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مجلة البحوث في مجالات التربية النوعية

معرف البحث الرقمي DOI: 10.21608/jedu.2021.67260.1294

المجلد السابع العدد 34 . مايو 2021

الترقيم الدولي

P-ISSN: 1687-3424 E- ISSN: 2735-3346

موقع المجلة عبر بنك المعرفة المصري https://jedu.journals.ekb.eg/

موقع المجلة http://jrfse.minia.edu.eg/Hom

العنوان: كلية التربية النوعية . جامعة المنيا . جمهورية مصر العربية

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Abstract:

The present study was carried out to know the effect of sprouted turnip seeds on anthropometric measurements, blood lipids, liver enzymes, serum glucose and thyroxin stimulating Hermon (TSH).The study was carried out on 45 female with body mass index (BMI) >28 and aged between 25 and 40 years were randomly divided into three main groups each one containing 15 females; Group one (15female) was a control group and fed on usual daily diet while, the second group (15 female) was given a low-calorie diet individually. The third group (15 female) was given a low calorie diet individually with sprouted turnips seed (100 g/ day) for two months. Participants were initially submitted to anthropometric measurements (weight, body fat %, height, waist circumference, and mid-upper arm circumference), and blood samples for analysis of serum glucose, lipid profile (total cholesterol, HDL-c, LDL-c, and triglycerides),liver enzymes including (AST & ALT) , TSH levels, total protein, and serum albumin. Then the groups started the intervention protocol lasting 8 weeks. After two months follow-up period, the study results revealed that the consumption of sprouted turnip seeds with low-calorie diet was useful in treatment of obesity, improved levels of lipid profiles, liver functions, blood glucose and TSH.

Keywords: Turnip seeds sprouts, Glucose, Hyperlipidemia, Liver enzymes, Obesity in females.

Introduction:

Obesity prevalence rates have increased worldwide since 1980 in all ages and both genders (**Chooi *et al*., 2019**). The highest rate of obesity in the world recorded for Egypt, they documented over (35.5 percent) of adult, According to a study published in 2017 in the New England Journal of Medicine. Also, it was found 19 million adults obese from 98 million Egypt's population. In addition, the Institute for Health Metrics and Evaluation in University of Washington's found that 3.6 million from Egyptian children are obese, around 10.2 % (**El-Geressi, 2019**).

Turnip (*Brassica rapa* var. *rapa*) is a popular herbaceous plant grown worldwide. It is indigenous to Europe, Asia, America, and Russia and is now extensively developed as vegetable and oil source far and wide (**Paul *et al*., 2019**). It is one of the first vegetables that have been used for human intake. Turnip contains high levels of vitamin C and antioxidants. It has useful effect in decreasing the hazard of obesity (**Liang *et al*., 2006**). Turnip portions (root, leave, and seed) have been used in old medicine generally for the treatment of some diseases such as diabetes (**Javadzadeh and Pouyan, 2010**). Ethanolic *Brassica* root may have possible anti-obesity manager via the reserve of adipocyte lipid buildup. Turnip root extract has anti hypercholesterolemic influence on rabbits due to flavonoids and vitamins contents; also it has a strong anti hyperlipidemic nutrient for patient with heart diseases (**An *et al*., 2010; Mirzaie *et al*., 2012 and Vafaeinejad *et al*., 2015**).

Attorri *et al*. (2010) demonstrated that the cardioprotective effect of rapeseed oils which can improve lipid profile. Turnip (*Brassica rapa* var. *rapa* Linn) has low calories, vitamin C, riboflavin, dietary fiber, and minerals (**Parveen *et al*., 2015 and Ma *et al*., 2016**). *Brassica rapa* seeds could be established as a functional food for liver protection (**Fu *et al*., 2016**). *Brassica oleracea* contain Beta carotene, Indole3Carbinole, omega 3 fatty acids pharmalogical action is anti-carcinogenic, powerful antioxidant (**Simoloka and Bhikha, 2016**).

Sprouting process has a confident effect on the human health. As germination decrease the amount of the anti-nutritive factors as trypsin inhibitor, phytic acid, pentosan, tannin in contrast to increase the useful compounds as sulphoraphane, sulphoraphene, isothiocyanates, glucosinolates, enzymes, antioxidants, vitamins which are showed to be effective in the inhibition of cancer (**Sangronis and Achado 2007 & Marton *et al*., 2010**).Sprouts and seedlings increase nutritional value of seeds due to increasing phytochemicals that are beneficial to health (**Chalorcharoenying *et al*., 2017**). *Brassica rapa* showing various colored lights, red and blue lights are the most active sources of polyphenolics content in *Brassica rapa* (**Nawaza *et al*., 2018**). *Brassica crops* are a good source of glucoraphanin, which, next hydrolysis, releases sulforaphane. Sulforaphane is a prospective treatment for obesity (**Martins *et al*., 2018**). **Xu *et al*., (2020)** reported that glucoraphanin are found in cruciferous vegetables decreased adipose tissue masses So that, glucoraphanin is a potential anti-obesity possible substance. Therefore, the present study investigates anti-obesity effect of turnip seeds before and after germination.

Subjects, Materials, and Methods

Subjects:

A total of 45 obese adult females, ranging in age from 25 to 40 years, were chosen at random. All of the participants had a BMI of 28–40 kg m2, did not take food supplements containing active ingredients found in the food (dietary fiber), and did not use weight-loss drugs or supplements. Females were assessed for anthropometric tests, liver enzymes (AST and ALT), total protein, serum albumin, triglycerides, TSH, total cholesterol (TC), LDL-C, HDL-C, and blood sugar in a pilot study prior to the experiment. Both participants were subjected to a pre-experiment and post-experiment study. The experimental period was continued for two months.

