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Biophysical, Biochemical and Nutritional Assessment of Camel Milk Consumers in Bikaner district of Rajasthan, India

Research Article

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Abstract

Camel milk has been a part of traditional diets for certain nomadic populations. It has recently gained attention as a health food throughout the world. In present investigation, study was conducted on camel milk consumers and non camel milk consumers residing in rural area of Bikaner District of Rajasthan. Their health status was assessed based on biophysical, biochemical and nutritional parameters. On calculating the values of nutrient intake, it was found that the mean intake of energy, protein, total fat, carbohydrate, dietary fiber, iron, calcium, β-carotene, thiamine, riboflavin, niacin, folic acid, vitamin-C and zinc for experimental and control male and female subjects was recorded to be at par with the RDA of ICMR, except for β-carotene, fat and folic acid intake. Diet analysis showed that adults suffered from calorie deficit but their intake of proteins met the allowances recommended by ICMR. None of the subject was suffering from severe anemia based on haemoglobin content. The mean LDL levels of all the subjects were found to be within normal ranges. Subjects in the experimental group were having higher HDL level as compared to control group and a significant difference was noted between these two groups. When the random blood glucose values were observed between control and experimental subjects, significant difference was noted. This variation in their glucose level may indicate impact of camel milk consumption by the experimental subjects.

Keywords: Biophysical; Nutrition; Biochemical; Camel milk consumers

Introduction

Camel milk is one of the most important milk among other mammal's milk due to its nutraceutical attributes. It has potential contribution in human nutrition in the hot and arid regions of the world. Recent years have witnessed growing interest in the use of natural products such as bovine and camel milk in the maintenance of general health and as alternative therapies for chronic health problems [1]. This milk contains all the essential nutrients as found in other milk. Fresh and fermented camel milk has been used in different regions in the world including India and Russia for human consumption as well as for treatment of a series of diseases. Although traditionally used within Middle East, Africa, and Asia, the advent of online pharmacies and natural health product awareness has increased the availability of camel milk to nontraditional settings such as North America and Europe [2].

Research shows that camel milk is better tolerated by people with lactose intolerance and allergies to cow's milk. It may also lower blood sugar, boost immunity, and aid certain behavioral, neuro-developmental conditions like autism and cancer [3-6]. In the last few years, awareness about nutritional and medicinal benefits of camel milk has rapidly increased [7].

Camel represents traditionally the lifeline of the rural population

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in Rajasthan, a state of India. Due to extreme hot environment and scarcity of water, conditions do not support the dairy cow; hence camel milk can plays a very important role in the diet of the people living in this state.

Although various studies have been conducted on the nutritional status of different age groups with different criteria but information regarding the nutritional status of camel milk consumers is lacking in the literature. People in Bikaner district of Rajasthan also represent a definite social sector with different food habits which in turn might affect their nutritional status. Similar may be the case for camel milk consumers. Therefore, the aim of the study is to access the nutritional status of milk consumers based on biophysical, biochemical and nutritional parameters in nearby areas in Bikaner District of Rajasthan.

Materials and Methods

The present study was conducted in nearby villages of Bikaner district of Rajasthan, selected on the basis of existing camel population.

Survey of the community

Nearby villages of Bikaner district like Bhamatsar, Gadhwala, Kanasar, Morkhana, Palana and Udasar where camel rearing community "Riakas" was residing, visited frequently to explore the camel milk consumers. Camel milk consumers in the age group of 30-50 years were selected, since occurrence of the most of the non-communicable chronic diseases is common after 40 years of the age [8]. A sample of 100 subjects of regular camel milk consumers was selected randomly [9]. Similar number of non-camel milk consumers in the same age group residing in similar rural areas was also identified to serve as control subjects. The experimental and control subjects were then contacted and impact of camel milk on their nutritional, biochemical and biophysical assessment of health status was studied. Subject's interest and their willingness to cooperate in the study were considered prior to their selection.

Data collection

General information about the subjects: This included information regarding their name, age, sex, education, address, food habits, types of family, total income, activity pattern, health status and availability of camel milk. Age of the respondents was defined as the number of years completed by the respondents at the time of interview.

