81% after the supplementation ($p<0.05$) [15].

Biochemical Attributes

The biochemical attributes such as FBS, PPBS, lipid profile, Serum cholesterol, triglycerides, HDL cholesterol, LDL cholesterol, heamoglobin were analysed before and after the supplementation of the ashgourd fermented beverage. Fasting blood samples were drawn after the subjects had fasted overnight for measurement of glucose and lipid concentrations. Results of Table **5** shows the distribution of biochemical parameters in experimental group and control group before and after the supplementation. Around 42% of inmates from experimental group and 58% of inmates from control group were diabetic, who with medication had a control in blood sugar levels. In experimental group, before the supplementation, FBS and PPBS were 90.8 mg/dL and 137.4mg/dL and after the supplementation it was reduced to 82.2 and 122.4mg/dL respectively and the changes were significant at $p<0.001$ for FBS and $p<0.01$ for PPBS levels, while in control group there was 20.1mg/dL increase in FBS and 28.6mg/dL increase in PPBS levels and the changes were significant at $p<0.05$ and $p<0.01$ respectively. In general, in the experimental group 83% had the normal FBS levels and 67% had the normal PPBS levels. In experimental group decline was observed in 77% of the subjects in FBS and PPBS while in control group, the changes were prominent in 77% and 83% of the subjects. The results reveal that inmates supplemented with ashgourd fermented beverage showed good control in blood glucose levels than those inmates who received no supplementation. Further considering the diabetic subjects in experimental group FBS decreased by 58%. The lipid profile data on the ashgourd fermented beverage supplementation group reflected that there was 9mg/dL decrease in serum cholesterol, 22mg/dL decrease in triglycerides and 6.9mg/dL decrease in LDL cholesterol levels. The changes in the serum cholesterol, triglycerides and LDL cholesterol levels declined in 73%, 83% and 77% of the inmates of experimental group with significance level of $p<0.05$, $p<0.001$ and $p<0.01$ respectively. But the control group inmates showed a slight increase in serum cholesterol from 185.4 to 194.2mg/dL, triglycerides from 138.4 to

Table 5: Biochemical Data of Experimental and Control Group, n = 30

Parameters	Experimental		Control	
	Before	After	Before	After
Fasting Blood Glucose (mg/dL)	90.8 ± 22.7	82.2 ± 17.0**	81.9 ± 14.1	102.0 ± 50.5*
Post Prandial Blood Glucose(mg/dL)	137.4 ± 49.1	122.4 ± 40.0**	120.0 ± 44.4	148.6 ± 86.5*
Serum Cholesterol (mg/dL)	191 ± 34.1	182.1 ± 32.6*	185.4 ± 32.4	194.2 ± 32.1**
Serum Triglycerides (mg/dL)	168.3 ± 74.3	146.3 ± 62.8***	138.4 ± 62.0	151.5 ± 63.6*
LDL CHOLESTEROL Cholesterol (mg/dL)	118.9 ± 30.7	112 ± 24.8**	118.6 ± 40	127.3 ± 39.1*
HDL CHOLESTEROL Cholesterol (mg/dL)	45.2 ± 5.9	48 ± 6.7**	49.7 ± 4.9	47.5 ± 5.9**
Haemoglobin (g/dL)	12.5 ± 1.1	13.2 ± 1.2	12.6 ± 1.4	12.7 ± 0.9