Turnips seeds Preparation:

Turnips seeds were purchased from a private company of agricultural seeds, spices, and medicinal plants, in Cairo, Egypt. The seeds were cleaned from all impurities and soaked for 16 h in water then the seeds were placed on a wet cotton tissue and covered the seeds by another wet tissue. The seeds were left to sprout in the dark at room temperature (25-30° C) and then sprouts were harvested after 3-4 days from seed sowing and applied for supplementation in the study.

Study design:

In this experiment, the participants were divided into three classes at random: Participants in G1 (the first control) consumed their daily diet, while the second control group includes participants who were subjected to a low- calorie diet individually. Participants in the third group were given a low-calorie diet that included sprouted turnip seeds (100 g per day). A low-calorie diet was provided individually for each case. Participants in G2 and G3 had some reservations, such as low sugar, low salt, and low fats (Table 1), till the end of the trail. After two months the participants were fasted all-night and all anthropometric and biochemical analyses were estimated again. Blood samples were collected and placed in a dry clean centrifuge tube, and then centrifuged (Multi Centrifuge OHAUS “Frontier™ 5706”) for 10 minutes at 3000 rounds per min to separate the serum. The serum was cautiously moved into a dry clean Wassermann tube by a Pasteur pipette and stored frozen till analysis.

Anthropometric measurements:

Anthropometric measurements including weight, height, waist circumference and mid- upper arm circumference were carried out by standardized procedures at baseline and after 8 weeks. Weight was measured by using electric weight balance by standing posture of the subject. Body mass index was measured as weight in kilograms divided by the square of their height in meter. Weight was measured while participants were wearing light clothing without shoes by using the weighing scale. Height measurement was taken using a portable tape meter without shoes and recorded to the nearest 0.5 cm. Waist circumferences (WC) of the subjects was measured with an inelastic tape used at the narrowest point below the ribs, or halfway between the lowest ribs and the iliac crests. Mid-Upper Arm Circumference (MUAC) was measured at the midpoint between the acromion and olecranon processes on the shoulder blade and the ulna, respectively, of the arm. Body fat (%) was determined by using In Body (120, Medi Needs). In Body is a bioelectrical impedance analysis (BIA) that depends on measuring the impedance of the body at each of 5 segments (right arm, left arm, trunk, right leg, and left leg) by applying micro-currents and then measure the voltage drop. After that, the body water, fat-free mass, body fat and other body components can be obtained.

Table (1): Composition of diet (1500 -1800 kcal) Low calorie food.

Days	Breakfast (from 7-9 am)	Between Breakfast and lunch	Lunch (2-3 pm)	Between lunch and dinner	Dinner
The firstday	. 2cups of water before breakfast - -Half a loaf of bread A piece of cottage cheese, -One tomato or any vegetable - Tea	100 g germinated turnips seeds	-2 cups of water before lunch. -Green salad (green pepper-tomato-cucum- ber-1 tsp lemon). -Red meat. -A small dish, stuffed (any type, the amount of rice and a few vegetables. without much fat).	-Fruit salad without sugar	cups of water before dinner - 2 A cup of vegetable soup. fruits.
The Second day	. 2cups of water before breakfast - (A cup of lemon juice (with no sugar -(Boiled egg or fried without fat (Half a loaf of bread - 1 service fruit and vegetable	100 g germinated turnips seeds	2.cups of water before lunch - -Green salad (green pepper-tomato-cecum-ber-spoon of vinegar). -Half a loaf of bread. -Grilled fish (1-2).	- Fruit apples or orange	.cups of water before dinner - 2 -A cup of skimmed milk cup.-Fruits.
The Third day	-.2 cups of water before breakfast - A cup of skimmed milk Half a loaf of bread 3 tablespoons bean (with a little oil and lemon) -Fruits and vegetables.	100 g germinated turnips seeds	.cups of water before lunch - 2 -Green salad (green pepper-tomato- cucumber -1 tsp lemon). - A quarter of skinned chick. -5 tablespoons of spaghetti or rice.	-Green salad.	-2 cups of water before dinner. .A cup of green tea or ginger - -Fruits and vegetables.
The fourthday	-.2cups of water before breakfast -Half loaf of bread or wheat toast slice- Grilled Eggplant with lemon, cumin, garlic, and pepper (half the-(fruit .Green peppers or vegetables - -Fruit and vegetable	100 g germinated turnips seeds	-2 cups of water before lunch. -Green salad (green pepper-tomato- cucumber -1 tsp lemon). -Sautéed vegetable dish (the-peas-zucchi-ni-green beans-cauliflower-potato). -A piece of chicken breast. - A fat-free chicken soup.	A cup of tea or coffee.	.cups of water before dinner - 2 -Fruits and vegetables.
The Fifth day	. 2cups of water before breakfast -Half a loaf of bread Bean, tomato and pepper and lemon.-fruit- Cup of skimmed milk or orange juice or lemon water or tea with-out sugar after eating	100 g germinated turnips seeds	-2 cups of water before lunch. -Green salad (green pepper-tomato- cucumber -1 tsp lemon). -bran bread. -Okra or spinach.	Fruits	.cups of water before dinner - 2 -Green tea with mint and lemon(with no sugar). -Fruits (Kiwi or tangerine or or-ange).
The sixthday	. 2cups of water before breakfast Half a loaf of bread Mashed potatoes (boiled potatoes with cumin and a pinch of salt- (and a pinch of skimmed milk Fruit vegetable oneFruits- -Tea or coffee after breakfast hours.	100 g germinated turnips seeds	-2 cups of water before lunch. -Green Salad (green pepper-tomato-cu-cucumber 1 tsp lemon). -Cup yellow lentils. -bran bread. -Fruits.	cup ginger and green tea	.cups of water before dinner - 2 -A quarter of bread. -Cottage cheese (30g)
The Seventh day	. 2cups of water before breakfast Half a loaf of my apostasy Fruit vegetable one A single fruit .Piece of cottage cheese- .Only one Tamiya- .A glass of lemonade or orange juice-	100 g germinated turnips seeds	-2 cups of water before lunch. -Green Salad (green pepper-tomato-cu-cumber-1 tsp lemon). -Vegetable soup (dish). -Chicken. -5 tablespoons rice.	Green Salad	.cups of water before dinner - 2 -Green Salad.

