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Nutritional status of colon cancer patients; food intake, fatty acids, specific amino acids and hematological results.

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ABSTRACT

Background: Food habit and lifestyle doubtless play a fundamental position in colon cancer incidence; however, the proportion of colon cancer risk that might be preventable is unknown. ***Objective:*** This investigation aimed to evaluate the food intake, fatty acids, specific amino acids, hematological results for colon cancer patients. ***Methods:*** A cross sectional study was carried out including (152) a convenience samples of colon cancer patients from Makah region. Daily nutritional consumption used to be collected using a questionnaire. Anthropometric measurements and laboratory test outcome including liver and kidney function were recorded from medical records. ***Results:*** The mean age and height for colon cancer was lower in female, while BMI as well as weight was higher in male. Mean

macronutrients intake for male and female were higher than 100% of dietary references intake except for calories which were lower than 100% of dietary references intake requirements. Mean vitamin A intakes of males and female were less than 100%. It is noticed that the proximate values for percent total saturated and unsaturated fatty acid fractions intake, being at equal shares nearly (50%). While mean percent of omega-6 fatty acid (% of required nutrient intake) was 74.36% in males which was higher than females (66-64%), but percent for both males and females was less than 100% of RNI. ***Conclusion:*** These results advocate that increasing the dietary fiber intake, fruits and vegetables like orange and orange juice, carrot, tomatoes, spinach, lettuce, broccoli and greens and decreasing fat and red meat intakes, with no alcohol, quit smoking early and increasing nutrition knowledge will decrease the colon cancer risk.

Keywords: Colon cancer, BMI, omega-6 fatty acid, nutrition

INTRODUCTION

Cancer is life threatening disease and increasing problem in developing countries (***Dyer et al***., ***2004***) It is the foremost cause of death in Mediterranean Region after cardiovascular and infectious diseases (***Couto et al***., ***2011***). Risk factors like smoking and changes in diet habits have greater affluence in cancer increase (***Toledo et al***., ***2015***; ***Giovannucci***, ***2002***).

Dietary habits and nutritional status play an important role in determining the risk of developing colon cancer. A diet habitually high in fresh fruits and vegetables, modest in calories and alcohol, and low in red meat and animal fat is cancer protective ***(Mason, 2002)***. Risk factors for colon cancer include both hereditary and environmental factors. Dietary patterns represent controllable risk factors for the focus on decreasing colon cancer risk through increasing intake of dietary fiber ***(Brady et al., 2000)***. Diet and nutrition can influence protection processes directly in the gastrointestinal tract by providing bioactive compounds to specific tissues via the circulatory system or by modulating hormone levels also differences in certain dietary patterns among populations explain a substantial proportion of cancer of the colon. These malignancies are largely influenced by a combination of factors which related to diet and nutrition ***(Giovannucci, 1999)***. ***Slattery et al., (2000)*** declared that dietary carotenoids are associated with common cancers including colon cancer. Meanwhile, ***Grasten et al., (2000)*** showed that, cereal fiber may reduce the risk of colon cancer by

diluting colonic contents due to increased fecal output, by accelerating intestinal transit, by increasing fecal frequency and by altering bacteria metabolism. Finally, ***Dyer et al., (2004)*** demonstrated that, poor diet is associated with development of colon cancer with the greatest risk from diet poor in vegetables, fruits and fibers and high in red and processed meats. Therefore, this study was aimed to evaluate the relationship between food intake, specific amino acids and fatty acids, hematological examinations of blood, and the increasing risk of colon cancer.

SUBJECTS AND METHODS

Subjects

A cross sectional study was carried out including (152) a convenience samples had colon cancer, age ranged between 40-50 years, colon cancer patients were selected from Makah region.

Methods

Data collection

Information about daily dietary intake either in hospital or at home was collected during the study period through interviews using the 24-hour recall sheet. Evaluation of food intake included assessment of the meals served in both the hospital and at home.