Biochemical assessment: The subjects were assessed for their haemoglobin level, their lipid profile and blood sugar levels to find out their health status.

A) Haemoglobin estimation

The subjects were assessed for their haemoglobin level using Cyanmet Haemoglobin method as suggested by Dacie and Lewis [10]. Their haemoglobin levels were compared with the standard values as given by WHO [11].

B) Random blood glucose

Blood sugar levels were monitored using Glucometer to assess the health status of subjects. A blood glucose test measures the amount of glucose in the blood. Random blood sugar measures blood glucose regardless of when we last ate. Random testing is useful because glucose level in healthy people do not vary widely through the day. Normal random blood sugar level should be less than 200 mg/dl [11].

C) Lipid profile

Thirty percent of the experimental and control subjects were assessed for their lipid profile at the laboratory of Thyrocare Techonologies Ltd (http://www.charbi.com). Lipid profile covers serum cholesterol, serum triglyceride lipoprotein i.e. low density lipoprotein (LDL), high density lipoprotein (HDL) and very low density lipoprotein (VLDL). All these parameters were estimated in male and female subjects from each group of experimental (30-30) and control (30-30), respectively.

D) Analysis of blood specimen in the laboratory

"Lipophotometery analyzer" was used to analyze the blood samples for various parameters at the laboratory of Thyrocare Technologies Ltd.

Nutritional and health status of the subjects: Nutritional and health status of the experimental and control subjects were assessed by using following methods-

Nutrient intake: The nutrient intake was calculated from the food consumed by the subjects in terms of protein, fat, carbohydrate, energy, fiber, calcium, iron, beta carotene, thiamin, riboflavin, niacin, folic acid, vitamin C and zinc by using food consuming tables [11]. The nutrient intake was compared with the recommended dietary intake for Indians [13] and the nutrient adequacy was calculated as follows:

$$\text{Nutrient adequacy } (\%) = \frac{\text{Mean intake}}{\text{Suggested intake}} \times 100$$

As the excess consumption of food rich in carbohydrate, fat and protein are responsible for the development of obesity in the individual and at the same time dietary fiber has its beneficial effect in the weight loss and weight management, these nutrients were taken into account.

Results & Discussion

Information about community survey

A community survey of 100 households associated with camel rearing in the villages of Gadhwala, Bhamatsar, Udasar, Sainsar, Palana, Morkhana and Kanasar in Bikaner district was carried out to gather information about the pattern of consuming camel milk. Similar numbers of the non-consumers of camel milk from same villages were also surveyed.

Among these villages Ghadwala village was an important study point since the village harbors maximum number of the she camels as well as the inhabitants of the village had preference for consumption of camel milk. The village is dominated by community of Raika who are known to rear camel either for milk or for transport purpose. The total camel milk production in the village is about 100-120 kg per day.

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A survey was conducted on consumers of camel milk (experimental group subjects n=100) and those who do not consume camel milk (control group subjects n=100) but all residing in the same village. Further the male and female subjects were equally represented in both the groups. Following aspects were dealt with while conducting the survey.

General information about the subjects

The general information of the subjects of control and experimental groups about their age and sex was collected. The selected subjects were aging between 30-50 years. Majority of cases (68 percent) who consume camel milk belonged to age group 41-50 years, followed by 31-40 years (32 percent). Same age groups of the non-consumers (control group) were also surveyed. The results illustrate that the camel milk is preferred by old aged persons as compared to their younger counterparts. As per the selection criteria, both male (n=100) and female (n=100) subjects were present in equal number (n=50) in each group i.e. control and experimental.

Nutrient intake

Food is the conveyer of nutrients and consumption of adequate diet is required for the maintenance, repair, growth and development of the body [14]. The nutrient composition of the diet was calculated in terms of energy, protein, fat, carbohydrates, iron, calcium, β-carotene, thiamine, riboflavin, niacin and vitamin C using food consumption table and the results were compared with the recommended dietary allowances (RDA) (ICMR, 2010). The pertinent results are presented in Tables 1, 2 [12].