Biochemical analysis of serum:

The total cholesterol TC was analyzed according to the method of **Allain *et al*. (1974)**, while the triglycerides TG was measured by the method described by (**Trinder and Ann, 1969)**. The High density lipoprotein – cholesterol HDL-C was estimated as mentioned in **Lopes-Virella *et al*. (1977)**, while serum low density lipoprotein – cholesterol LDL-C value was calculated by the equation of **Friedwald *et al*. (1972)**:

LDL=TC-(HDL + TG/5)

Aspartate transaminase (**AST**) and Alanine aminotransferase (ALT) were measured by the method of **Reitman and Frankel (1957**), the protein was estimated by **Sonnenwirth and Jaret (1980**), and albumin was analyzed by **Drupt (1974)** method. Glucose was analyzed in the serum as in the method of **Trinder (1959). T**hyroxin stimulating Hermon (TSH) was analyzed by **Demers and Spencer (2014).**

Preparation of the alcoholic extract:

About 5g of air-dried plant powder were reflexed with 2.5 L of 70% methyl alcohol for 6 hours, and then filtered. The residue powder was then washed several times with hot alcohol. The combined filtrates were concentrated under reduced pressure at 50ºC, and then used for the following tests: Tests for alkaloids, glycosides, cardiac glycosides, saponins, phenols, sterols, tannins, and flavonoids.

Estimation of total flavonoid content (TFC):

The amount of Total Flavonoid content in extract was determined by aluminum chloride assay through Colorimetric method. A 0.5ml aliquot of appropriately diluted sample solution was mixed with 2 ml of distilled water and subsequently with 0.15ml of a 5% $NaNO_2$ solution. After 6 minutes, 0.15 ml of a 10% $AlCl_3$ solution was added and allowed to stand for 6 minutes, then 2 ml of 4% NaOH solution was added to the mixture. Immediately, water was added to bring the final volume to 5ml, then the mixture was thoroughly mixed and allowed to stand for another 15 minutes. Absorbance of the mixture was determined at 510 nm versus prepared water blank. Rutin was used as standard compound for the quantification of total Flavonoid. Total flavonoid content was expressed as mg rutin/g dry weight (mg rutin/g DW), through the calibration curve of Rutin. All samples were analyzed in three replications **(Samatha *et al*., 2012 and Han and May, 2012)**.

$$y = 0.0012x + 0.0011R_2 = 0.9986$$

(**y**) was the absorbance and (**x**) was the µg rutin/mg of the extract.

Analyzing the total phenolic:

The amount of total phenolic in extract was determined with the FolinCiocalteu reagent. Gallic acid was used as a standard and the total phenolic was expressed as µg/mg gallic acid equivalent to (GAE). Concentrations of 10, 20, 30, 40 and 50µg/ml of gallic acid were prepared in methanol. Concentration of 1mg/ml of plant extract was also prepared in methanol and 0.5 ml of each sample were introduced into test and mixed with 2.5ml of a 10 fold dilute FolinCiocalteu reagent and 2ml 0f 7.5% sodium carbonate. The tubes were covered with parafilm and allowed to stand for 30 minutes at room temperature before the absorbance was read at 760nm spectrophotometrically. All determination was performed in triplicate. The FolinCiocalteu reagent is sensitive to reducing compounds including polyphenols. They produce a blue color upon reaction. This blue color was measured spectrophotmetrically (**Chun *et al*., 2013 and Maurya and Sing, 2010).** Line of Regression from Gallic acid was used for estimation of unknown phenol content. From Standard curve of Gallic acid line of Regression was found to be.

$$y = 0.0013x + 0.056R^2 = 0.9872$$

(**y**) was the absorbance and (**x**) was the µgrutin /mg of the extract.

Measuring the total alkaloids using gravimetric method:

About (2g) of the plant parts were extracted with 90 % ethanol till exhaustion (tested with Mayer's reagent). The alcoholic extract of the plant was concentrated under reduced pressure until dryness at a temperature not exceeding 40 °C, acidified with HCl (3 %), and filtered; the filtrate obtained was extracted with chloroform to remove acid alkaloid portion. The acidic aqueous layer was adjusted to alkaline media with ammonia and the liberated alkaloid base portion was extracted with chloroform till exhaustion (tested by Mayer and Dragendorrf's reagents). The chloroform extract was filtered over anhydrous sodium sulfate and evaporated under reduced pressure till dryness, then weighed it to calculate the percent w/w **(Woo *et al*., 1977)**.