Anthropometric measurements:

Anthropometric measurements was recorded according to ***Jelliffe (1966)*** included weight and height. Body mass index (BMI) was calculated [weight (Kg)/ height^2 (m)] and used to determine the nutritional status of women according to ***Garrow (1988)*** who reported that BMI value <20 under weight, 20-24.9 indicates desirable weight, 25-30 overweight and >30 obesity (all as Kg/m^2).

Determination of daily nutrient intake

Daily nutrient intake was obtained for a week and nutritional values of consumed food were calculated using the Computer Program for Ready to Eat Egyptian Foods, Faculty of Home Economics, Menufyia University, Egypt (***Diet Analysis Program, 1995***). Total fat/ gram, saturated fatty acids (SFA) gram, monounsaturated fatty acid (MFA) /gram and polyunsaturated fatty acid (PFA)/gram were calculated. The adequacy of diets with regard to

references intake ***(DRI, 2005)*** and recommended dietary allowances ***(RDA, 1989)*** was assessed. Amino acids scores (AAS) were calculated as follow:

AAS% = g/16g N of test protein ÷ g/16g N of the FAO pattern %100.

The pattern used was the ***DRI (2005).*** The values of the essential amino acids as g/16g N were used to calculate the essential amino acids index (EAAI) and biological value (BV) of protein which were estimated in relation to egg protein according to ***Oser (1959)***, while protein efficiency ratios (PER) were calculated according to ***Alsmeyer et al., (1974)*** using 3 equations.

PER_1 = -0.684 + 0.456 Leucine – 0.047 Proline.

PER_2=-0.468 + 0.454 Leucine – 0.105 Tyrosine.

PER_3 = -1.816 + 0.435 Methionine + 0.78 Leucine +0.211 - Histidine – 0.944 Tyrosine.

Laboratory analysis

Complete blood count (CBC)

The concentration of hemoglobin (Hgb), hematocrit (HCT) and red blood cells count (RBC) were estimated according to the method described by ***Dacie and Lewis (1998),*** while mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were estimated according to the method described by (***Lee and Nieman, 1996***).

Determination of serum transaminase

Glutamic pyruvic transaminase (GPT) activity was measured according to the method described by (***Clinica Chimica Acta, 1980***), while glutamic oxaloacetic transaminase (GOT) according to method described by (***Hafkenscheid, 1979***), serum alkaline phosphatase activity was measured according to the method of (***Rec, 1972***). Serum glucose was determined according to the method of (***Tietz, 1976***), serum uric acid was measured according to the method worked by (***White et al., 1970 and James, 1971***), serum creatinine was determined according to the method of (***Folin, 1934***), serum urea nitrogen (***Patton and Crouch 1977***), total serum protein by (***Doumas et al., 1971***) serum albumin was measured according to method described by (***Henry, 1964***) respectively.

Statistical analysis

Statistics data were investigated using the statistical program SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). All the qualitative variables, frequency distributions and percentages and

chi-square tests were calculated, whereas for quantitative variables, the mean, the standard deviation and T-test were performed.

RESULTS AND DISCUSSION

In our study, we included152 cases of colorectal cancer. We studied the site distribution as well as the morphological types of all cases. Rectum was the most common site affected constituting about 30 (39.47%) cases, followed by ascending colon, sigmoid colon, descending colon, caecum and transverse colon reference. The most common finding macroscopically was an ulcer proliferative growth. The predominant histological type of colon cancer in our study was adenocarcinoma constituting 71 cases (93.42%). Similar finding was reported by ***Rasool M et al., (2014).*** We also reported one gastrointestinal stromal tumor (GIST). Histological grade shows a predominance of moderately differentiated type and the least common were poorly differentiated type. Similar incidence of histological types is reported by ***Laishram et al., (2010) .***

Present study could not find any association between the morphological type of cancer or the site distribution with the dietary intake.

