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Chemical Characterization, Antioxidant, Anticancer and Hypolipidimic Activities of Chamomile (*Matricaria chamomilla L.*)

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Abstract

Highest grade chamomile is widely cultivated in Egypt and is one of the most important medicinal plants. The current study reported newly specification and characterization of chamomile flower. Results revealed that iron, flavonoid content, total phenolic, total antioxidant capacity, saponins, glucan and mannan were 788 ppm, 467.1 mg/100 g QE, 556.44 mg/100 g GAE, 785.88 mg/100 g ACE, 2.385%, 79.44 g/Kg and 83.65 g/Kg, respectively. GC/MS analysis of chamomile methanolic extract ensured the presence of thirty seven compounds: salinomycin (32.09%), uvaol (5.81%), terpinoline (1.95%), humulene (0.72%) and curcuminol (1.06%). Fatty acid profile indicated the existence of linoleic acid (17.78%) and palmitic acid (15.91%). DPPH and ABTS assays were applied to monitor the antioxidant capacity of chamomile extract. Assessment of antitumor activity of methanolic extract of chamomile flowers were fruitful with recorded IC_{50} = 15.2 µg/ml and IC_{50} =33 µg/ml for intestinal (Caco-2) and colon (HCT) carcinoma cell lines.

Aqueous chamomile extract was prepared and screened for its cholesterol lowering property *In-vivo*. Rats were fed hyperlipidemic diet and administered aqueous chamomile extract for eight weeks. There was a decrease in cholesterol level in chamomile treated rat group comparable to hyperlipidemic group. Chamomile extracts reduced cholesterol and LDL levels. Increase of HDL level was observed in chamomile administered group in comparison with positive control. Non-significant difference in triglyceride level existed between negative and positive controls. Administration of chamomile had no effect in altering triglyceride.

The study presented newly results concerning chamomile regarding its high iron and biologically active phytochemical contents, antitumour potency against two life threatening cancer cell lines and hypocholesterolimic effect.

Keywords: *Chamomile flowers, Chemical analysis, Methanolic and aqueous extracts, Antioxidant and antitumor activities, In-vivo study*

Introduction

According to the World Health Organization (WHO) over three quarters of the world's population relies mainly on the use of medicinal plants for their health care. From approximately 250,000 *species* of *higher plants* on Earth, research suggests that even two thirds of them have medicinal value [1a,b]. Chamomile or *Matricaria chamomilla L.*, from the family Compositae, was an important medicinal herb in ancient Egypt, Greece and Rome [2]. Chamomile is sometimes known as "the plant doctor", because it is thought to help the growth and health of many other plants, especially ones that produce essential oils. It is thought to increase production of those oils, making certain herbs, like mints (spearmint, sage, oregano) and basil stronger in scent and flavor [3-5].

Flowers are one of the most important parts of a plant that has polyphenols, carotenoids, and many bioactive compounds. The flowers of many plants are consumed as tea because of their antioxidant properties and their important role in the human diet [6]. Common chamomile is one of the most popular flowers used in different fields (such as cosmetics, food and beverage production, medicine, and aromatherapy). In addition to being used in traditional medicine, it is also used for tea and vitamin supplements [7]. Chamomile plant extracts, one of the most consumed herbal teas, have also been reported to many biological activities [8]. Chamomile is known for it's as anti-inflammatory, anti-diarrhea [9], antioxidant [10], anti-cancer [11], neuro-protective [12], anti-allergic [13] and antimicrobial [14] effects. It also improves cardiac health [15]. Chamomile is an annual herbaceous plant and is Generally Regarded as Safe (GRAS) because it neither contains toxic compounds nor represents any acute toxicity for humans and animals [16]. Chamomile is known for its richness in phenolic compounds believed to be responsible for its biological activities [17]. It contains phenolic compounds such as the flavonoids apigenin, quercetin, patuletin and luteolin, glucosides and coumarins [18]. As far as could be ascertained, there is no published report in the literature on the hypolipidimic activity of chamomile flower.