Estimation of total saponins:

2g plant parts were dispersed in 20 ml of 20 % ethanol. The suspension was heated over a hot water bath for 4 hours with continuous stirring at about 55°C. The mixture was filtered and the residue was re-extracted with another 200 ml of 20 % ethanol. The combined extracts were reduced to 40 ml over water bath at about 90°C. The concentrate was transferred into a 250 ml separating funnel and 20 ml of diethyl ether was added and shaken vigorous. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated and 60 ml of n-butanol was added. The combined n-butanol extract were washed twice with 10 ml of 5 % aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation, the samples were dried in the oven to a constant weight. The saponins content was calculated in percentage according to **Obadoni and Ochuko (2001) and Okwu and Ukanwa (2007)**.

$$\text{Saponins \%} = \frac{\text{weight of saponin}}{\text{Weight of sample}} \times 100$$

Estimation of Total Tannins using Gravimetric Method (Copper Acetate Method):

This method depends on quantitative precipitation of tannin with copper acetate solution, igniting the copper tannate to copper oxide and weighing the residual copper oxide **(Ali *et al*., 2011)**.

Two grams of parts were separately extracted for about one hour with two successive quantities, each of 100ml of acetone-water (1:1) and then filtered. The combined extract, in each case, was separately transferred into a 250ml volumetric flask and adjusted for volume with distilled water. Each extract was quantitatively transferred to a 500ml beaker and heated till boiling, then 30ml of 15% aqueous solution of copper acetate was added with stirring. The precipitate of copper tannate was collected on ashless filter paper and the precipitate was ignited in a porcelain crucible (the crucibles were previously ignited to a constant weight at the same temperature). Few drops of nitric acid were added to the residue and reignited to constant weight. The weight of copper oxide was determined and the percentage of tannin was calculated according to the following correlation: Each 1g of Cuo = 1.305g tannins.

Statistical analysis:

Statistical analysis was carried out using the programme of Statistical Package for Social Sciences (SPSS), PC statistical software (Version 20; Untitled–SPSS Data Editor). The results were expressed as mean ± standard deviation (mean± SD) and statistically analyzed using one-way analysis of variance (ANOVA) by the Duncan test. Also, a paired-samples T test was used to determine the statistical difference between the pre- and postmeans for each parameter in each group **(Sendcor and Cochran, 1979).** The statistical significance of difference was taken as $P \leq 0.05$**.**

Results:

Total active materials of turnips seeds and sprouted turnips seeds:

The results in table 2 explained that, the sprouted turnips seeds contained the highest concentration of total phenolic, total flavonoid, and total tannins than the turnips seeds (P≤0.001). On the other hand, the concentration of the total alkaloids was higher (P≤0.001) in turnips seeds, while saponin was declined in sprouts.

Table (2): Total active materials in turnips seeds and sprouted turnips seeds.

Total active materials	Turnips seeds	Sprouted turnips seeds
Total flavonoids (mggm^{-1}rutin)	145±0.21	**189±0.2
Total phenolic acids (mggm^{-1} Gallic acid)	195±0.4	**254±0.3
(%) Total Saponins	0.9±0.02	**0.81±0.02
(%) Total Alkaloids	1.4±0.4	**0.8±0.3
(%)Total Tannins	1.6±0.2	**2±0.5

** indicates values for sprouts and seed of turnips were significantly different (t-test, P≤0.001).

The effect of sprouted turnips seeds on the anthropometric measurements:

The documented data in Table 3 showed the effect of feeding on sprouted turnips seeds on final body weight, body fat, BMI, waist and mid-upper arm circumference. The data cleared a highly significant (p≤0.05) decrease in the weight, body fat, and BMI of participants after exposing to a low-calorie diet with sprouted turnips seeds for G3 and participants of G2 who exposed only to a low-calorie diet without sprouted turnips seeds. The percentages of weight reduction, body fat, and BMI were (-6.67% and -14%), (-8.66% and -26.3%) and (-9.52% and -18.42%) for G2 and G3, respectively, compared to G1 (the control) who consumed their usual diet (-1.25%, -2.02% and -2.14%), respectively.

Table (3): The effect of sprouted turnips seeds on the anthropometric measurements in adult females.

Parameters \ Groups		Group 1 M±SD	Group 2 M±SD	Group 3 M±SD
Weight (Kg)	**Before**	87.36±5.4	90.73±10.6	89.52±9.35
	After	86.26±3.8[a]	84.68±8.9[a]	76.98±7.76[b]
	% reduction	-1.25%	-6.67%	-14%
T. test		1.70	3.89	5.21
Sig.		0.110[NS]	0.002[**]	0.000[**]
Body fat	**Before**	33.71±4.9	36.03±6.96	39.40±9.72
	After	33.03±4.56[a]	32.91±5.78[a]	29.04±4.10[b]
	% reduction	-2.02%	-8.66%	-26.3%
T. test		1.66	4.22	3.54
Sig.		0.119 [NS]	0.001[**]	0.003[**]
BMI (Kg/m^2)	**Before**	33.13±2.4	34.89±5.45	33.50±2.96
	After	32.42±2.23[a]	31.57±2.8[a]	27.33±7.46[b]
	% reduction	-2.14%	-9.52%	-18.42%
T. test		2.09	2.75	4.45
Sig.		0.055[*]	0.015[*]	0.001[**]
Waist circumference (cm)	**Before**	91.46±6.98	77.80±25	95.43±8.20
	After	88.93±6.52[a]	74.83±25[b]	83±6.76[ab]
	% reduction	-2.77%	-3.82%	-13.03%
T. test		1.74	3.77	5.87
Sig.		0.10 [NS]	0.002[**]	0.000[**]
Mid-upper arm circumference (cm)	**Before**	35.60±2.29	36.26±5.02	35.53±4.05
	After	33.40±2.841[a]	34±4.19[a]	33.20±4.44[a]
	%reduction	-6.18%	-6.23%	-6.56%
T. test		0.36	3.60	3.70
Sig.		0.72 [NS]	0.003[**]	0.002[**]

Means within the same row with different letters are significantly different (P≤0.05)
***P<0.05, ** P < 0.01 *** P<0.001 NS = not significant**

As well, the data in Table 3 presented significant decrease in waist circumference of participants in G3 than those in G2.The percentages of waist circumference reduction (-3.82% and -13.03%) for G2 and G3, respectively, compared to G1 (-2.77%). While an insignificant difference was noticed in the mid-upper arm circumference of the participants in G3 and G2. (-6.23% and-6.56%) for G2 and G3, respectively compared to G1 (-6.18%).The reduction in weight, body fat, and BMI and waist circumference detected in participants of G3 than those of G2.