Energy

Our body needs energy for maintaining body temperature, metabolic activities and for supporting physical growth. Cereals accounted for the major source of energy in the diet of the subjects. During present study, the values were calculated based on the food intake by four categories of respondents *viz*. male and female in experimental group and control group separately (Tables 1,2). It was observed that among experimental male subjects, the average daily intake of energy was very close to the recommended values i.e. 2730 kcal and the results further revealed that the energy intake by males in experimental group and control group satisfied more than 90 percent as recommended by ICMR [13]. In case of female subjects, when compared with RDA it was noted that the adequacy of energy intake was more than 80 percent of RDA. It must be due to adequate and approximately adequate intake of energy rich foods like cereals and fat.

Protein

Dietary protein is essential in synthesis of new protein that will replace those, which are constantly being broken down. Dietary proteins provide amino acids for the synthesis of body protein and other biochemically important nitrogenous compounds in the body [15]. When compared with the RDA values, it was observed that for male of both experimental and control groups, the protein demand of the body is satisfied and they were consuming more protein than recommended (Table 1). The data for females when compared with recommended value revealed that in females of experimental and control groups the protein intake was slightly higher i.e. 109.38 percent and 111.83 percent, respectively (Table 2).

The above stated results of higher intake of protein by adult subjects are in concomitance with the findings of Singh et al who also found higher consumption of protein by them while doing study on adult subjects [16]. However, the higher intake of protein by the subject needs to be viewed in term of dietary source i.e. the cereals consumed by them. Further the protein energy derived in the diets of the subjects ranged from 12.48 to 12.97 percent and 12.58 to 12.70 percent of total energy in case of control and experimental subjects, respectively .This is obliviously quite lower than the recommended values.

Fat

Fat in the diet can be of two kinds, the visible fat and invisible fat.

Table 1: Mean nutrient intake of the male respondents.

Items	Experimental Group				Control Group			
	Mean food intake	SD	RDA	Percent RDA	Mean food intake	SD	RDA	percent RDA
Energy (Kcal)	2559.21 (2040-3146.4)	32.15	2730	93.74	2505.21 (2134.59-2873.63)	34.2	2730	90.81
Protein (g)	80.6 (65.02-92.28)	6.88	60	134.33	77.9 (63.7-85.52)	7.11	60	129.83
Visible fat(g)	19.10(11.2-25.5)	4.33	30	63.66	19.95 (10.5-30.75)	3.86	30	66.5
Invisible fat(g)	27.46 (19-36.08)	5.62	30	91.53	23.44 (20.61-30.34)	5.88	30	78.13
Total Fat (g)	46.56(30.2-61.58)	7.34	60	77.6	43.39 (31.11-61.09)	6.98	60	72.31
Carbohydrate (g)	456.09 (367.2-509.87)	20.4	444	102.73	448.56 (398.82-506.32)	18.6	444	101.02
Crude fiber(g)	67.82 (55.08-72.74)	30.11	30	226.06	67.61 (60.73-73.96)	29.15	30	225.36
Iron (mg)	41.43 (38.01-46.2)	2.8	17	243.70	41.15 (33.37-45.77)	3.1	17	242.05
Ca (mg)	648.75 (519.73-1397.14)	32.6	600	108.12	566.44 (411.1-654.99)	40.2	600	94.40
β carotene (µg)	1340 (1001.75-1701.87)	46.4	4800	27.91	1234.34 (1026.8-1478.59)	43.6	4800	25.71
Thiamine (mg)	2.32 (2.05-2.9)	0.41	1.4	165.71	2.29 (1.86-2.44)	0.82	1.4	163.57
Riboflavin (mg)	1.72 (1.45-2.24)	0.68	1.6	107.5	1.36 (1.18-1.66)	0.72	1.6	85
Niacin (mg)	18.73 (15.11-19.75)	1.4	18	104.05	18.02 (16.91-20.4)	1.6	18	100.11
Folic acid (µg//day)	105.7 (86.36-124.74)	5.7	200	52.85	98.3 (274.64-366.86)	4.8	200	49.15
Vitamin C(mg)	65.26 (45.26-77.28)	125.4	40	163.15	64.35 (45.51-82.2)	98.42	40	160.87
Zn(mg)	15.66 (12.7-17.3)	1.5	10	156.6	15.30 (13.47-16.93)	1.3	10	153

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Table 2: Mean nutrient intake of the female respondents.