The present study has been designed to define chemical constituents of chamomile flowers and monitoring the effectiveness of methanolic and aqueous extracts by In-*Vitro* and *In-Vivo* assays.

Materials and Methods

Plant Material

Chamomile was purchased from Beni-Suef governorate, located 120 km south Cairo on the west bank of the Nile River during the year 2020. The plant specimen was identified by the Botany Department, Faculty of Science, Helwan University. The flowers were solar dried in solar energy department of National Research Centre, Giza, Egypt. After drying process, seeds of flowers were separated and grounded to finely coarse powder and kept in plastic bags till the completion of the work.

Nutritional Evaluation of Chamomile Flower Seeds powder

Ash, silica, fats, fibres, moisture and crude protein were determined according to the [19]. Carbohydrate content was calculated by difference [20]. Minerals measurement of Fe, Zn and Cu was conducted according to the [21]. The amino acids were estimated by the [22] protocol. Total aflatoxin was performed according to [23].

Phytochemical Analysis

Total flavonoid was determined according to [24], total phenolic compounds [25] and total antioxidant capacity [26]. Saponin content was determined by double solvent extraction gravimetric [27] **and m**annan [28]. HPLC determination of beta-glucan was conducted according to [29].

Methanolic Extract of Chamomile flowers Powder

Two hundred grams of chamomile flowers powder were exhaustively extracted with two liters of 80% methanol (v/v) using a Turrax mixer set at 11,000 rpm for 20 seconds. After full extraction, the extract was then centrifuged at 3000 rpm for30 minutes to remove the residues [30]. The methanol extract was concentrated *in vacuo* at 45°C and partitioned with chloroform. Chloroform extract was then evaporated to dryness *in vacuo*, affording an oily dark brown green extract (15.3 g). Oil stored refrigerated until fatty acid profile, GC/MS analysis, screening of antioxidant activities as well as *In-Vitro* assays.

Fatty Acid Composition

Fatty acid of methanolic extract was Trans esterified into their corresponding fatty acid methyl esters as described by [31].

GC/MS Identification

Characterizations of methanol extract components by GC/MS technique [32] was performed at the Regional Center for Food and Feed (RCFF) using GC (Agilent Technologies 7890A) equipped with a mass-selective detector operating by HP-5ms capillary column (30 µm x 0.25 mm i.d. and 0.25 µm film thickness). The temperature was increased from 80°C to 230°C with rate of 3°C min^{-1}. Carrier gas was helium at a flow rate of 1 ml min^{-1}.

Identification of secondary metabolites was performed by comparing mass spectra and retention time with those of authentic standards and by matching with the database of National Institute of Standard and Technology (NIST).

Antioxidant Activity

Antioxidant activity of methanolic chamomile flowers extract was measured using *2, 2-Diphenyl-1-picryl-hydrazyl (DPPH)* [33] and 2, 2-azino-bis (3- ethylbenzothiazoline-6-sulphonic acid (ABTS) assay [34].

Antitumor Activity

Anticancer study was assessed using SRB method at National Cancer Institute, Cairo, Egypt. Colon (HCT) and intestine ($Caco^{-2}$) carcinoma cell lines were chosen to monitor anticancer activity of methanolic chamomile extract. Samples were prepared by dissolving 1:1 Stock solution and stored at -20°C in dimethylsulfoxide (DMSO) at 100 mM. Different concentrations of the drug were used (5, 12.5, 25, 50 µg/ml).

SRB is a protein stain that binds to the amino groups of intracellular proteins under mildly acidic conditions to provide a sensitive index of cellular protein content **[35]**.

Calculation

Percentage of cell survival was calculated as follows:

Surviving fraction = OD (treated cells)/OD (control cells)

The IC_{50} values (the concentrations of resveratrol required to produce 50% inhibition of cell growth) were also calculated.

Aqueous Extract of Chamomile flowers Powder

Fifty grams of chamomile flowers powder was extracted in boiled water (1 L) with stirring for 30 min. After cooling, the aqueous solution was filtered to afford aqueous extract about 890 g.