The effect of sprouted turnips seeds on the serum lipid profile:

Data in the table (4) stated that diet with sprouted turnips seeds and diet only presented significantly decrease in the levels of serum lipid in the study participants (P<0.01). The percentages reduction in TG, TC and LDL were (-21.46% and -44.42%), (-20.16% and -29.77%) and (-28.25% and-36.52%) for G2 and G3, respectively, compared to G1 (0.69%, -0.55% and -0.36%). Also, Table (4) shows a significant (P<0.01) increase in HDL of participants in group 2 and group 3 by 8.03% and 7.16%, respectively.

Table (4): The effect of sprouted turnips seeds on the serum levels of triglycerides, total cholesterol, LDL, and HDL in adult female

Parameters	Groups	Group 1	Group 2	Group 3
		M±SD	M±SD	M±SD
Triglyrides (mg dl-1)	Before	216.9±57.4	139.2±23.6	154.2±38.1
	After	218.4±54.6[a]	109.33±21.2[b]	85.7±7.5[b]
	% difference	0.69%	-21.46%	-44.42%
T. test		-0.732-	8.47	7.19
Sig.		0.476 [NS]	0.000[**]	0.000[**]
Total Cholesterol (mg dl-1)	Before	254.8±28.6	225.7±37.04	247.2±23.5
	After	253.4±25.2[a]	180.2±27.17[b]	173.6±13.6[b]
	% difference	-0.55%	-20.16%	-29.77%
T. test		0.382	6.68	17.8
Sig.		0.708 [NS]	0.000[**]	0.000[**]
LDL (mg dl-1)	Before	170.6±29.7	152±36.9	172.49±25.2
	After	169.98±29.22[a]	109.06±27[b]	109.5±13.4[b]
	% difference	-0.36%	-28.25%	-36.52%
T. test		0.179	6.36	13.7
Sig.		0.860 [NS]	0.000[**]	0.000[**]
HDL (mg dl-1)	Before	40.8±3.9	45.6±3.1	43.86±5.09
	After	39.8±4.8[b]	49.26±2.7[a]	47±2.8[a]
	% difference	-2.45%	8.03%	7.16%
T. test		1.19	-3.96-	-2.63-
Sig.		0.250 [NS]	0.0001[**]	0.020[*]

Means within the same row with different letters are significantly different (P≤0.05)
***P<0.05, ** P < 0.01 *** P<0.001 NS = not significant**

The effect of sprouted turnips seeds on the liver enzymes, total protein, and albumin:

The results of Table 5 indicated that there was a highly significant (p<0.001) reduction in liver enzyme; AST and ALT, of participants of G2 and participants of G3 compared with the control G1, however, there was an insignificant difference between participants in G2 and G3. The reduction percentages of those groups than control were (-33.16% and-22.06%) and (-21.12% and -10.72%) in AST and ALT respectively, while the reduction percentage in the control group was (-9.8% and -7.11%), respectively. Also, an insignificant difference was recorded in serum T. protein and albumin of participants in G2 and G3.

Table (5): The effect of sprouted turnips seeds on liver enzymes, total protein, and albumin levels in adult females

Parameters \ Groups		Group 1	Group 2	Group 3
		M±SD	M±SD	M±SD
AST U L-1	Before	31.33±3.6	38.6±3.7	38.4±5.8
	After	28.26±4.5[a]	25.8±6.96[a]	29.93±5.3[a]
	% difference	-9.8%	-33.16%	-22.06%
T. test		2.44	5.47	5.74
Sig.		0.028*	0.000**	0.000**
ALT U L-1	Before	31.93±6	32.2±4.53	32.93±3.95
	After	29.66±6.83[a]	25.4±4.8[a]	29.4±4.8[a]
	% difference	-7.11%	-21.12%	-10.72%
T. test		0.983	4.26	2.13
Sig.		0.342 NS	0.001**	0.051*
T.protein	Before	7.57±0.78	7.14±0.65	7.62±0.68
	After	7.62±0.57[a]	7.42±0.46[a]	7.54±0.45[a]
	% difference	0.66%	3.92%	-1.05%
T. test		-0.381-	-1.61-	0.606
Sig.		0.709NS	0.129 NS	0.554 NS
Albumin	Before	5.4±0.25	4.66±0.45	4.36±0.4
	After	4.78±0.23 [a]	4.63±0.48 [a]	4.78±0.29 [a]
	% difference	-11.48%	-0.64	9.63%
T. test		3.7	0.572	-4.27-
Sig.		0.002**	0.576 NS	0.001**

Means within the same row with different letters are significantly different (P≤0.05)
***P<0.05, ** P < 0.01 *** P<0.001 NS = not significant**

The effect of sprouted turnips seeds on serum levels of glucose and thyroxin stimulating Hermon (TSH):

The data in Table 6 revealed a significant (p≤0.05) reduction in serum glucose of participants of G2 and G3. Their mean difference significantly decreased from (90.2±10.1 and 90.66±7.7mg / dl) to (83.6±5.5 and 85.33±5.9 mg / dl) respectively, While there was an insignificant difference in TSH hormone of all individuals before and after participating in this study.