Anthropometric measurements

Comparison between age and anthropometric measurements of studied samples according to gender groups were showed. Mean for age and height were lower in female, meanwhile weight and BMI were higher for male.

In a study by Hassanein, Manal (2003) it was found that, means for body weight, height and BMI of women were lower at age <25 years than at 25–50 and >50 years, which was nearly equal for the last two groups (table 1) .

Percentage distribution of studied sample according to body mass index showed that 61.9% of the female were in the range BMI 20-24.9 (desirable weight), while 52.94% of the male fell in the BMI range 20-24.9 (desirable weight), while 7.1% of female in the range MBI >30 (obese). These results were agree with the findings of Su and Arabl (2003) who stated that high BMI is a well-known risk factor of cancer; overweight colon cancer patients amounted to 29.14 and 26.2% for males and females respectively (table 2).

Dietary intake

Data (table 3 and 4) show the mean daily nutrients intake by colon cancer patient as compared to (DRI) daily requirements. Mean of macronutrients intake for male and female were higher than 100% of (DRI) except for calories which were lower than 100% of (DRI). On the other hand macronutrients intake for males were higher than females in calories, total protein, Animal protein, plant protein, total fat, Animal fat, plant fat and carbohydrates. These results were in line with the finding of **Giovannucci (2002)**. Regarding mean daily fiber intake by male and female patients were (14.1±5.5 and 16.1±3.7 g respectively). In this respect, ***Reddy et al., (2000)*** found a relationship between the intakes of dietary fiber particularly that from cereal grains and colon cancer risk. ***Ronald (1996)*** suggested that not only the amount but also the type of dietary fat is of great importance in the etiology of colon cancer. Minerals intake of males were higher than 100 % of RDA except for calcium which consumed at lower than 100% of RDA representing nearly half the requirements, while minerals intake of females were higher than 100% of RDA except for calcium and iron which consumed at lower than 100% of RDA. These results agreed with the finding of ***WU et al., (2002)*** reported that higher calcium intake is associated with reducing the risk of distal colon cancer and suggested that calcium intake beyond moderate levels may not be associated with a further risk reduction. Also, the results were agreed with ***Shaheen et al., (2003)*** who reported that cancer risk increased with increasing age and total iron intake, Mean of vitamins intake for males and female were higher than (DRI) except vitamin A, it was markedly less than 100% of DRI for males but was near 100% for females. These results agreed with ***Wideroff et al., (1998)*** who reported a several earlier case control with high dietary or biomarker levels of caroteniods, folate, Vit C and E., and agreed with ***Slattery et al., (2001)*** who suggested that incorporating foods i.e. lettuce, tomatoes, oranges, carrots, celery and greens into the diet may help reduce the risk of developing colon cancer due to these foods sources of coroteniods. Finally, in the present study, the mean intake of many macro and micro nutrients was nearly higher than 100% (of DRI and RDA) with deficiencies in calories, calcium and Vit.A. These results were agreed with the finding of ***Jokovljevic et al., (2002) and Malin et al., (2003).***

Dietary Fat

Table (5) shows the value of mean daily consumption of saturated, monoenoic, polyenoic and total unsaturated fatty acids, as presented for the different sex groups. For males myristic $C_{14:0}$, palmitic $C_{16:0}$ and stearic fatty acids had the highest percentage intake among other saturated fatty acids (15.19%, 50.5% and 22 total 87.69%) respectively, which were slightly higher than

females (14.68%, 49.71% and 23.29% total 87.68%). In the present study oleic $C_{18:0}$ fatty acid had the highest intake among other monounsaturated fatty acids with mean±SD (9.87± 6.96g and 10.149±6.60g) for males and females respectively, nevertheless in concern to the mean±SD of daily total consumption of polyunsaturated fatty acid and their percentage according to sex for all studied samples. Linoleic $C_{18:2}$ and Linolenic $C_{18:3}$ fatty acids showed higher intakes among other polyunsaturated fatty acid, while arachidonic $C_{20:4}$ fatty acid had the lowest intake among other polyunsaturated fatty acids.