In-vivo Assay

A study was carried out to evaluate the biological impacts for chamomile flowers aqueous extract on lipid profile for rats of hypercholesterolemia. Cholesterol, triglyceride, HDL, LDL and body weight were monitored after eight weeks experimental period.

Experimental Design

Biological experiment lasted for eight weeks was assessed using 27 male albino rats weighing 90±10 g. Rats were divided into three groups of nine each. Control group (**I**), Hyperlipidemic group (**II**) and hyperlipidemic with administration of aqueous chamomile extract group (**III**). The rats were housed in stainless steel cages and maintained at 22-24°C with relative humidity 45-55%. Diet and water were provided ad-libitum. Adaptation time was three days using barley as the sole diet. At zero time, after 4 weeks and at 8- weeks (end of experiment) rats of each group weighted individually and anaesthetized with CO_2 and blood samples were collected via the retro-orbital plexus [36,37]**.** Serum was obtained by centrifuging at 3000 rpm for 15 min **[38]** separated and kept at 4 °C until biochemical analysis of triglycerides, cholesterol [39], High Density Lipoprotein (HDL) [40] and Low Density Lipoprotein (LDL) [41].

Diets

Three Types of diets (I, II and III) were Prepared as Follows

Group fed a standard diet (**I**) served as negative control formulated according to NRC, 1995 [42] and drunk tap water. Treated group (**II**) "positive control" fed lipid enriched diet included 20% soya bean oil as fat source to prepare high fat diet and drunk tap water, and group (**III**)

fed lipid enriched diet (**II**) and supplied with freshly prepared aqueous extract of chamomile flowers as the sole source of fluid. All diets were analyzed for moisture, crude protein, fiber, fat and ash [43].

Reagents and Standards

All chemicals and solvents were obtained from Merck and Sigma Aldrich, and they were analytical grade. Ultrapure water was used throughout this study (Millipore Direct Q, Bedford, MA, USA). Calibration graphs were constructed using standard solutions at different gallic acid and trolox levels to determine antioxidant activity and total phenolic content in the samples. BioTek Eon Elisa Microplate spectrophotometer was used for all measurements.

Statistical Analysis

Analysis of variance (Multivariate) and Duncan's test were conducted using a statistical Analyses software SPSS (2017) [44]. A probability to ($P \leq 0.05$) was used to establish the statistical significance.

Results and Discussion

Chemical Composition of Dried Chamomile Flowers Seeds Powder

Proximate Analysis

As shown in Table 1, fat and protein were 7.8% and 15.3% respectively. Chamomile is packed with metal enzymes iron, zinc and copper which play roles in Anemia of Iron deficiency, growth and good cholesterol respectively. Iron valued (788 ppm), zinc (47.5 ppm) and copper (7.96 ppm). The presence of these nutrients was most abundant that reported with [45] and may interpret chamomile flowers as a complement in management of human related ailments and promotion of health. Ash and moisture contents were 9.5 and 9.6%, respectively. It was reported that ash and moisture in chamomile didn't exceed 13% and 12%, respectively [46]. The results showed that chamomile flower seeds powder are rich with carbohydrate (54.74%). Carbohydrates are the most abundant nutrient in several fruit peels [47].

Amino Acids Profile

Amino acids were determined and presented in Table 2. Proline (1.07 mg/100 g), glutamic (2.08 mg/100 g) and aspartic (1.41 mg/100 g) acids and were the most abundant in the dried flowers seeds powder as compared with obtained with [48]. Essential and non -essential amino acids are detected in the powder.

Table 1: Chemical analysis of chamomile flowers (g/100 g dried flowers seeds powder).

Parameter	Results (%)
Ash	9.5
Fat	7.8
Moisture	9.6
Protein	15.3
Silica	3.06
Total Carbohydrates	54.74
Mineral	**(ppm)**
Iron	788
Zinc	47.5
Copper	7.96

Table 2: Amino acid profile of dried chamomile flower powder.