Items	Experimental group				Control group			
	Mean food intake	SD	RDA	Percent RDA	Mean food intake	SD	RDA	Percent RDA
Energy (Kcal)	1865.66 (1463.77-2334.39)	30.3	2230	83.66	1879.38 (1501.08-2257.68)	28.6	2230	84.27
Protein (g)	60.16 (49.79-74.29)	3.6	55	109.38	61.51 (49.16-73.87)	4.2	55	111.83
Visible fat(g)	10.11 (8.40-12.10)	3.89	25	40.44	10.07 (8.10-12.05)	2.8	25	40.28
Invisible fat(g)	19.85 (14.59-26.48)	5.22	25	79.4	19.86 (14.29-27.02)	5.10	25	79.44
Total fat(g)	29.96 (22.99-38.58)	7.26	50	59.92	29.93 (22.39-39.07)	7.5	50	59.86
Carbohydrate (g)	346.01 (284.54-418.7)	12.8	362	95.58	345.20 (280.79-420.11)	14.2	362	95.35
Crude fiber(g)	51.48 (43.75-60.45)	3.4	30	171.6	52.68 (43.13-61.74)	3.6	30	175.6
Iron (mg)	31.75 (25.86-37.65)	2.8	21	151.19	30.22 (26.22-42.15)	3.1	21	143.90
Ca (mg)	474.07 (346.33-713.21)	19.4	600	79.09	455.68 (336.9-574.47)	20.8	600	75.94
β carotene (µg)	1042.18 (853.69-1319.13)	34.4	4800	21.71	992 (824.84-1159.16)	30.6	4800	20.66
Thiamine (mg)	1.78 (1.48-2.09)	0.94	1.1	161.81	1.76 (1.47-2.01)	0.82	1.1	160
Riboflavin (mg)	1.17 (0.80-1.58)	0.43	1.3	90	1.16 (0.86-1.46)	0.36	1.3	89.23
Niacin (mg)	14.97 (12.2-16.7)	1.1	14	106	15.22 (12.37-18.08)	1.4	14	108.71
Folic acid(µg)	79.6 (65.78-103.34)	6.8	200	39.8	78.79 (210.12-314.68)	5.4	200	39.39
Vitamin C (mg)	59.11 (45-67.19)	4.6	40	147.77	59.02 (43.09-74.96)	3.8	40	147.55
Zn(mg)	11.84(10.06-14.54)	32.54	10	118.4	12.77 (10.39-15.15)	28.64	10	127.7

The mean intake of fat in its visible and invisible form was calculated. While comparing fat consumption pattern it is obvious from the results that immaterial of the type of group, all subjects had higher intake of invisible fat than that of visible fat. It must be due to higher intake of invisible fat containing food sources like pearl millet and milk by the subjects. The data also revealed that fat consumption was observed to be higher among male subjects in comparison to female subjects of both the groups. Percentage of energy intake by the subjects was also calculated and it was observed that percentage of energy derived from fat in the diets of the subjects was lower than the recommended value.

Carbohydrate

Carbohydrate derived from cereals is a chief source of energy in Indian diet [14]. In the present study also, the carbohydrate was the main food to be consumed in the form of cereals. The data on carbohydrate intake by the males of experimental group and control group is presented in Table 1. The analysis of data shows that the males were taking almost adequate amount of carbohydrate which is essential for their day to day activities. The mean carbohydrate intake of females in experimental group as well as in control group was also found to be adequate amount. The percentage of energy derived from carbohydrate in the daily diets of the male and female subjects of control and experimental groups was calculated and it was noted to be 71.87, 72.81, 71.08, and 73.06 percent, respectively. Thus the figures for carbohydrate energy were noted to be slightly higher than the recommended values i.e. 60-70 percent of total energy.

Dietary Fibre

Dietary fibre is defined as that portion of food derived from plant cells, which is resistant to hydrolysis/ digestion by the elementary enzyme system in human beings. The intake of dietary fiber was higher than the suggested value (25-40 g per day) given by Gopalan et al [14].