Table (6): The effect of sprouted turnips seeds on the serum levels of glucose and thyroxin stimulating Hermon (TSH) in adult females

Parameters / Groups		Group 1	Group 2	Group 3
		M±SD	M±SD	M±SD
Glucose mg dl-1	Before	95.66±7.9	90.2±10.1	90.66±7.7
	After	92.6±6.2[a]	83.6±5.5[b]	85.33±5.9[b]
	% difference	-3.2%	-7.32%	-5.88%
T. test		1.15	2.3	1.9
Sig.		0.268[NS]	0.036[*]	0.077[*]
TSH (mIUL)	Before	2.28±0.82	1.77±0.49	1.91±0.67
	After	2.09±0.92[a]	2.6±0.9[a]	2.46±0.82[a]
	% difference	-8.33%	46.89%	28.8%
T. test		1.19	-.955-	-2.85-
Sig.		0.253[NS]	0.356[NS]	0.013[NS]

Means within the same row with different letters are significantly different (P≤0.05)
***P<0.05, ** P < 0.01 *** P<0.001 NS = not significant**

Discussion:

Innovative products must have added value, such as food for wellness. New uses of nutrients and bioactive components will drive emerging food technologies **(Ubbink and Mezzenga, 2006)**. Cruciferous sprouts contain non-nutrient/health-promoting compounds, like diverse types of glucosinolates and phenolic compounds **(Baenas *et al.*, 2017).**The biological activity developed by these compounds is mainly due to their antioxidant capacity, which could lower the deleterious consequences of excessively high levels of Reactive oxygen species (ROS) in cells, thus, decrease oxidative stress (OS) by providing cells with molecular tools to combat the imbalance between the production of ROS and the capacity to modulate the redox balance. These properties have direct effects on a number of cellular processes triggered by ROS, which are related to inflammation and oxidative reactions on DNA, proteins, and cell lipids **(Gagne, 2014).** In addition, to provide further molecular tools to cells to lower oxidative stress, many bioactive phytochemicals present in edible sprouts display biological functions that are crucial for the prevention of carcinogenesis processes and other chronic diseases **(Gan *et al.*, 2017).**

The cruciferous seeds are an important source of riboflavin, thiamine, dietary fiber, and macro and micro elements. It represents a new type of ready-to-eat vegetable intended for direct consumption in fresh form and can also be used as ingredients in human diets. Currently, nutritionists have recommended the general consumption of various whole grains, vegetables and fruits, including germination or fermentation products **(Henryk *et al.*, 2005).**

The present result reveled that, sprouted turnips seeds contained the highest amount of total phenolic, total flavonoid, and total tannins than the turnips seeds. Flavonoids are another major type of compounds in turnip, and are always present as glycosides. Of the 35 flavonoids reported from this plant, kaempferol, quercetin, and isorhamnetin are the most common aglycones **(Vallejo *et al.*, 2004).** The previously phytochemical investigation on turnip revealed the presence of glucosinolates (1 to 20), isothiocyanates (21 to 36), flavonoids (37 to 71), volatiles (111 to 188), and other compounds (72 to 110) **(Pierre *et al.*, 2011 & Taveira *et al.*, 2009).** Our obtained results accord with the results of **Choi *et al. (*2006)** who noticed that the turnip extract contains high content of glucosinolates, isothiocyanates, flavonoids, phenols, indoles, volatiles and sulfur compounds that have been medicinally used to treat headaches, chest complaints, gastritis, constipation and other diseases because these bioactive compounds neutralizes the reactive oxygen species that otherwise cause destruction to the structure and function of liver.

The nutritional value of turnips for humans can be summarized as low in fat and calories, but an excellent source of minerals, vitamins, bioactive compounds and high dry matter digestibility essential for the healthy life. The high dietetic values of turnip are derived from the rich chemical composition of the plant. Besides being an important vegetable, turnip contains a significant amount of phytochemicals, aromatic compounds, organic acids, essential oils and other on-nutritive compounds, which provide desirable health benefits, like antibacterial properties, anti-carcinogenic properties, increase the immune system in human body beyond basic nutrition **(Haliloglu *et al.*, 2012).** The antioxidant property exhibited by the non-nutritive compounds (polyphenols, flavonoids, isoflavones and glucosinolates) present in turnip assists the body to scavenge harmful free radicals and may therefore protect tissues against oxidative damages, prevention from cancers, inflammation and helps to boost immunity **(Silva *et al.*, 2004).** The intake of natural antioxidants from turnip is necessary for healthy life because the high antioxidant property of *Brassica* species showed a protective effect on the oxidation of lipoproteins **(Kural *et al.*, 2011).**

In the present findings, we revealed the effect of sprouted turnips seeds on obesity subjects. Results presented in table (1&2) stated that groups (G2& G3) who consumed low calorie diet only and low calorie diet with sprouted turnips seeds (had significant decrease in weight ,body fat, body mass index , waist circumference and arm circumference. While there was no significant difference in each weight and body fat (G1).