Amino acid	Result (mg/100 g)%
Essential amino acids	
Hisitidine	0.34
Isoleucine	0.56
Leucine	0.85
Lysine	0.76
Methionine	0.34
Phenylalanine	0.62
Therionine	0.56
Valine	0.72
Total essential amino acids	**4.75**
Non-essential amino acids	
Aspartic	1.41
Serine	0.66
Glutamic	2.08
Proline	1.07
Glycine	0.75
Alanine	0.78
Cysteine	0.25
Tyrosine	0.47
Argnine	0.80
Total non-essential amino acids	8.27

The dried chamomile flower seeds powder was free from aflatoxin and ocratoxin and safety usage for the different assays. Chamomile is an annual herbaceous plant and is Generally Regarded as Safe (GRAS) because it neither contains toxic compounds nor represents any acute toxicity for humans and animals (Tolouee et al., 2010).

Phytochemical Quantification

Total antioxidant capacity, total flavonoid, total phenolic, saponins, β-Glucan and mannan were 785.88 mg/100 g AAE, 467.1 mg/100 g QE, 556.44 mg/100 g GAE, 2.385%, 79.44 g/Kg and 83.65 g/Kg, respectively (Table 3).

The total phenolic contents were determined as mg gallic acid/100 g chamomile flowers seeds on comparison with a

Table 3: Phytochemical analysis of chamomile extract.

Parameter	Results
Total antioxidant	785.88 mg/100 g AAE
Total flavonoid	467.1 mg/100 g QE
Total phenolic	556.44 mg/100 g GAE
Saponin	2.385%
β-Glucan	79.44 g/Kg
Mannan	83.65 g/Kg

standard gallic acid curve. The chamomile flowers seeds showed a high total phenolic content (556.44 mg gallic acid/100 g). The total flavonoid content (467.1 mg quercetin/100 g) was determined as mg quercetin/100 g chamomile flowers seeds after comparison with the quercetin calibration curve. The extract also has 2.385% of crude saponin. As per literature, these compounds can be found not only in the eatable part of the fruits but also in the non-eatable portions and have different biological activities such as antioxidant, antihepatotoxic effects and anti-inflammatory activity [48-50a]. Plant secondary metabolites such as polyphenols, play an important role in the defense against free radicals. Medicinal plant parts (roots, leaves, stems, flowers and fruits) are commonly rich in phenolic compounds, such as flavonoids, tannins, stilbenes, coumarins, lignans [50b]. The total antioxidant activity of the chamomile flowers seeds was 785.88 mg Ascorbic Acid Equivalence (AAE)/100 g. The total antioxidant capacity may due to its flavonoids and phenol contents of chamomile flower seeds. The antioxidant properties of polyphenols are due to their redox properties, which allow them to act as reducing agents, hydrogen donators, metal chelators and single oxygen quenchers. Polyphenolics exhibit a wide range of biological effects including antibacterial, anti-inflammatory, antiallergic, hepato-protective, antithrombotic, antiviral, anticarcinogenic and vasodilatory actions; many of these biological functions have been attributed to their free radical scavenging and antioxidant activity [51a]. β-Glucan and mannan were79.44 g/Kg and 83.65 g/Kg, respectively; as shown in Table 3 increase the immunity toward blood diseases [51b].

Table 4: Fatty acid of chamomile extract.

Fatty acid	Name	Concentration
C10:0	Capric acid	3.45%
C12:0	Lauric acid	0.73%
C14:0	Myristic acid	4.03%
C16:0	Palmitic acid	15.91%
C16:1 ω9	Palmatolic acid	3.11%
C17:0	Heptadecanoic acid	1.19%
C18:0	Stearic acid	5.40%
C18:1 ω9	Oleic acid	9.64%
C18:1 ω7	Vaccinic acid	0.47%
C18:2 ω6	Linoleic acid	17.78%
C18:2ω4	PUSFA Mixture mixture acid mixture	13.90%
C18:3ω3	Linolenic acid	5.71%
C18:4ω3	Alpha octadecatetraenoic	1.04%
C20:0	Arachidic acid	1.83%
C20:2ω6	PUSFA Mixture	12.41%
C20:3 ω6	Eicosatrienoic acid	0.63%
C20:4 ω6	Arachidonic acid	1.13%
C22:4 ω3	Eicosatrienoic acid	0.59%
C22:0	Behenic acid	1.02%
Non Identified fatty acids		0.03%