Jokovljevic et al., (2002) stated that highly consumption of a specific fatty acid (i.e., linoleic acid) was associated with more than threefold greater cancer risk. ***Slattery et al., (2001)*** reported the greater risk of developing colon cancer when subjects consumed high levels of trans fatty acids.

Table (6) shows the mean daily intake of fatty acids fractions and their percentages of the total fat daily intakes according to different sex groups. For females group mean±SD of total saturated fatty acids were 23.1±3.6 g with percent 46.55% form total fat, while the mean ±SD of total saturated fatty acids were 23.29±5.6 g with percent 40.48% for males. For total monounsaturated fatty acids, the mean±SD was 13.89±7.1 g and 13.3±4.4 g in females and males respectively, the mean ± SD value of polyunsaturated fatty acids were 15.51±6.07 g and 14.21±2.99g for males and females respectively, while the mean±SD value of total unsaturated fatty acids were 28.91±5.21 and 28.19±4.62g for males and females respectively. Results noticed the proximate values for percent total saturated and unsaturated fatty acid intake fractions, being at equal slates nearly (50%). While mean percentage of omega-6 FA (% of RNI) was 74.32% in males which was higher than females (66.61%), but percentages of in males and females were less than 100% of RNI. Also, the percent of omega-3 FA% of RNI in males was higher than females. P/S (and T_{unsat}. FA/T_{sat}. FA) in males and females at equal nearly. ***Dwyer (1997)*** reported that there is insufficient evidence to conclude that specific fatty acids are associated with cancer development in humans. Hambly et al., (1997) reported that the high risk diet was high in fat (45% of calories) and low risk diet was low in fat (<5% of calories).

Narayanan et al., (2003), reported that consumption of diets high in omega-3, polyunsaturated fatty acids reduced the risk of colon cancer.

On the other hand, ***Ronald (1996)*** concluded that a highly Omega-6 PUFA diet enhanced colonic tumor growth and pulmonary colonization n in a dose – dependent manner also, high

dietary concentration of omega – 3 - PUFA inhibit the pulmonary colonization of cells. In the same time, both high and low dietary concentration of omega-3 - PUFA effectively reduce colonic transplant development.

Protein and essential amino acids intake

Data of table (7) show the essential amino acids (EAA) and quality of consumed protein for males and females with colon cancer. It is evident that all amino acids scores (AAS) were higher for females than the males. All AAS were more than 100% except for lysine of males (94%) which may be possibly the limiting EAA (LA) although the percent (74.2%) is actually quite high and acceptable. The high quality of protein consumed by females was confirmed by calculation of EAAI, B.V., and PER.s calculated by 3 equations (PER, 1, 2, 3) which were higher for females, who consumed higher calculated protein % of DRI (Table 3). Lowest % of DRI was found for lysine.

Laboratory analysis

Data in tables (8 and 9) show the CBC, hematological and biochemical analysis for the studied samples. Mean RBC, HGB, HCT, MCV and MCH of males were higher than female, while mean WBC, MCHC and PLT of females were higher than males. But the differences were not significant between males and females.