Iron

Iron is an essential element for the formation of haemoglobin and plays an important role in the transport of oxygen. Iron deficiency leads to anemia which is very common among females in India. During present study, the iron intake by the subjects was computed and presented in Table 1,2. The results revealed that mean iron intake by males of experimental group as well as in control group of this region are very high if the data are compared with RDA value. The RDA value is 17 mg whereas the experimental males and control males were taking 243.70 percent 242.05 percent higher amount of Iron, respectively [13]. Perusal of data for females also revealed that mean iron intake in experimental group and that of control females was 151.19 percent and 143.90 percent higher than the recommended value.

The data regarding iron intake of the subjects clearly revels that immaterial of the gender or the type of group all were having very high iron in their diet. The main source of this higher iron intake was high intake of pearl millet in their diets. However, this must be viewed in the light of the fact that bio availability of iron from cereal based diet is always low [13]. However, studies conducted by Singh et al reported low iron intake by their subjects who were consuming wheat instead of pearl millet as compared to the subjects of the present study [17].

Calcium

Calcium is required for formation and maintenance of bones, teeth, normal functioning of muscles, contraction of heart, nervous activity and clotting of blood. Cereals and milk contributes the major portion of calcium in human body. The data on calcium intake by the respondents are presented in Table 1,2. Perusal of data reveals that males of experimental groups consumed more calcium (108.12 percent) in their diet as compared to control males (94.40 percent). In case of females the data revealed that experimental and control females, consumed 79.09 and 75.94 percent of recommended value (600 mg/day). Further the data clearly reveals that immaterial of the type of their groups; female subjects were having lesser amount of calcium in their diets as compared to their male counterparts. This must be due to the variation in their milk intake.

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β-Carotene

β-Carotene as precursor of vitamin-A, is essential for normal vision to maintain the integrity of epithelial tissues and for a wide variety of metabolic functions. The data on β- carotene intake in the present study is presented in Table 1,2. Perusal of data for males in experimental and control groups revealed that the β-carotene intake by the males of experimental group was nearly one fourth (27.91percent) and that of control group, it was 25.71percent of RDA. Perusal of data indicates that all the subjects of in study were consuming quite low amount of β carotene (992-1340 µg per day) in their diet as compared to the recommended values. The β carotene adequacy ratio was found to be ranging between 20.66-27.91 percent only. Female subjects were consuming still lower intake of β-carotene than their male counterparts. The reason behind low intake of β-Carotene must be their low intake of β-carotene rich foods like green leafy vegetable and fruits. Singh et al were also of the opinion that adult male and female residing in rural area of Rajasthan consumes low β-carotene containing diet [17]. The results are in accordance with the findings of Gupta and Sharma as they also observed that the β-carotene intake was grossly inadequate for adult subjects under their study [18].

Thiamine

Thiamine pyrophosphate functions as a coenzyme for carboxylase which is intimately involved in carbohydrate metabolism. Data pertaining to thiamine intake is presented in Table 1, 2. Perusal of data reveals that males of experimental and control groups consumed more thiamine against the RDA value of 1.4 mg per day, indicating 165.71 and 163.57 percent of adequacy, respectively. Similarly experimental females and control females consumed more thiamine. When compared with RDA (1.1 mg) the subjects were found to be having 161.81 and 160 percent of thiamine adequacy in their diets, respectively. Since the subjects of the present study consumed cereal based diet their thiamine adequacy ratio was found to be very higher. Similar results have also been reported while conducting studies on adult population of rural area of Rajasthan [17]. A higher intake of thiamine (1.26-2.43 mg per day) among the adult subjects of study in Madurai district was also reported [19].

Riboflavin

Riboflavin is part of flavo-protein which is intimately connected with biological oxidation and plays an important role in maintaining the integrity of muco-cutaneous structures. Comparison with RDA value reveals that experimental and control group were consuming 107.5 percent and 85 percent of RDA, respectively. Table 1&2 explains that riboflavin adequacy in females was more than 85 percent for all the subjects. Where in the experimental male subject had 107.5 percent adequacy ratio which may be due to their higher camel milk intakes.