151.5mg/dL and LDL cholesterol from 118.6 to 127.3mg/dL. When compared with the control group, experimental group inmates showed better improvement in lipid profile. The supplementation of ashgourd fermented beverage showed higher improvement in declining of triglycerides followed by LDL cholesterol and serum cholesterol in experimental group. However, in control group, 20-33% of the inmates showed a decline in lipid profile parameters. Also, the decline in triglycerides was more prominent in female group. Lim [16] also reported that after the supplementation of ashgourd extract 60% reduction in blood glucose, plasma triglycerides and free fatty acids in rats. Kurowska *et al.* [17] showed consumption of orange juice 750 mL/d improved blood lipid profiles in hypercholesterolemic subjects, confirming recommendations to consume ≥5–10 servings of fruit and vegetables daily. In rabbits with experimental hypercholesterolemia induced by a casein-based, semipurified diet in which drinking water was replaced with either orange juice or grapefruit juice, serum LDL cholesterol decreased by 43% and 32%, respectively [18]. Upritchard *et al.* [19] reported that consumption of commercial tomato juice increases plasma lycopene levels and the intrinsic resistance of LDL cholesterol to oxidation almost as effectively as supplementation with a high dose of vitamin E, in patients with diabetes. However, no literature is available on vegetable fermented beverage and hence the present study is the first report on ashgourd fermented beverage. Supplementation of ashgourd fermented beverage revealed that HDL cholesterol increased from 45.2mg/dL to 48mg/dL as shown in Table **5**. HDL cholesterol increased significantly ($p<0.01$) in 80% of the experimental group inmates, while in control group, about 23% of the subjects showed an increase in HDL cholesterol. Thus the supplementation of ashgourd fermented beverage has shown the positive effect through reduction in triglycerides, LDL cholesterol, serum cholesterol with increased HDL cholesterol in the present study. Figure **3** reveals the distribution of experimental group and control group inmates according to Haemoglobin estimation before and after the supplementation. The haemoglobin levels before supplementation in experimental group and control group were 12.5g/dL and 12.6g/dL respectively, while after the supplementation in experimental group it increased by 0.7g/dL. According to WHO standards, [20] the level remained normal after supplementation in experimental group. Overall 38.5% of inmates in experimental group were anaemic and 61.5% were normal. The supplementation of ashgourd fermented beverage has reduced anaemia from 38.5% to 23.5% i.e. decline of 15%. After the supplementation, shift from anaemia to normal was more in case of experimental female (19%) than experimental male (11%). Premavalli *et al.* [15] also reported that supplementation of ashgourd juice to adults in desert area, reduced the percentage of anaemia from 60% to 33%. The overall percentage of non-anaemic inmates in experimental group increased from 61.5 to 76.5 percent after supplementation. It was observed that 41% of control group inmates were anaemic and after 60 days a slight change to the higher side, 42.5% was observed. Thus the supplementation of ashgourd fermented beverage has improved the heamoglobin levels thereby the anemic condition.

CONCLUSION

The present study on the supplementation of ashgourd fermented beverage for 2 months on geriatric population can be concluded that the supplementation showed significant improvement in BMI grades, reduced the blood glucose levels, improved the lipid profile status, heamoglobin levels in experimental group when compared with the control group.

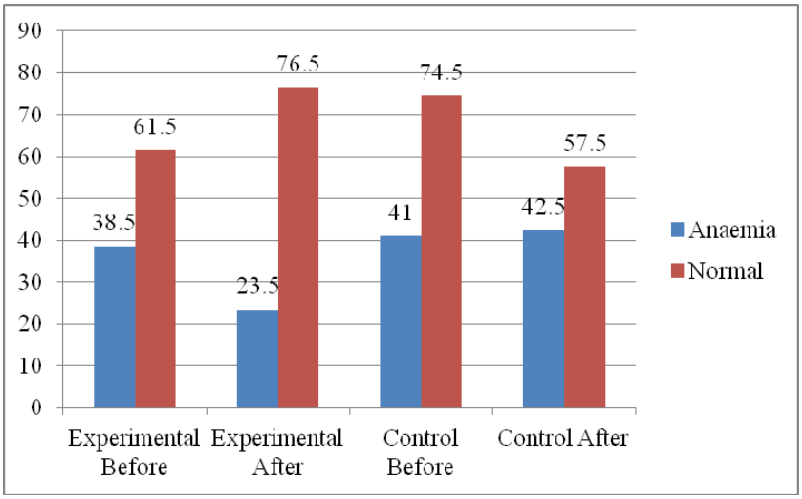

Figure 3: Effect of Feeding on Profile of Anaemia in Inmates in Experimental Group.

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