Fatty Acid Profile of Methanolic Extract

Fatty acid of chamomile extract is presented in Table 3. Linoleic acid (17.78%), palmitic acid (15.91%) and oleic acid (9.64%). Saturated and unsaturated fatty acid existed in chamomile extract (Table 4).

GC/MS Identification of Methanolic Extract of Chamomile Seeds Powder

Table 5: GC/MS analysis of chamomile methanolic extract.

NO	RT (min)	NAME	AREA SUM (%)
1	7.5	Cedrenol	1.53
2	7.7	Terpinolene	1.95
3	7.95	Elemene-ϒ	0.48
4	8.16	-Patchoulene ϒ	0.76
5	8.33	B-Gurjunene	1,08
6	9.34	Aromandendrene	2.49
7	10.028	(±)-Cadinene	0.95
8	11.006	-Selineneϒ	25.2
9	11.18	7,8-Dihydroxy-4-methylcoumarin-3-actic acid	4.69
10	11.32	Uvaol	5.81
11	12.3	Salinomycin	32.09
12	12.37	Lutein	0.41
13	12.69	Manumycin A	0.41
14	12.93	(+)- Isovalencenol	1.35
15	13.1	Curcumenol	1.06
16	13.3	Geranyl-ɋ-terpinene	1.21
17	13.45	ɋ-Vetivol	0.32
18	13.65	Retinal	0.85
19	13.96	Ylangenol	1.1
20	14.17	Geranyllinalool	0.57
21	14.53	-Humuleneβ	0.72
22	14.72	Valerenol	0.53
23	14.94	-Himachaleneϒ	0.58
24	15.18	-3 Arachidonic acid ethyl esterω	3.12
25	15.64	Isovitexin	0.38
26	15.64	-Bisabololα	0.38
27	16.16	Digoxigenin	1.22
28	16.37	(-)-Globulol	3.44
29	17.14	Squalene	0.4
30	17.5	-Iononeα	0.4
31	17.8	All-trans-farnesyl acetate	0.4
32	18.15	-Terpinyl acetateα	0.33
33	18.42	Betulin	0.35
34	18.775	3-Carene	0.74
35	19.1	Phenol,2,3,5-trimethyl	0.41
36	19.23	2′,3′-Dimethoxyyflavanone	0.33
37	24.8	Isomyristic acid	1.29

GC/MS chromatogram elucidated the existence of thirty seven compounds: terpinoline, α-bisabolol, salinomycin, uvaol, curcuminol and humulene. Data clarified that most of the identified compounds belonged to the class of sesquiterpenes. Our results are in accordance with WHO (1999) that sesquiterpenes formed up to 50% of chamomile oil (Table 5).

Antioxidant Activity of Chamomile Methanolic Extract by DPPH and ABTS Assays

To assess antioxidant activity of chamomile extract, DPPH and ABTS methods were applied. DPPH is a stable free radical with absorption band at 515 nm. It loses this absorption when reduced by antioxidant such as phenolic compound and plant extracts (Table 6) [52].

Ascorbic acid and chamomile were prepared in concentration range of 0.195-50 mg/ml and 3.125-50 mg/ml, respectively. DDPH scavenging activity of chamomile extract ranged between 89.514% at 50 mg/ml to 20.971% at 3.125 mg/ml, While for ABTS scavenging activity ranged between 91.885% at 50 mg/ml to 36.065% at 3.125 mg/ml. it was obvious that the antioxidant activity increased with increase in chamomile concentration.

Table 6: Antioxidant activity of chamomile extract.