Niacin

Niacin takes part as a component of coenzyme in oxidative reaction concerned with metabolism of carbohydrates, fats and protein. The data on consumption pattern of niacin in experimental and control group is presented in Table 1,2. The data clearly reveals that niacin adequacy ratio for all the subjects ranged between 100.11-108.7 percent indicating that all the subjects had approximately recommended intake of niacin. This could be due to their cereal dominating diets. The results regarding niacin intake of the present study are in line with those reported by Singh et al while studying niacin intake of adults under their study [17]. The results are in also coherence with those reported by Reddy et al who also found higher consumption of niacin (11.65-15.23 mg) by the adult subjects in Madhya Pradesh [20].

Folic acid

The primary function of Folic acid is related to the transfer of single carbon in the synthesis of a number of metabolites in the body. The deficiency of folic acid if prolonged and severe may lead to magaloblastic anemia. The male subjects of the study were found to be consuming nearly half of the recommended value of folic acid (200 µg), whereas their female counterparts consumed still lower level (39.39-39.8 percent) of folic acid (Table 1,2). This lower intake reveals lack of folic acid rich food in their diets [13]. Similar results have been reported by Singh et al regarding inadequacy of folic acid intake by subjects under their study conducted at Jodhpur [17].

Vitamin C

Vitamin C is involved in collagen synthesis, bone and teeth maintenance and many other reactions in the body as a reducing agent [14]. The percent adequacy of vitamin C as compared with RDA (40 mg) was 163.51 and 160.87 percent for male subjects of experimental and control groups, respectively (Table 1,2). It was 144.77 and 147.55 percent for female subjects of experimental and control group respectively, indicating a higher intake by all the subjects. However, this higher intake of vitamin C needs to be considered in view of its availability after cooking. Since the major source of vitamin C in the diet of subjects was vegetable only. In harmony with present findings, Mathuravalli et al also found higher vitamin C intake by adult subjects [19].

Zinc

Zinc is essential for normal growth, development, reproduction and immunity of living organism. Mean daily intake of zinc by the subjects of present study was also calculated (Table 1,2). The male subjects of experimental and control groups were consuming 15.66 and 15.30 mg and the female subjects were having it in the range of 11.84 and 12.77 mg of mean zinc in their daily diet against the RDA of 10 mg [13]. The percent adequacy of zinc for experimental and control group was 156.6 to 118.4 and 153 to 127.7 percent, respectively, indicating higher consumption of zinc by all subjects. Cereals are the good sources of zinc, which was consumed by the subjects adequately.

Overall view of the nutrient intake by the subjects clearly reveals that experimental male subjects had better nutrient adequacy ratio as compared to their female counterparts in both the groups. With reference to protein, calcium and riboflavin owing to their greater milk consumption. Further nutrients adequacy was observed in case of protein, carbohydrate, iron, thiamin, riboflavin and zinc intake. However, intake of riboflavin, calcium and energy was near to their respective RDAs, whereas nutrients like β-carotene and folic acid were consumed less than 50 percent of RDA.

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Biophysical Assessment

A) Blood pressure

The relationship between blood pressure (BP) and risk of CVD (Cardio Vascular Disease) events is continuous, consistent and independent of other risk factors. The higher the BP, greater is the chance of heart failure and stroke. The mean systolic blood pressure and systolic blood pressure (SBP) of experimental and control subjects of both the genders are shown in Table 3. No significant difference was observed between the two genders. Similarly the difference in the diastolic blood pressure (DBP) between the two genders was also found to be non significant. A similar finding was also reported by Agrawal et al in their study with a mean 118.4 SBP and a mean 75.0 mm Hg DBP in adults of rural area of Rajasthan [21].

In the present study data of systolic and diastolic hypertension were presented in male as well as in female subjects (Table 4). Following this, Stage-I hypertension was reported in only control male subjects which is further classified as systolic and diastolic Stage-I hypertension in 4 percent and 2 percent subjects, respectively.

Classification of blood pressure indicates that majority of the subjects were falling in normal category in systolic and diastolic blood pressure. Few of them were either pre hypertensive or were suffering from stage I hypertension but control group had greater prevalence of hypertension than the experimental subjects.

Biochemical Examination

A) Haemoglobin estimation of the subjects

Level of haemoglobin (Hb) in an individual is widely used as an index in the assessment of nutritional status, because its synthesis is sensitive to the deficiency of several nutrients such as protein, iron, vitamin B_{12} and folic acid [23].