Mean hemoglobin level for male and female patient were (10.46±1.2 and 10.23±2.47 g/dl) respectively. In this respect ***Wardlaw and Insel (1995)*** reported that anemia can be indicated by Hgb level and RBC count. The desirable level for hemoglobin of blood is 15 g/dl for men and 13.69 for women. It is worthy to notice that values of (RBC, Hgb and HCT) for all patients were below normal level. The normal levels for these parameter respectively were for males (4.11:0.87 10^6/ L) (12:16 g/dl) and (37:75%) for males and (3.92:0.83 10^6/ L) (12:16 g/dl) and (33:77%) for females respectively. Low Hgb level may be caused anemia which resulted from the colon cancer. Also, all patients were hyperuricemic because uric acid and alkaline phosphatase levels higher 8.18±2.61 & 9.8±3.21 mg/dl and 181.8±111.37 &212.78±17.8 U/L .Albumin level for male (8.27 ±0.8) and female (7.1 ±0.89) patients were higher than normal levels (3.5-7.0 & 3-5.7 mg/dL) and we found urea nitrogen level for male and female 94.31 ±15.39 and 103.61 ±13.71 respectively. This result was agreed with ***Tsigris et al., (2002)*** who found that urea nitrogen was more in colon cancer patients. Meanwhile, albumin level was higher for male and female patients than normal. ***Knekt, (2000)*** found

serum albumin to be (17.03 g/dl). Hematological and biochemical parameters values for female were higher than males except for albumin and total protein.

Finally, in the present study, the mean of many complete blood counts (CBC) for males were higher than females except for WBC, MCHC and PLT.

The results presented in table (9) demonstrate the kidney function parameters. It was noticed that the mean total protein and albumin in serum of males was higher than females, it was (6.91±1.8, 8.27±0.80 and 6.83±0.91, 7.1±0.85 mg/dl) respectively, while mean creatinine of females were higher than males, it was (1.61±0.39 and 1.2±0.54mg/dL) respectively; difference also not significant. These results were agreed with ***Knekt et al., (2000)*** who reported that dietary factor associated with serum albumin may be a risk factor for distal colon cancer.

Concerning liver function, data in table (9) revealed that the mean SGOT and SGPT of female were higher than males they were (35.64±19.96, 24.71±11.43 and 31.55±14.50, 22.91±10.00U/L) respectively and differences were insignificant, meanwhile the differences were no significant.

Regarding mean fasting serum glucose, as shown in table (9) the levels were (136.9±26.8 and 145.22±22.71 mg/dL) for male and female patients respectively. It is worth mentioning that ***Park et al., (2000)*** reported an inverse relationship between serum glucose and colon cancer risk.

Conclusions

The present work suggests that increasing calcium, iron fiber intake, fruits and vegetables (i.e. oranges and orange Juice, carrots, tomatoes, spinach, lettuce, broccoli and greens) should be targeted to have adequate levels of antioxidants in the diet and decreasing fat and red meat intake, increased nutrition knowledge and nutritional awareness is indispensable.

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Conflict of interest

There is no conflict of interest among or between the authors.

Table 1: Mean±SD of age, weight, height and body mass index (BMI) for patient.

	Male (n= 68) Mean±SD	Female (n=84) Mean±SD	T-test	Sig.
Age (years)	49.34±13.30	47.06±11.23	0.748	0.460
Weight (kg)	82.15±9.50	75.77±12.97	3.251	0.006**
Height (cm)	168.98±5.81	164.81±4.70	2.018	0.049*
BMI (kg/m^2)	28.8±2.83	27.81±5.2	0.543	0.215

*p <0.05 **p<0.01*

Table (2): Distribution of studied sample according to BMI.

Sex group	Male		Female		X^2
BMI	No	%	No	%	Sig.
< 20- under weight	8	11.76	4	4.76	
20-24.9 Desirable weight	36	52.94	52	61.9	
25- 29.9 over weight	20	29.14	22	26.2	25.166
>30 obese	4	5.88	6	7.1	0.003
Total	68	100	84	100	

X2= chi-square tests

Table 3: Mean and SD of macro- nutrients intake and its percentage of daily requirements for studied samples according to sex.