Sample	Concentration (mg/ml)	DPPH%	ABTS%
Ascorbic	50	91.219	94.714
	25	92.583	94.884
	12.5	92.497	94.884
	6.25	92.412	94.884
	3.125	92.497	96.419
	1.562	92.412	-
	0.781	92.327	-
	0.39	84.057	-
	0.195	43.478	-
Chamomile	50	89.514	91.885
	25	89.343	94.918
	12.5	68.968	94.344
	6.25	36.913	60.327
	3.125	20.971	36.065

DPPH and ABTS assays ascertained the antioxidant capacity of chamomile extract as monitored in our results. These findings are consistent with Lim et al. (2007). As a result, antioxidant of chamomile extract may be mainly related to high level of phenol and flavonoid contents [53]. Cited that phenols and flavonoids contributed to antioxidant activity of extracts. An important compound detected in chamomile is terpinoline reputable as antioxidant [54], anti-inflammatory [55] and chemotherapeutic [56]. It exerted effective DPPH-scavenging activity (Kim *et al.*, 2004) and may lower LDL oxidation (Tisserand and Young, 2014). The presence of β-humulene acted as antioxidant in chamomile oil increased the value of this herbal plant packed with naturally occurring sesquiterpenes. Described the antioxidant potential of β-humulene against free radicals [57].

Antitumor Activity of Chamomile Methanolic Extract

Antitumor activity for methanolic extract of chamomile (Table 7 and Figure 1) against human colon (HCT) and intestinal ($Caco^{-2}$) carcinoma cell lines were tested. Antioxidants, which prevent the oxidative degradation of free radicals in the human body and help, prevent or reduce different diseases such as cancer, cardiovascular, and neurodegenerative diseases, have an important role in protecting human health [58a]. It is known that antioxidants in natural foods with antioxidant potential are safer and more beneficial compared to many synthetic antioxidants. Therefore, the antioxidant potentials of many vegetables, fruits, leaves, roots, spics, and herbs are still being investigated today. *In-vitro* studies ascertained the impact of chamomile extract on the viability of colon (HCT) and intestine ($Caco^{-2}$) cancer cells with IC_{50} of 33 and 15.2 µg/ml, respectively. The viability and survival rates of cancer cell lines decreased as the concentration

Table 7: Antitumor activity of chamomile extract against intestinal and colon carcinoma cell lines.

Methanolic Extract	$CaCo^{-2}$	HCT
IC_{50}	15.2	33

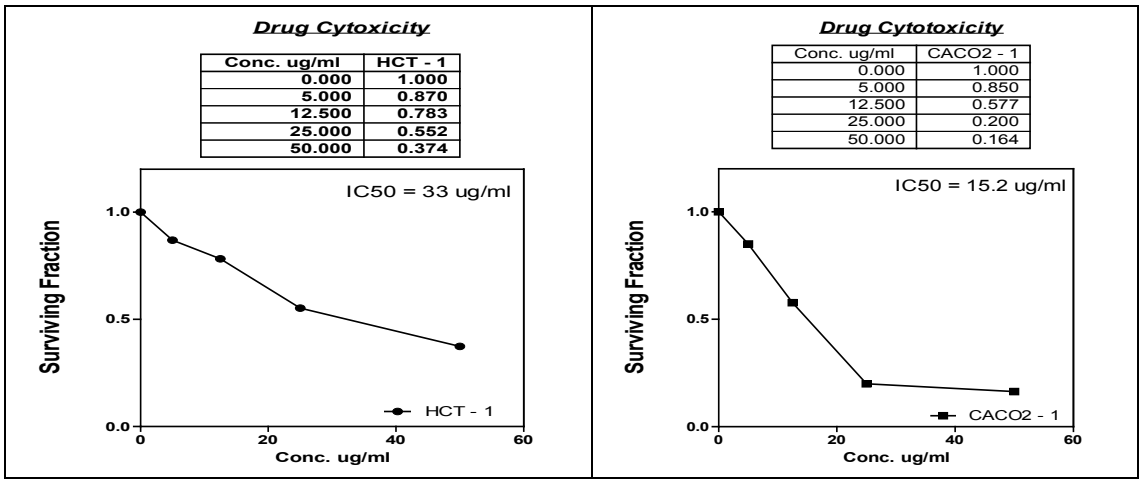

Figure 1: Antitumour activity of methanolic chamomile extract.

of chamomile extract increased, proving anti-tumor potency of chamomile that may be due to presence of sesquiterpenes. Activity of chamomile extract may refer to uvaol that affected positively conditions of colonic inflammation by suppressing macrophage infiltration and pro-inflammatory cytokine release *In-vivo* [58b].