The mean Hb level of the male and female subjects in their experimental and control categories was found to be 13.0 and 12.22 in males while in female subjects it was 11.34 &10.76, respectively. While comparing Hb level, it is obvious to note that female subjects had lower Hb levels as compared to their male counterparts. None of the subject was suffering from severe anemia. Subjects were classified based on haemoglobin level [24]. Greater numbers of females in control as well as experimental category were suffering from moderate (10 to 3.3 percent) or mild forms of anemia (53.3 to 56.6 percent). However, among male subjects prevalence of mild anemia was more (26.6 percent) among control subjects then their experimental counterparts (16.6 percent). Low prevalence of anemia among the subjects could be due to their high iron, vitamin C and protein intakes. These finding are in tune with those reported in literature [17].

B) Blood glucose level of the subjects

Blood glucose level is an important determinant of the healthy status of a person. Besides being a predictor for diabetes, elevated blood glucose level predict increased risk of heart disease and mortality also. According to Khaw et al [25], the risk of death rises proportionally to blood sugar level and when it comes to predicting risk of heart disease risk, measuring blood glucose level is as important as cholesterol and triglyceride levels (American Diabetes Association, 2000). The postprandial blood glucose is better than fasting blood glucose in predicting cardiovascular events in patients with type II diabetes. Epidemiological studies and preliminary intervention studies have shown that post prandial hyperglycemia is a direct and independent risk factor for cardiovascular disease [26]. Under the study 26.6 percent male and 23.3 percent female of control subjects were found to be suffering from diabetes and in experimental subjects only 3.3 percent male were found to be suffering from diabetes.

Further review of Table 5, result clearly indicates significant difference between control and experimental subjects for their random blood glucose values. Although all the subjects had their mean random blood sugar values below the reference value but the experimental subjects had significantly lower random blood sugar value as compared to their control counterparts. This variation in their glucose level may indicate impact of camel milk consumption by the experimental subjects. In India, a comparison between conventionally treated juvenile diabetes with those also drinking camel milk showed that the group drinking the milk had significantly reduced blood sugar and reduced Hb levels [21]. He also reported low blood glucose levels among respondents of Raika community then that of their non Raika counterparts [21]. Camel milk is believed to be a suitable hypoglycemic agent in experimental animals and patients with diabetes. Most of the studies demonstrated the favorable effects of camel milk on diabetes mellitus by reducing blood sugar, decreasing insulin resistance and improving lipid profiles [27]. Camel milk has insulin like activity, regulatory and immunomodulatory functions on β cells and it exhibits hypoglycemic effect when given as an adjunctive therapy, which might be due to presence of insulin/ insulin like protein in it and possesses beneficial effect in the treatment of diabetic patients [4].

Lipid profile

A) Lipid profile of the selected subjects

Total serum cholesterol (TC) and lipoproteins i.e. low density (LDL), high density (HDL) are the major constituents of lipid profile. Their biochemical investigation is of vital significance in the diagnosis of many disorders especially cardiovascular diseases.

B) Total cholesterol

Total serum cholesterol is one of the most varying parameters of the body. The major sources of cholesterol to the body are both exogenous (i.e. through diet) and endogenous. It has both beneficial as well as detrimental effects on body. On the basis of recommendations of National Cholesterol Education Programme and National Institute of Health consensus statements [28,29], serum cholesterol levels in the ranges below 200, 200 to 240, and above 240 mg/dl are considered as "desirable", "borderline high" and "high risk," respectively.

The mean cholesterol level of the subjects of control and experimental group was noted to be 170.57 and 167.77 mg/dl for male subjects and 164.5 and 162.07 mg/dl for female subjects, respectively with a non significant difference in the value. All the subjects were having normal cholesterol level. Brennan also observed the similar phenomenon of normal serum cholesterol in adults [30].

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Table 3: Distribution of the subjects with respect to their mean blood pressure level.

Blood pressure mm Hg	Male		t-value	Female		t- value
	Experimental	Control		Experimental	Control	
Systolic (mm of Hg)	119.22 ±11.33	122.46±15.19	0.93	118.84±5.81	122.36±7.67	2.00
Diastolic (mm of Hg)	78.76±7.01	81.16±8.53	1.19	77.88±5.17	80.32±4.84	1.88

Table 4: Classification of subjects with respect to blood pressure levels.