Sex	Male (n=68)		Female (n=84)		T.test	Sig.
Macronutrients	Mean ± SD	% of DRI	Mean ± SD	% of DRI		
Calories (kcal)[1]	1984.07±275.5	68.42	1744.2±268.1	79.3%	-2.145	0.034*
Total protein (g)	66.04±19.63	117.92	61.38±19.03	133.43%	-1.146	0.257
Animalprotein (g)	29.11±15.21		26.5±12.81		-0.960	0.345
Protein- Plant (g)	36.93±3.81		34.88±6.4		0.867	0.325
Total fat (g)	57.79±26.58		50.49±19.15		-1.401	0.162
Animal Fat (g)	36.76±25.84		30.63±17.79		-1.180	0.239
Fat – Plant (g)	21.03±0.68		19.86±1.41			
Carbohydrate (g)	300.12±82.37	230.8	261.11±64.1	200.8%	2.180	0.032*
Fiber (g)	14.1±5.5		16.1±3.7		-1.175	0.182
Cholesterol (mg)[1]	124.11±117.9	41.37	187.1±160.9	62.36%	1.814	0.036*

** p <0.05 **p<0.01 DRI: Daily Reference Intake (2002). 1- RDA (1989)*

Table 4: Mean and SD of micro- nutrients intake and its percentage of (DRI) for studied samples according to sex.

Sex	Male (n=68)		Female (n=84)		T.test	Sig.
Micronutrients	Mean ± SD	% of DRI	Mean ± SD	% of DRI		
1- Minerals						
Calcium (mg)	567.1±171.85	56.71%	511.4±224.1	51.14%	-0.812	0.415
Phosphorus (mg)	1161.4±319.3	165.91%	1101.6±224.2	157.73%	-0.854	0.336
Total Iron (mg)	16.4±4.51	205%	14.23±4.41	79.1%	-2.558	0.35
Animal iron (mg)	3.23±1.52		3.12±1.8		-0.225	0.736
Plant iron (mg)	13.12±2.8		11.11±2.5		1.88	0.421
Zinc (mg)	12.48±3.2	113.5 %	10.68±3.3	133.5%	-1.725	0.067
2- Vitamins						
Vitamin A (µg)	681.22±344.61	75.7%	661.7±159.3	94.52%	3.198	0.007**
Vitamin D (µg)	4.8±1.02	96%	6.1±1.3	122%	2. 891	0.041*
Vitamin C (mg)	137.53±33.9	152.8 %	102.9±44.8	137.2%	-0.221	0.822
Vitamin B_1 (mg)	1.61±5.43	134.2 %	1.36±4.9	123.64%	-0.244	0.801
Vitamin B_2 (mg)	2.09±0.89	160.8%	1.49±0.91	135.45 %	1.033	0.278
Niacin (mg)	15.12±9.4	94.5%	14.76±6.71	105.4%	-0.132	0.898

** p <0.05 **p<0.01 DRI: Daily Reference Intake (2002).*

Table 5: Daily consumption (in g) of fatty acids & their percentage of total FA group.