Another article, declared that uvaol, natural triterpene, exerted remarkable selective anticancer effect in human hepatocarcinoma HepG2 cells [59]. An increase in apoptosis rate, down regulation of the AKT/PI3K signaling pathway and reduction in Reactive Oxygen Species (ROS) level in HepG2 cells were observed. The role of uvaol on human astrocytoma line 1321N1 through maximizing rate of apoptotic process via activation of the JNK pathway [60] and stated that uvaol had effect on MCF-7 cells by decreasing reactive oxygen species and cell viability.

Table 8: Effect of aqueous chamomile extract on hyperlipidemia.

Parameter	Group	Time		
		Zero time	After 4-weeks	After 8-weeks
Cholesterol	I	$^{B}79.11_{c}\pm1.52$	$^{B}91.11_{b}\pm2.04$	$^{B}105.78_{a}\pm1.24$
	II	$^{A}90.89_{c}\pm3.04$	$^{A}103.89_{b}\pm1.83$	$^{A}118.89_{a}\pm1.79$
	III	$^{A}87.56_{a}\pm1.20$	$^{C}80.89_{b}\pm1.21$	$^{C}73.00_{c}\pm0.75$
HDL	I	$^{A}40.89_{a}\pm1.45$	$^{B}26.78_{b}\pm0.66$	$^{B}28.44_{b}\pm0.93$
	II	$^{C}22.56_{a}\pm0.50$	$^{C}16.44_{b}\pm0.53$	$^{C}14.56_{b}\pm0.73$
	III	$^{B}28.11_{c}\pm0.86$	$^{A}38.11_{b}\pm1.03$	$^{A}44.44_{a}\pm1.47$
LDL	I	$^{A}42.00_{c}\pm0.41$	$^{A}44.56_{b}\pm0.99$	$^{B}48.67_{a}\pm0.37$
	II	$^{A}41.56_{b}\pm0.63$	$^{A}44.33_{b}\pm1.01$	$^{A}52.33_{a}\pm1.46$
	III	$^{A}42.44_{a}\pm1.14$	$^{B}38.78_{b}\pm0.55$	$^{C}33.67_{c}\pm0.53$
Triglycerides	I	$^{A}186.22_{b}\pm1.33$	$^{B}181.33_{b}\pm3.27$	$^{B}211.44_{a}\pm2.89$
	II	$^{B}176.00_{c}\pm2.37$	$^{B}187.22_{b}\pm2.03$	$^{B}206.22_{a}\pm1.98$
	III	$^{B}172.67_{c}\pm2.13$	$^{A}203.33_{b}\pm4.00$	$^{A}232.22_{a}\pm3.17$

- Within the same column, various superscript letters indicate significant differences (Duncan, $P<0.05$).
- Capital letters were used to compare three groups vertically.
- Group I (Control group).
- Group II (hyperlipidemic group).
- Group III (hyperlipidemic diet and aqueous chamomile extract).

Another effective compound in chamomile extract is salinomycin and was cited that salinomycin fight breast cancer stem cells in mice 100 times more than anticancer drug paclitaxel. Due to its ability to targeting cancer stem cells, salinomycin is the key valuable compound in pharmaceutical company [61].