Blood pressure levels (mm Hg)		Classification	Male		Female	
			Experimental (n=30)	Control (n=30)	Experimental (n=30)	Control (n=30)
Systolic (mm of Hg)	<<120	Normal	52 (26)	42 (21)	58 (29)	54 (27)
	1120-139	Pre hypertension	8 (4)	14 (7)	2 (1)	6 (3)
	1140-159	Stage I Hypertension	-	4 (2)	-	-
	≥ ≥160	Stage II Hypertension	-	-	-	-
Diastolic (mm of Hg)	< <80	Normal	56 (28)	50 (25)	58 (29)	56 (28)
	880-89	Pre hypertension	4 (2)	8 (4)	2 (1)	4 (2)
	990-99	Stage I Hypertension	-	2 (1)	-	-
	≥ ≥100	Stage II Hypertension	-	-	-	-

Classification devised by JNC VII [22]

Table 5: Mean blood glucose level of the subjects.

Parameter	Male		t- value	Female		t-value
	Experimental (n=30)	Control (n=30)		Experimental (n=30)	Control (n=30)	
Blood glucose (mg/dl)	98.67 ±8.81	115.50 ±28.12	3.12*	95.93 ±5.17	110.50 ±35.22	2.24*

C)Low density lipoprotein (LDL)

What is critical is not only the amount of cholesterol in the blood but how it is distributed in different lipoprotein fractions is also equally important. Raised concentration of plasma LDL and a low concentration of HDL fractions associated with high blood pressure are the important risk factors of coronary heart diseases. With the gain in body weight, the situation worsens.

It carries about two third or more of the total plasma cholesterol in addition to other lipids. It is mainly synthesized in the liver and transports fat and cholesterol to the tissues. As LDL carries cholesterol to the cells for depositing in the tissues, it is considered the main agent of concern in elevated serum cholesterol levels. An excess of cholesterol gets deposited in the arteries hence LDL is commonly called as BAD CHOLESTEROL. Hence it was necessary to find out LDL level of the subjects under the study. The mean LDL levels of all subjects was found to be within normal ranges i.e. 80-100 mg/dl and the difference between the values of experimental and control subjects was observed to be non significant (Table 6) [11]. Guthrie has stated that consumption of groundnut oil in daily diets increases MUFA intake and thereby balances the LDL level. The subjects of the present study were also consuming groundnut oil as chief source of fat in their diet [31]. Moreover, their mean energy intakes were also almost matching the RDA values.

D) High density lipoprotein cholesterol (HDL)

HDL carries less total lipid and more protein and therefore, has the highest density. It is also synthesized in the liver from endogenous fat sources. As HDL transports free cholesterol from the tissues to the liver for catabolism and excretion, higher levels of serum HDL are considered protective against cardiovascular diseases and considered as GOOD CHOLESTEROL. The National Institute of Health of USA and the American Diabetic Association in their consensus statements reported that HDL level below 35 mg/dI of blood is a major risk factor irrespective of total serum cholesterol levels [29].

During present investigation the mean level of HDL in experimental and control male and female group was noted to be 51.93 mg/dl, 53.43 mg/dl, 45.07 mg/dl and 43.37 mg/dl respectively. Subjects in the experimental group were having higher level (51.93 mg/dl) of HDL cholesterol as compared to control group (45.07 mg/dl) and a significant difference was noted between the groups. In conformity with present findings Singh et al also observed significant difference in HDL levels among adults (aging 25-65 years) [32].

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Conclusion

Camel rearing community in Bikaner district of Rajasthan commonly consumes camel milk, may be helpful in reducing the nutritional deficiencies and morbidities in adult community in addition to diabetes. With this aim, study was designed to assess the nutritional status of adult population of Raika community in Bikaner district by means of clinical examination and to study the association between nutrition, if any. The results of present study revealed that adults suffered from Energy Deficiency, Folic acid and beta carotene deficiencies. It is suggested that training on the nutritional and medicinal value of camel milk in particular should be integrated in the livestock extension program.

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