Groups Fatty Acid	Male (N=34)		Female (N=42)	
Total saturated fatty acids	**Mean ±SD**	**% of T. PUSFA**	**Mean ± SD**	**% of T. PUSFA**
Capric $C_{10:0}$	2.19 ±0.69	8.05	1.93 ±0.11	8.28
Lauric $C_{12:0}$	2.16 ±0.6	7.94	1.37 ±0.76	5.88
Myristic $C_{14:0}$	3.59 ±1.41	13.19	3.38 ±1.04	14.50
Palmitic $C_{16:0}$	11.62 ±3.15	42.69	10.49 ±2.44	45.00
Stearic $C_{18:0}$	5.13 ±1.4	18.85	5.61 ±2.74	24.07
Lignoceric $C_{24:0}$	2.53 ± 0.17	9.29	0.53 ±0.75	2.27
Total	27.22 ±5.6	100.00	23.31 ±3.5	100.00
Monounsaturated Fatty acid	**Mean ±SD**	**% of T. PUSFA**	**Mean ± SD**	**% of T. PUSFA**
Palmitoliec $C_{16:1}$	3.24 ±1.06	18.83	2.89 ±0.51	20.10
Oleic $C_{18:1}$	9.71 ±2.96	56.42	10.13 ±2.6	74.65
Eicosenoic $C_{20:1}$	1.99 ±0.09	11.56	0.29 ±0.07	1.11
Erucic $C_{22:1}$	2.27 ±0.01	13.19	0.69 ±0.09	4.14
Total	17.21 ±3.5	100.00	13.35 ±3.1	100.00
Polyunsaturated Fatty acid	**Mean ±SD**	**% of T. PUSFA**	**Mean ± SD**	**% of T. PUSFA**
Linoleic $_{[C18:2\ \omega\ 6]}$	7.19 ±2.29	69.67	6.33 ±4.76	56.41
Linolenic $_{[C13:3\ \omega\ 3]}$	2.10 ±2.19	20.35	4.72 ±4.78	42.06
Arachidonic $_{[C20:4\ \omega\ 6]}$	0.91 ±0.01	8.82	0.15 ±0.13	1.34
Eicosapentaenoic $_{[C20:5\ \omega\ 3]}$	0.11 ±0.001	1.07	0.01 ±0.001	0.09
Docosahexaenoic acid $_{[C22:6\ \omega\ 3]}$	0.01 ±0.001	0.10	0.012 ±0.001	0.11
Total	10.32 ±2.1	100.00	11.22 ±2.95	100.00

T. SFA: *Total saturated fatty acids* ***T. MUSFA:*** *Total monounsaturated fatty acids* ***T. PUSFA:*** *Total polyunsaturated fatty acids*

Table 6: Fatty acids (g) and percentage of daily intake.

Sex groups Fatty Acid	**Male (N=68)** Mean ±SD	 % of DI	**Female (N=84)** Mean ±SD	 % of DI	Sig.
Total saturated fatty acid	27.22 ±5.6	50.56	23.31 ±3.5*	46.17	0.049
Total monounsaturated fatty acid	17.21 ±3.5	29.78	13.53 ±3.1	26.80	0.457
Total polyunsaturated fatty acid	10.32 ±2.1	19.59	11.22 ±2.95	22.23	0.537
Total unsaturated fatty acid	27.53 ±3.3	49.37	24.75 ±4.62	49.02	0.092
Omega-6 FA	8.1 ±3.21	15.75	6.48 ±4.72*	12.83	0.018
Omega-3 FA	2.1 ±1.49	3.63	4.72 ±2.95*	9.35	0.038
T. unsat. FA/ T.sat. FA	1.01 ±0.02		1.06 ±0.05		0.139
P/S	0.38 ±0.01		0.48 ±0.01		0.107

P/*s:* *T. Polyunsat. FA/ T.sat. FA.* ***DI:*** *daily intake* * *p <0.05* **p<0.01*

Table 7: Protein quality and value of protein intake for both samples.

Six groups	Male (N=68)				Female (N=84)			
Amino acids	MI g/d	g/16 gN	DRI g/16 gN	AAS	M.I. g/d	g/16 gN	DRI g/16 gN	AAS
Isoleucine	2.69	4.09	2.50	164	2.71	4.45	2.50	178
Leucine	4.49	6.83	5.50	124	3.69	6.06	5.50	110
Lysine	3.2	4.87	5.10	95	3.14	5.16	5.10	101
Methionine	1.29	1.96			1.39	2.28		
Cystine	0.82	1.25			0.93	1.53		
Phynilalanine	3.36	5.11			1.46	2.40		
Tyrosine	2.39	3.64			2.47	4.06		
Threonine	2.39	3.64	2.70	135	2.49	4.09	2.70	151
Tryptophan	0.79	1.20	0.70	172	0.81	1.33	0.70	190
Valine	3.59	5.46	3.20	171	3.69	6.06	3.20	189
Histidine	1.67	2.54	1.80	141	1.76	2.89	1.80	161
Arginine	3.24	4.93			3.53	5.80		
Alanine	2.67	4.06			2.89	4.75		
Aspartic	4.55	6.92			3.98	6.54		
Glytamin	14.3	21.75			12.3	20.20		
Glycine	2.32	3.53			2.56	4.20		
Proline	5.84	8.88			4.79	7.87		
Serine	2.74	4.17			2.99	4.91		
Methonine & Cystine	2.19	3.21	2.50	128	2.32	3.81	2.50	152
Phynilalanine &Tyrosine	5.68	8.75	4.70	186	3.93	6.45	4.70	137
E.A.A.I	76.07				79.49			
B.V.	71.19				74.92			
PER_1	2.00				1.71			
PER_2	2.24				1.86			
PER_3	1.45				0.68			