An *et al.*, (2010) showed that safety and efficacy of ethanolic extracts of *Brassica rapa* roots (EBR) as anti-obesity cause via the reserve of adipocyte lipid buildup and the motivation of beta3-AR-dependent lipolysis. **Chang *et al*. (2011)** studied that anti-obesity action of indole-3-carbinol in high-fat-diet prompted obese mice and established that indole-3-carbinol (I3C), a derivative from cruciferous vegetables such as cabbage, prevents adipocyte differentiation and thereby decreases body weight in mice. These results agreed with **Abo-Youssef and Mohammed (2013)** who studied that effect of *Brassica rapa* on fructose-prompted metabolic syndrome in rats, and founded generation of metabolic syndrome (MS) was connected with increased body weight gain. *Brassica rapa* reduced most of the changes associated with MS. It reduced weight gain. And also agreed with **Yang *et al*. (2017)** who studied that 3, 3'-Diindolylmethane defeats high-fat diet-induced obesity through preventing adipogenesis of pre-adipocytes by affecting USP2 activity and founded that cruciferous vegetables, which can produce DIM (3,3-diindolylmethane) as a metabolite, have the potential to prevent or treat chronic obesity**.** Turnip has exposed an anti-obesity effect and this may be accredited to the high content of fibers. This is in accordance with previous findings by **Bahreynian *et al*. (2018)** who revealed that dietary fiber intake may have a protecting role against obesity, where higher fiber intake was related to lower anthropometric guides involving weight and waist circumference. **Martins *et al.* (2018)** reported that *Brassica* crops are a good foundation of glucoraphanin, which, following hydrolysis, reliefs sulforaphane as bioactive compound which used in treatment of obesity. In harmony with our findings **López-Chillón *et al*. (2019)** studied the influence of Broccoli sprouts on overweight adults subjects and determined anthropometric parameters as body fat mass, body weight, and BMI also valued inflammatory markers connected to obesity. They resolved that Broccoli sprouts are rich in glucosinolates and isothiocyanates which are important in combat obesity and decreasing inflammatory indicators.Germination of seeds caused an increase in the total phenolic content and enhanced antioxidant activity (**Dziki *et al*., 2020)**. The previous studies revealed that the antioxidant activity related to suppression of leptin release. So that, it is effective in reducing obesity. **Xu *et al.* (2020)** reported that glucoraphanin are found in broccoli seeds and cruciferous vegetables decreased liver weights, adipose tissue masses and concentrations of serum inflammatory factors. So that, glucoraphanin is a potential anti-obesity potential substance.

The present findings showed that there were significant decrease in AST, ALT and albumin in group consumed low fat diet and sprouted seeds (turnips). Turnip has a hepatoprotective action, through its anti-oxidative capacities, **Rafatullah *et al*. (2006)** proved that treatment with turnip juice reduced AST, ALT and ALP in the serum of rats due to presence of flavonoids, anthocyanins and sulfur. **Daryoush *et al*. (2011)** showed that oral administration of turnip root ethanolic extract (TREE) at dose of 200 mg/kg in 10 ml/kg normal saline for 8 following weeks can alteration liver function enzymes to normal ranges. The ethanolic extracts of *Brassica oleracea* and its leaf seems to preserve the structural integrity of the hepatocellular membrane **(Bhavani *et al*., 2014)**. **Hamideh *et al.* (2015)** showed that turnip extract has antioxidant properties as flavonoids and derivatives of hydroxycinnamic acid that are abundantly found in turnip roots and eliminate free radicals and protect from liver toxicity. Oral administration of turnip water extract (TWE) resulted in a significant decrease in liver and kidney markers in serum of rats, may be due to the avoidance of the leak of these intracellular enzymes as a result of the presence of polyphenols, flavonoids and ascorbic acid which can lead to cell membrane strength or cellular renewal **(Darwish *et al*., 2016)**. **Fu *et al*. (2016)** proved that *Brassica rapa* seeds have hepatoprotective effect as it presented high phenolic substances and strong antioxidant actions. They could recover liver damage and increase the antioxidant defense system. Sinapine thiocyanate was the main component as hepatoprotective. Sulphoraphane is an obviously happening isothiocyanate found in widely consumed cruciferous vegetables, such as broccoli, cabbage and Brussels sprouts, and it has antioxidant, detoxification and anticancer properties **(Yamagishi and Matsui, 2016). Sharma and Sangha (2018)** cleared that antioxidant potential of broccoli extract and sprouts in rats can prevent severe alterations of liver biochemical markers as AST and ALT. **Paśko *et al*. (2020)** found that *Brassica* sprouts significantly decreased ALT and had no effect on AST. cruciferous vegetables contain a metabolic product called 3,3-Diindolylmethane (DIM), which has antioxidative, anti-inflammatory , anti-cancer properties ,anti-fibrotic properties and anti-apoptotic abilities reduced serum ALT and AST of rats induced CCl_4 by inhibiting oxidative stress, inhibition of ROS, reduction of pro-inflammatory mediators and apoptosis **(Munakarmi *et al*., 2020)**.

Our results presented in table (5 & 6) cleared that there were significant increase in serum HDL for (G2) and (G3). In the same time, there were significant decrease in LDL for (G2) and (G3) as compared to control group. Regarding triglyceride and total cholesterol, our data showed significant decrease in triglyceride and total cholesterol in (group 2 and 3) as compared to control group.

Al-Snafi, (2015) revealed that *Brassica rapa* has antiobesty and antihyperlipidemic effects. Administration aqueous extract of turnip leaf reduced total cholesterol and LDL-c in diabetic rats **(Fard *et al*., 2015)**. **Fard *et al*. (2016)** reported that the aqueous extract of turnip root was active in reduction of total cholesterol, triglyceride and LDL-c in diabetic rats. **Xu *et al*. (2016)** cleared that saponin which found in red cabbage extract has hypolipidemic effect for lowering blood cholesterol , rises refusing of bile acids and impartial fats out of the body. **Saarinen *et al.* (2018)** proved that Mono- and polyunsaturated fatty acids presented in turnip seed oil developed triglyceride in men suffered metabolic syndrome. **Al- Saeed *et al.* (2020)** settled that red cabbage ethanolic extract reduced blood lipids in rats. **Xu *et al.* (2020)** directed that cruciferous vegetables as a broccoli seeds have glucoraphanin which used as antiobesity factor and constituent for moderating lipid metabolic rate.