Hypolipidimic Effect of Chamomile Aqueous Extract

Aqueous extract of chamomile flowers dried powder was prepared and screened for its cholesterol lowering property in rats fed hyperlipidimic diet for eight weeks. There was a decrease in cholesterol and LDL levels in chamomile treated group comparable to hyperlipidemic group (Table 8). Increase of HDL level was observed in chamomile administered group in comparison with positive control. Non-significant difference in triglyceride level existed between negative and positive controls. Administration of chamomile didn't alter triglyceride level. Lowering of cholesterol may be due to existence of curcuminol possessing antioxidant and hypolipidimic properties. Chamomile aqueous extract contained β-glucan considered as water soluble dietary fiber. Lowering of cholesterol level by chamomile extract may be contributed to β-glucan that formed viscous layer in small intestine [62], this layer attenuated and minimized uptake of dietary cholesterol with increased production of bile acid and reduced blood cholesterol level. According to [63], consumption of oat β-glucan lowered blood cholesterol and reduced risk of heart coronary diseases. β-glucan availability is greater when consumed in beverage other than solid matrix [64]. Also, the presence of mannan, another dietary fiber, induced hypolipidemia by modulation of gut microbiota, increasing bile acid excretion and decreasing plasma cholesterol [65].

Body Weight Monitoring of Treated Groups

As shown in (Figure 2), body weight of rat group fed high fat diet and administered aqueous chamomile extract showed decreased weight gain in comparison with positive hyperlipidemic group. Our results are in accordance with [66] who stated that a reduction in weight of hypercholesterolimic rats fed glucomannan compared to control diet may be due to low daily food intake and the presence of insoluble fiber in the gastrointestinal tract.

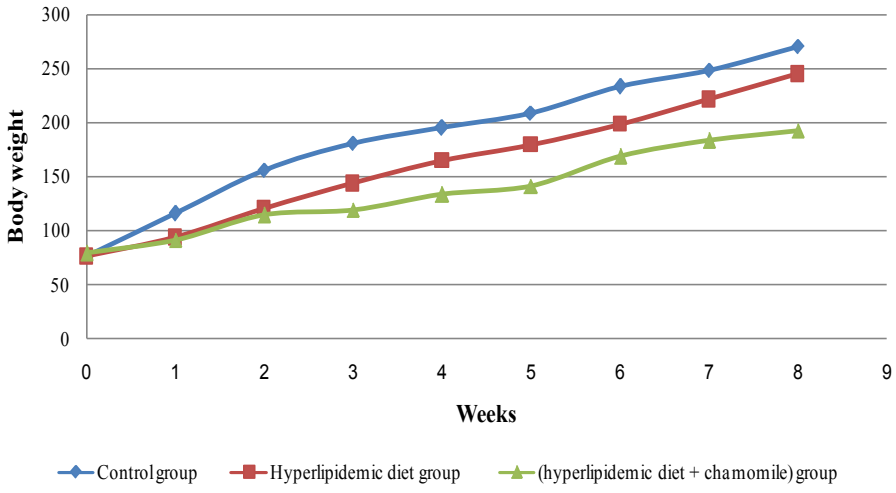

Figure 2: Effect of chamomile aqueous extract on rat body weight.

Conclusion

This study could be concluded that Aqueous extract of chamomile flower seeds is a good nutritious source of carbohydrates, protein, crude fiber, essential and non-essential amino acids which are vital for human nutrition and maintains a good health. Chemical characterization of chamomile ascertained for the first time the presence of β-glucan and is appreciable for its lipid lowering properties. This herbal medicine acquired special interest as natural source of important phytochemicals (mannan, Glucan, flavonoids, phenols and sesquiterpines) which play important roles in scavenging the free radicals which strongly needed to fight ailments. Aqueous extract showed very high improving HDL and reducing LDL and total cholesterol profile for hypercholesteremic albino rats. Economic advantages of chamomile tea recommended to be applied in food processing and appear its vital role in therapeutic nutrition especially with hypercholesteremic, heart disease and weight control patients. Chamomile was reported to induce apoptosis in cancer cells Also, chamomile is packed with metal enzymes iron, zinc and copper which play roles in Anemia of Iron deficiency, growth and good cholesterol respectively. Further studies will be conducted to assess the bioavailability of these minerals in a trial to be supplemented as a compliment in malnutrition treatment.

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