MI: Mean intake. DRI: Dietary reference intake (2005).

EAAI: Essential amino acid index. BV: Biological value. PER: Protein efficiency ratio.

Table 8: Complete blood counts (CBC) for studied samples.

Sex groups	Male (n=68)		Female (n=84)		T. test	Sig.
Parameters	Mean±SD	Normal	Mean±SD	Normal		
WBC (wL×10^3/µL)	9.19±3.32	4:11	10.21±2.72	4:11	1.565	0.124
RBC (RL×10^6/µL)	3.11±0.87	4.2:54	3.42±0.83	4.2:5,2	- 0.412	0.671
Hgb (g/dl)	10.46±1.2	12:16	10.23± 2.47	12:16	- 0.861	0.381
HCT (%)	32.75±3.33	37:47	33.77±3.88	37:47	- 1.86	0.211
MCV (µm^3%)	85.82±3.22	76:100	84.99±46.29	76:100	1.922	0.101
MCH (pg)	28.44±13.51	29:35	28.5±17.39	27:34	2.127	0.062
MCHC (g/ dl)	32.96±35.48	29.11	33.49±7.9	29:35	1.151	0.21
PLT (PU×10^3/µL)%	222.01±93.18	140:420	236.19±76.6	140:420	0.310	0.71

RBC: Red blood cell count **WBC:** White blood cells **MCV:** Mean corpuscular volume * *p <0.05* ***p<0.01*

HGB: Hemoglobin concentration **PLT:** Platelets count **MCH:** Mean corpuscular hemoglobin

MCHC: Mean corpuscular hemoglobin concentration **HCT:** Haematocrite value or **PCV:** Packed cell volume

Table 9: Hematological and Biochemical parameters for studied sample.

Sex groups	Male (n=68)		Female (n=84)		T. test	Sig.
Parameters	Mean±SD	Normal	Mean±SD	Normal		
Liver function						
SGOT (U/L)	31.51±14.4	Up to 12:40	35.66±19.91	Up to 12:40	1.011	0.329
SGPT (U/L)	22.75±10.2	Up to12:45	24.77±11.49	Up to12:45	0.722	0.477
ALP (U/L)	181.8±11.1	68:306	212.78±17.8	68:306	1.059	0.291
Fasting Serum glucose						
Glucose (mg/dl)	136.9±26.8	80:120	145.22±22.71	80:120	0.811	0.411
Kidney function						
Total protein (mg/dl)	6.91±1.8	6	6.83±0.91	8	-487	0.639
Urea nitrogen (mg/dl)	94.31±15.39	15:45	103.61±13.71	15:45	0.271	0.787
Creatinine (mg/dl)	1.20±0.54	0.4:1.3	1.61±0.39	0.4:1.3	2.021	0.531
Uric acid (mg/dl)	8.18±2.61	3.5:7	9.8±3.21	3.5:5.7	1.378	0.091
Albumin (g/dl)	8.27±0.80	3.2:5.5	7.10±0.89	3.2:5.5	- 0.81	0.406

** p <0.05 **p<0.01* ***SGOT****:* serum glutamic-oxaloacetic transaminase

SGPT: Serum glutamic pyruvic transaminase ALP: alkaline phosphatase

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