Our data found in table (7) indicated that group which feeding low calorie only (G2) and group which feeding low calorie and sprouted turnips seeds (G3) presented significant decrease in serum glucose. In contrast, group of (G3) presented significant increase in serum TSH before and after treatment.

Abo-Youssef and Mohammed (2013) investigated that the importance of turnip in lowering blood glucose. **Al-Snafi (2015)** reported that *Brassica rapa* possessed antidiabetic and hypolipidemic effects. *Brassica rapa* leaves has positive effect on β cell and motivate these cells to create more insulin, modifiable carbohydrate uptake, decreasing liver gluconeogenesis, stimulating glucose uptake in tissues. In addition, polyphenol compounds, tannins and flavonoids are presented in aqueous extract of *Brassica rapa* leaves have responsible for decreasing blood glucose in diabetic rats **(Fard *et al.*, 2015)**. Also**, Khashan and Al-Turfi, (2017)** cleared that hypoglycemic effect of *Brassica oleracea* ethanolic extract because of enhancement of insulin sensitivity**. Saarinen *et al.* (2018)** investigated that nutritional turnip rapeseed oil developed insulin sensitivity and it has mono- and polyunsaturated fatty acids. *Brassica oleracea* extract a novel helpful mediator for controlling blood glucose by decreasing of lipogenic gene expressions **(Nanna *et al.*, 2019)**. Ethanolic extract of red cabbage has positive effect of controlling diabetes and reducing blood glucose level **(Al-Saeed *et al.*, 2020)**. **Sahai and Kumar, (2020)** revealed that sprouts of *Brassica oleracea* was effective in reducing blood glucose as compared to drug Glibenclamide.

Chandra *et al.* (2006) and **Kob (2018)** stated that cruciferous plants (i.e. cabbage, cauliflower, turnip, radish, mustard, etc.) are very widespread foods, mainly in plant-based diets. They have many healthy nutrients, such as phytochemicals with anti-oxidative, anti-carcinogenic, and anti-inflammatory activity. However, they also have goitrogens such as glucosinolates and progoitrin, which may interfere with the manufacture or utilization of thyroid hormone. Rutabaga sprouts belong to the Brassicaceae family which intake by healthy rats did not cause any harmful effect on their health, including thyroid function. For animals with hypothyroidism, rutabaga sprouts improved the adverse effect of iodine lack **(Pasko *et al*., 2018)[a]**. Broccoli sprouts have been confirmed safe effects on the thyroid homeostasis in animals in terms of TSH,fT3andfT4 levels which stayed unaffected. For animals with hypothyroidism, broccoli sprouts apply a beneficial influence on the antioxidant balance of the thyroid gland **(Pasko *et al*., 2018)[b]**. also these results agree with **Paśko *et al*. (2020)** who proved that safety of consumption rutabaga sprout seeds and considered this seeds anti thyroid agent and a factor that improves the harmful clinical structures only when joined with iodine shortage and sulfadimethoxine breakdown.

Conclusion:

This study showed that turnip sprouts reduced body weight and improved blood lipids, liver enzymes and blood glucose. Therefore, turnip sprouts can be active against obesity, high cholesterol, and high glucose level in humans. Therefore this study fortified the consumption turnip sprouts as beneficial effects on health.

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تأثير بذور اللفت المنبتة كعوامل خافضة لدهون الدم ومضادة للسمنة على الإناث البالغات

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المستخلص العربى

أجريت الدراسة الحالية لمعرفة تأثير براعم بذور اللفت على المقاييس الجسمية ، دهون الدم ، انزيمات الكبد ، جلوكوز الدم وتحفيز هرمون الغدة الدرقية .(TSH) تم إجراء الدراسة على 45 أنثى بمؤشر كتلة ≤ 28 و تراوحت أعمارهن بين 25 و 40 سنة و تم تقسيمهم بشكل عشوائي إلى ثلاث مجموعات رئيسية ، كل مجموعة تحتوي على 15 أنثى. المجموعة الأولى هي مجموعة ضابطه تغذت على النظام الغذائي اليومي المعتاد ، المجموعة الثانية تم تزويدها بنظام غذائي منخفض السعرات الحرارية . أعطيت المجموعة الثالثة نظام غذائي منخفض السعرات الحرارية وتدعيمها ب 100 جرام في اليوم من بذور اللفت المنبت لمدة شهرين. تم خضوع المشاركين في البداية إلى المقاييس الجسمية (الوزن ، نسبة الدهون في الجسم ، الطول ، محيط الخصر ، ومحيط منتصف العضد) ، وعينات الدم لتحليل الجلوكوز في الدم ، صورة الدهون (الكوليسترول الكلي ، LDL–c،HDL–c ، والدهون الثلاثية) مستويات AST، ALT ،TSH، البروتين الكلي وألبومين السيرم. ثم بدأت المجموعات بروتوكول التدخل الذي استمر شهرين. وبعد انتهاء فترة المتابعة والتى استمرت شهرين ، أظهرت نتائج الدراسة أن تناول بذور اللفت كان مفيدًا في علاج السمنة ، وتحسين مستويات الدهون ، ووظائف الكبد ، وجلوكوز الدم ، و TSH.

الكلمات المفتاحية: براعم بذور اللفت ، الجلوكوز ، ارتفاع دهون الدم ، إنزيمات الكبد ، السمنة عند الإناث.